2017 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 University of Illinois is a preeminent public university, recognized worldwide, and the College of Agricultural, Consumer and Environmental Sciences [ACES] has contributed to building this legacy from day one. In ACES, we use what we discover through cutting-edge research to ensure nutritious and safe food, sustainable and innovative agriculture, strong families and communities, and environmentally sound use of natural resources. The result is betterment of the lives of people, not only in Illinois but also around the world. That is the essence of our land-grant experience.

Illinois is among the world's leading institutions in disciplines and programs that constitute ACES domains. To keep our leading edge, we must: [1] Provide excellent education so our students realize exceptional career outcomes; [2] Attract and retain the highest caliber faculty, sufficient to grow enrollment and build our research enterprise; [3] Empower our scientists with adequate resources to achieve widely recognized, transformational research; and [4] Keep promising talent in Illinois.

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

We transform lives. We discover, develop, translate, and disseminate knowledge that is used by scholars, influencers, stakeholders, and community members to address societal concerns and to educate and train the next generation of experts and leaders in our disciplines. We embrace accessible academic programs, a range of fundamental to applied research activities, and relevant outreach education. ACES is an interdisciplinary community of scholars and learners, spanning life sciences, social sciences, and engineering. Nearly 1,500 people work for ACES, including 188 faculty FTE, and the college includes 2,578 undergraduate and 684 graduate students.

ACES is distinctive in the following ways: [1] University of Illinois Extension [Extension] and the Illinois Agricultural Experiment Station [IAES] are subsidiary units of ACES, representing local, state, and federal cooperation; [2] Of the almost 1,500 ACES employees, 655 are associated with Extension, including 230 academic staff; [3] Extension relies on its statewide staff and 25,000 volunteers to connect with 1.5 million Illinois residents each year, including 200,000 4-H youth, in all 102 counties; [4] IAES represents the federal-state research partnership, funded through the National Institute of Food and Agriculture [USDA-NIFA] and matched by state investment; and [5] ACES expenditures in FY 2017 totaled $172 million, of which $77.5 million involved Extension activities within academic units, the Extension organization, and ACES administration. Of our FY 2017 spending, $62.8 million resulted from research activities, including those associated with the IAES.

ACES is fiscally solvent, despite successive reductions and reallocations of permanent base funding, but the recent budget situation created unprecedented uncertainty about recurring state support and crippled significant state funding lines and grants for Extension and other programs. During FY 2017, aggregate expenditures by the college decreased by 2.5% [-$4,449,944] over the previous year, reflecting

conservative fiscal management, reduced spending, and workforce restraint, most significantly in Extension. Our strategic intent is to meet our challenges head-on and lead the way with new approaches to fulfill our land-grant ideals.

The Illinois Agricultural Experiment Station [IAES]

Exceptional research with high impact is core to our identity as a research university. ACES research mission aligns with the Illinois Agricultural Experiment Station, a state-federal investment in research on the forefront of discovery, balanced with application, relevant to Illinois' food, agricultural, environmental, and human interests, and impactful for the world's scientific community. More than 250 scientists contribute to our diverse and impressive portfolio. Our research and education centers provide a vital testing ground where research can generate practical applications to benefit consumers, producers, interested organizations, government agencies, and businesses.

Investigators receive funding from a diverse portfolio of federal, state and private grants and contracts. Federal competitive contracts have been variable, but in the $14-18 million range over the past five years, whereas state contracts have declined from about $1.4 million to $576,000 during the same period. ACES enjoys excellent private sector support, research contracts, and industry collaboration, but we need to reinvigorate some of those sources. Aggregate private support crested five years ago. Private gifts vary annually around $5 million to $5.5 million, but private contracts declined during the period, from $8.2 million in FY 2012 to $4.5 million in FY 2017, partly due to reduced faculty capacity, cyclical industry contraction, and redirection of priorities by commodity organizations. Greater industry engagement is important to reverse the trend.

ACES is leaning into research opportunities in high profile challenge areas including data analytics, bioproducts innovation, food safety and security, health and nutrition, commodity markets and financial risk, and international development. Leadership of the Office of Research is currently in transition. We will enhance opportunities to reposition our strategic research assets with additional grant support and related services for ACES investigators.

University of Illinois Extension

Extension is a core University mission, complementary and distinct from research and education. The University has vast amounts of knowledge, research, and adaptive capacity embodied in its faculty, students, and infrastructure, but the public value and social return on these public investments is dependent upon the transfer, adoption, and use of research and knowledge by individuals, communities, industries, and governments.

Extension's presence in every county, broad reach, and substantial online and media bandwidth are scaled to effect meaningful and measurable environmental, economic, and social change. Extension seeks sustained solutions over one-off efforts. For example, research shows 90% of community gardens fail within three years without a dedicated volunteer base. Extension's over 3000 master gardener volunteers provide expertise and guidance to community members, sustaining gardens over time.

Extension trains and employs staff who are culturally competent to engage effectively with diverse audiences. Abriendo Caminos, the 4-H Juntos program, and SNAP-Ed are leading examples of this aspect of our work. Our STEM programs and teacher interaction programs in Cook County allowed us to reach thousands of students, many in historically underserved areas.

More than 1.3 million Illinois residents take part in Extension programs each year, including nearly 200,000 youth who participate in 4-H programs. Each year, U of I Extension web pages draw more than 70 million page views, including over 4 million page views of our Spanish websites. Extension staff in 27 units

located throughout Illinois directly serve communities. In addition, over 20,000 people serve Illinois families and communities through Extension volunteer programs. This includes over 17,000 adult volunteers leading 4-H clubs and thousands of events statewide providing an average of 125 hours each per year, 3,019 Master Gardeners providing over 215,000 hours of service [equivalent to about 103 full time employees], and 862 Master Naturalists providing over 76,000 hours [equivalent to about 36 full time employees].

Dean Kidwell convened a task force in June of 2017 to strategically advance ways to maximize opportunities for the translation of useful research outcomes to community members, and to maximize stakeholder input into the research agenda. This task force, Extension 3.0, reviewed background materials on the LGU research dissemination process, seminal internal reports and strategic plans, and documents pertaining to outreach strategies nationally and at other institutions. The task force surveyed ACES faculty and Extension personnel about their perceptions of what constitutes extension work, what are the strengths and limitations of Extension, and respondents' involvement with the Extension system. Focus groups were conducted with external stakeholders regarding the strengths, limitations, and perceptions of Extension. Based on this information, the task force addressed items from the charge by outlining strengths and limitations of the translation and dissemination process within the College of ACES. Based on this list, the task force drafted what the "ideal Extension" would be in the 21st Century, analyzed barriers that were leading to the limitations, and drafted recommendations that could lead to addressing barriers, fostering new opportunities, and working toward the ideal model. Extension 3.0 will be advanced in the coming year through translation of the task force priorities into actions that will deliberately move Illinois forward toward that ideal.

After experiencing significant reductions [-26%] in revenue between FY 2015 and FY 2016 for Extension, the multi-year Illinois budget impasse was finally resolved during FY 2017. Modest increases [+10%] in overall funding from FY 2016 to FY 2017 were realized through partial restoration of the dedicated appropriations through the Illinois Department of Agriculture, although the IDOA funding still fell $10 million short of the budgeted allocation, and slight increases in local, total federal, and miscellaneous revenue. While Extension has relied heavily on the drawdown of reserves that accumulated concomitant with the last statewide reorganization, contingency plans have been developed to proactively address the outlook for FY 2018 and beyond through maximizing opportunities for expansion of revenues and maintaining a firm focus on fiscally responsible spending.

Changes In The College of ACES

In February of 2018 Dr. George Czapar retired from his position as an Associate Dean in the College of ACES and Director of the Illinois Cooperative Extension Service. Dr. Czapar became Director of CES in October of 2013. The Interim Director for CES will be Dr. Shelly Nickols-Richardson. Dr. Nickols-Richardson has been head of the Department of Food Science and Human Nutrition in the college for the last five years. Dr. Nikki Engeseth will serve as department head in Dr. Nickols-Richardson's absence.

In January of 2018 Dr. Neal Merchen retired from his position as an Associate Dean in the College of ACES and Director of the Illinois Agricultural Experiment Station. Dr. Merchen took over for Dr. Jozef Kokini in September of 2012, having previously served as head of the Department of Animal Sciences. In December of 2017 Dr. German Bollero was named to be the next Associate Dean for Research and IAES Director. Dr. Bollero had previously served as head of the Department of Crop Sciences. Dr. Patrick Tranel is serving on an interim basis as department head for Crop Sciences.

Dr. Rodney Johnson became the new department head for the Department of Animal Sciences in January of 2018. Dr. Johnson has previously served the College as a professor and as director of the Division of Nutritional Sciences. Dr. Johnson takes over for Dr. Doug Parrett who was serving as department head on an interim basis [Dr. Steven Loerch was the previous head; Dr. Loerch left to become Senior Associate

Dean in the College of Agricultural Sciences at Penn State University]. In February of 2018 Dr. Elvira de Mejia became the new director for the Division of Nutritional Sciences.

Dr. Pennie Crinion retired from her position as Director of Assessment and Planning for Illinois Extension in April of 2017. Elizabeth Welbes was named the new Director of Program Planning and Assessment and started in that role in January of 2018. Ms. Welbes was previously the Associate Director at the Center for Prevention Research and Development in the School of Social Work at the University of Illinois.

The Planned Programs

Agricultural and Biological Engineering - Extension activities in 2017 continued to focus on the **Certified Livestock Manager Program**, now with an online certification option, regular updates to online manure management resources [including a manure value estimator], **Operation S.A.F.E Fly-ins**, and outreach efforts of the Illinois **AgrAbility Unlimited** program. Research activities included an effort to improve the efficiency of liquid agricultural chemical application systems, a variety of projects aimed at increasing corn yield by aiding the breeding process using an agricultural engineering perspective, a project that uses unmanned aircraft systems [UAS] as agricultural monitoring tools in cost and resource constrained environments, and work to develop a new satellite-based algorithm for measuring crop productivity.

Agricultural and Consumer Economics - Research activities included a project that will allow us to identify the best ways to communicate nutrition information to consumers, a study that expanded the knowledge base of those working in the agricultural sector in assessing crucial information provided in bankers' forecasts of farmland values, a project that will study the economic impacts of policies and interventions designed to help developing world small farmers, and work focusing on household financial decision making. Extension agricultural and consumer economics programs focused on profitability outlook and management challenges through the **2017 Illinois Farm Economics Summit** and regular updates to the University of Illinois **farmdoc** website. The **Money Mentor** program expanded with more trained volunteers who provided local community financial education outreach through one-to-one consultation. The **Financial Wellness Peer Educators** program, with 20 trained college students, provided financial outreach to peers and launched a new social media campaign by college students, for college students.

Animal Health and Production - Extension annual statewide programs addressed animal production and health with a number of exciting opportunities related to beef production including the **Driftless Regional Beef a**nd **Heart of America Grazing Conferences** that drew participants from throughout the Midwest. The **4-H Livestock Conference** returned for a second year as did the **4-H Livestock Ambassadors** program. Research activities included work to develop efficacious drugs against C. parvum infections in livestock, an effort to better understand the regulation of muscle development, growth, and metabolism and improve the efficiency of meat production, experiments on the use of water-cooled perches for laying hens kept in heat stress conditions, research that seeks to improve the efficiency of cattle feeding systems, and an effort to generate an integrated view of the multiple adaptations of the cow to nutritional management.

Community Resource Planning and Development - Research activities included research to generate information about how immigrant Latino parents living in rural and non-metropolitan communities negotiate the challenges of parenting adolescents in the U.S., efforts to explicate the role of different types of violence in different patterns of judicial involvement among divorcing mothers with and without a history of

violence, and work to identify the types of challenges and dilemmas that leaders encounter and the strategies experienced leaders used to address these dilemmas. Extension activities included data analysis and 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". One success story this year is how Extension educators assisted one small Illinois community nurture partnership to launch a **Community Innovation Center** to serve as an incubator [a rare resource for communities of this size]. The **UCCI Leadership Training** program had another successful year training 26 elected and appointed county officials to develop and refine their ability to effect change.

Food Safety and Food Security - Extension activities addressing food insecurity included a record 315,000 meals packaged, paid for, and distributed to community food pantries by **Illinois 4-H Feeding & Growing Our Communities**. Master Gardeners teamed up with SNAP-Ed educators to develop four new garden-sourced food donation locations. Food security programming encompassed field crop and fresh produce management and production. A variety of schools and conferences were offered to fruit and vegetable producers in locations throughout Illinois. An Extension educator completed national training to become the Lead Trainer in Illinois, educating growers about regulations established by the **Food Safety Modernization Act Produce Rule**. Research activities included the development of effective management of X. cucurbitae in pumpkins, a study of the potential for agroforestry systems to contribute to food production, an effort to better understand the material conditions that reduce or reproduce household food insecurity, an examination of food microstructures and an evaluation of the changes due to food processing, and the use of dynamic infrared imaging to provide a relatively simple, robust means of ensuring seal, bond, and weld integrity to improve food system safety in packaging, distribution, and storage.

Human Health and Human Development - Research activities included a research program aimed at preventing the burden of adult obesity among women, work to improve our understanding of how individual genetic material interacts with the environment to promote or delay metabolic effects that result in excessive weight gain or related diseases, an examination of the health, well-being, and economic opportunities available to LGBT persons in rural Illinois, and the development of research findings that will improve our understanding of the mechanisms of soy products that reduce colon cancer risks. Extension programs have addressed 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 a series of **Aging Summits**, held primarily in rural areas throughout the state, that address the needs of older adults in the areas of health and wellbeing. Two initiatives have entered their second year as **ABC's of School Nutrition** expanded training and assistance to school nutrition professionals and **Abriendo Caminos** expanded its reach to Hispanic audiences with health and wellness programming

Natural Resources and the Environment - 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. 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. Local unit efforts to promote environmental awareness and action included an annual **Stewardship Week** that drew students from eleven counties and the new **Conservation@Home Cook County** program that recognizes and certifies properties that demonstrate environmentally sound landscape practices. Research activities included work highlighting how crop insurance programs reduce the incentive to adapt to climate change, research that seeks to improve our understanding of the chemical

inputs resulting from atmospheric deposition, work that seeks to improve our understanding of the influence of environmental conditions and time since invasion on forests ecosystem structure and function, research that seeks to advance knowledge of the socio-economic contribution forests and trees on farms have made in the past and may make in the future, and work to estimate the values of natural resources and environmental amenities to guide resource management decisions.

Plant Health, Systems and Production - Research activities included work to improve our understanding of how E. amylovora infects hosts and causes disease, the development of additional methods for control of H. glycines to supplement existing control strategies, ongoing genomic selection breeding efforts, work to develop improved winter wheat varieties adapted to Illinois, an ongoing soybean breeding program focused on developing knowledge, technology, germplasm, and varieties that will increase the productivity, profitability, and sustainability of soybean production in Illinois, and a rigorous assessment of the effects of crop rotation and tillage on soil properties and crop yields. Extension activities encompassed a significant number of websites and webinars addressing horticulture topics. **First Detector Workshops** and **University of Illinois Plant Clinic** continued to be trusted sources for identifying pests and unusual, exotic, and invasive species. The popular **Four Seasons Gardening** webinar series was offered again and live broadcasts were archived for easy access. Extension Master Gardeners took the lead in working with Extension staff and community members to support nearly 500 community gardens throughout Illinois.

Sustainable Energy - Members of Extension's Energy and Stewardship Team collaborated on the development of a proposal that resulted in new funding from the Illinois Science and Energy Innovation Foundation focused on conducting outreach to educate consumers about the use of **Smart Grid/Smart Meter** technology. Extension was involved in the **Northern Illinois Renewable Energy Conference** again this year in addition to many presentations, demonstrations, tours, and displays provided by Extension educators**.** Research activities included work to identify and develop high-yielding dedicated energy crops for various land types, research focusing on the economic aspects of biofuel production, studies to examine the incentives of farmers to adopt perennial energy crops, the development of a genetic modification system for the solvent producing clostridia to produce renewable chemicals [the use of mycotoxin contaminated corn for non-food fermentation based applications has been verified for the production of value-added chemicals], and research that represents one of the first field experiments to explicitly evaluate how biofuel crops affect animal movement and landscape connectivity.

4-H Youth Development - Activities in 2017 focused on efforts to continue the goal of expanding 4-H youth development opportunities into urban/metro environments and to better engage Hispanic youth. 4-H youth and adult volunteers were active in conducting, supporting, or participating in many of the activities referenced in other planned programs of this report. A new program launched this year was the **Healthy Soils C.S.I**. [**Carbon Soil Investigation**] **Challenge**, in which youth learned to analyze and assess soil quality through a series of experiential activities. 4-H youth made amazing contributions to their communities, organizing meal packaging days and creating a mobile pantry to bring food to rural communities. More than 12,000 adult volunteers created learning environments that allowed young people to practice the real-world skills they need today and in the future.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	150.0	0.0	180.0	0.0
Actual	165.0	0.0	216.0	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

Proposals in the Department of Food Science and Human Nutrition are prepared by investigators and reviewed internally by two peers. The department head reviews proposals as needed for any further input. Investigators modify their proposals as recommended by reviewers before submitting to USDA. In the Department of Animal Sciences Hatch proposals are reviewed and evaluated by a standing research committee. The committee members are asked to review the proposals and submit questions to the committee chair who compiles the questions and submits them to the PI. The PI makes appropriate revisions and returns the proposal to the committee which determines approval or non-approval. In the Department of Human Development and Family Studies proposals are typically reviewed by the department head. For unique circumstances [such as for a highly specialized field of study] the department head would request input or review by another full professor in the department. Each review ensures that the proposed research addresses an issue of scientific and societal significance, rests on a firm foundation of existing scholarship, uses appropriate research methods, includes some focus on non-metropolitan or rural populations, and would have applied or practical implications. The review also confirms that the PI is capable of conducting the proposed project and will produce products [such as publications] of high quality and that the timeline for the project is feasible.

In the Department of Agricultural and Biological Engineering all proposals are reviewed by two external peers with knowledge in the subject area. The reviewers are provided with specific instructions regarding enhancing the proposal as opposed to seeking the recommendation to accept or reject the proposal. Researchers take the reviewers' comments into consideration in revising their proposal to prepare a final version for submission to USDA-NIFA. In the Department of Crop Sciences the merit review process of Hatch proposals is based on the review of the proposal by two faculty members. In addition, the department head reviews this process. In the Department of Natural Resources and Environmental Sciences investigators 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?; and [6] Are the users of the results [clientele] identified and how will they access results of the proposed work?

Extension county directors are expected to seek input from Extension multi-county unit councils regarding identifying priority issues for educational programming. 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
- Survey of selected individuals from the general public
- Other (Department Advisory Committees)

Brief explanation.

In the Department of Agricultural and Biological Engineering stakeholders' needs are very important factors in guiding the development of mission-oriented projects. Faculty members interact actively on issues that may be addressed using engineering and technical methods. Research funding is heavily funded by industrial partners; therefore a substantial effort is made to engage with industry. ABE also has a good number of projects that involve institutions in other countries. These institutions have become very important international stakeholders. ABE has frequent opportunities to meet with our stakeholders in formal and informal settings and always welcomes stakeholders' input on research, education, and Extension/outreach activities. ABE also participates in meetings with broader stakeholders of the College of Agricultural, Consumer and Environmental Sciences, the College of Engineering, campus, and throughout the university system.

The Department of Natural Resources and Environmental Sciences is an interdisciplinary program that brings biological, physical, and social scientists together to teach and discover techniques to improve the health and integrity of urban and natural ecosystems. Researchers continue to work with state and federal environmental agencies to discuss research areas and learn of needs within the organizations. The Department of Food Science and Human Nutrition undergoes an external review of programs, including research, once every seven years. Annually, the department asks the external advisory committee to provide formal feedback on departmental activities. The department head reviews the priority areas of NIFA and offers comments as requested via the college and/or

USDA-NIFA. The Department of Crop Sciences meets annually with their state advisory committee that is formed by representatives of the many areas that relate to Crop Sciences. The committee writes a report every year with suggestions on the direction and future of the department. The members of the committee are invited to serve based on recommendations from faculty.

The College of ACES Communications and Marketing office plays a crucial role in informing the public and ACES stakeholders about the most recently published research and other activities in the college. They maintain a list of nearly 1,000 media outlets to which they selectively distributes approximately 300 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. Their 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 also due to memberships in two subscription services for journalists -- Eurekalert [a distribution service with AAAS] and AlphaGalileo [a British news distribution service].

In addition to communicating ACES research stories to media, they produce ACES@Illinois, a 36-page magazine that is delivered in print or electronic form twice each year to ACES alumni, donors, potential students, current students, faculty, staff, and others who are interested in the college. A pdf of the most recent issue is available at http://go.illinois.edu/ACESIllinoisF17.

In 2017, they also produced a 60-page full-color publication entitled AdvanCES in Research to share research findings with the public and invite feedback. The publication was distributed at the 2017 Farm Progress Show and at the 2017 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.

Another vital contribution of the ACES Communications and Marketing office is connecting ACES researchers with media and helping researchers prepare to be interviewed by media. Journalists contact our writers nearly every day for help in setting up an interview with an ACES faculty member in response to a press release on their research. Their staff are also contacted daily by media seeking an expert to comment on current issues in the news.

Extension county directors are expected to seek input from Extension multi-county unit councils and advisory committees regarding identifying priority issues for educational programming. 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. In many cases, this input is structured around a formalized prioritization process facilitated with council members. 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. County directors and field staff are often invited to participate in community and regional planning processes by external groups. This provides a unique opportunity to benefit from the collective work of these groups to surface potential areas of focus for local plans of work. 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 Department Food Science and Human Nutrition holds an annual external advisory committee meeting during which input is actively sought from EAC members. These individuals represent academia, government, industry, and small businesses. Individual faculty members are asked to comment on stakeholder input solicitations. Requests for proposals are reviewed by faculty and staff in the department. The Department of Natural Resources and Environmental Sciences external advisory committee is comprised of four representatives from environmental agencies including state government, consulting, and conservation. The group includes personnel from the Illinois Farm Bureau. These committee members work with the department to provide input from their individual constituent bases. The most recent meeting of the committee was held in the Spring of 2017.

In the Department of Agricultural and Biological Engineering input is sought from faculty members who have been in frequent contact with stakeholders. ABE has a departmental external advisory committee. The committee members play a critical role in connecting the department with stakeholders. The development, corporate relations, and public engagement offices in our college and on campus also provide a great deal of assistance in engaging with stakeholders. ABE investigators are very active in attending regional, national, and international conferences [oftentimes by invitation] where stakeholders and their high priority issues can be identified. The Department of Animal Sciences has an ongoing relationship with the major commodity groups and industry partners that are the stakeholders to Animal Sciences' research and outreach programs. Faculty members regularly participate as liaison or ex-official board members for the beef, swine, dairy and equine state associations. The department also interacts with the Illinois Department of Agriculture and cooperates on educational programs and applied research. In addition, the department has an external advisory committee of eight to twelve members that represent various corporations, commodity groups, and the general public and provides ideas and feedback on Animal Sciences' programs. Stakeholders are invited to speak in classes, serve on graduate research committees, and serve on faculty search committees.

Extension Advisory Council members and local Extension volunteers across Illinois 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. County directors reported that 762 "Grass Roots Organizations" were engaged throughout Illinois to intentionally seek input from organizations that serve members of a Civil Rights protected class. 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
- Survey of 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
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public
- Survey of selected individuals from the general public

Brief explanation.

The Dean of the College of ACES [Dr. Kim Kidwell beginning in November 2016] and the Associate Deans for Research and Extension [Dr. Neal Merchen and Dr. George Czapar until early 2018] 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. The 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.

Specific interactions in FY 2017 of the Associate Dean for Research/Director of AES with stakeholders included: [1] Attended and interacted with a broad range of domestic and international stakeholders at the World Food Prize meetings and Borlaug Dialogue in October 2016; [2] Attended the meetings of the American Society of Agricultural and Biological Engineering [ASABE] and participated in the Symposium on Reducing Post-Harvest Loss in Stellenbosch, South Africa in October 2016; [3] Met or teleconferenced on multiple occasions with leadership and members of the Illinois Farm Bureau throughout FFY 2017; [4] Invested much time in development of collaborative activities with corporate partners [major contacts included ADM, Tate and Lyle, Growmark, Agrible, and Kraft Heinz]; [5] Served as a member of the joint steering committee of the University of Illinois/Dow AgroSciences partnership to coordinate collaborative efforts in research, education, and outreach between the two organizations; [6] Participated in the meeting of the Illinois Agricultural Legislative Roundtable in January 2017 [this meeting included representation from the Illinois Farm Bureau, multiple commodity organizations, and other educational institutions in Illinois that have agricultural programs]; [7] Met and worked with representation of the Illinois Corn Growers Association on development of an internal seed grant program associated with an award from the Regional Conservation Partnership Program; [8] Interacted extensively with the ADM Institute on

Prevention of Post-Harvest Loss [the ADM Institute is housed in the College of ACES at the University of Illinois]; [9] Met with Chapin Rose, member of the Illinois House of Representatives, and representatives of local county chapters of the Illinois Farm Bureau concerning progress and activities of the Integrated Bioprocessing Research Laboratory [IBRL] currently under construction on the University of Illinois campus; [10] Participated in the Global Food Security Symposium organized by the Chicago Council on Global Affairs in Washington, DC in March 2017; [11] Participated in meetings of the north central region AES directors in April 2017; [12] Met with Mr. Jimmy Ballard, staff member of the office of Congressman Rodney Davis, and with Congressman Davis on issues of importance in agricultural research in April 2017; [13] met with the external advisory committee of the Department of Natural Resources and Environmental Sciences; [14] Helped coordinate and participated in a celebratory event recognizing the 40th anniversary of the Orr Agricultural Research and Development Center [OARDC] in August 2017 [the Orr Center is an important off-campus research center located in Pike County, Illinois]; [15] Participated with research and Extension staff at the Dixon Springs Agricultural Center [DSAC] in meeting with faculty from Southern Illinois University to discuss development of collaborative programs in research and education at DSAC; and [16] Extensive involvement in activities of the Dudley Smith Research Program [this is an endowed program in sustainable agricultural production centered on the Dudley Smith Farm in Christian County, Illinois].

The process most often used by Extension to collect input involved both formal and informal methods proactively initiated through professional staff contact with current funders, key community leaders, Extension Council members, Extension volunteers, and program participants. 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. County directors and field staff are often invited to participate in community and regional planning processes by external groups. This provides a unique opportunity to benefit from the collective work of these groups to surface potential areas of focus for local plans of work.

Internal stakeholders, Extension staff who served as planning ambassadors, were mobilized this year to comprehensively review and refine programs, outputs, and outcomes using a structured planning process conducted through a series of meetings. These forty planning ambassadors represented the diversity of roles, program areas, and regions across Extension.

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 meetings and advisory committee meetings. The strategic planning committee also uses stakeholder input to make decisions on strategic directions. The Department of Animal Sciences external advisory committee meets annually. The agenda consists of key issues for the advisory committee to act on and formulate recommendations; these recommendations are then implemented by departmental administration through the committee structure. In the Department of Crop Sciences recommendations from stakeholders are considered in faculty meetings and departmental advisory committee meetings. In the Department of Natural Resources and Environmental Sciences input is 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 impacts course content for our undergraduate and graduate students. In the Department of Agricultural and Biological Engineering stakeholder input is discussed in departmental meetings, faculty/staff meetings, administrative committee meetings, faculty advisory committee meetings, and in external advisory committee meetings. Plans of actions are developed in these meetings. The discussions frequently help to shape the decisions of future research activities. Individual faculty/staff members often bring stakeholder input to the attention of the head and to other appropriate colleagues within the department.

Extension staff members were once again encouraged to involve Extension councils in reviewing, and if warranted, revising the three to five priorities to be reflected in a FY 2017 multi-county plan of work. 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 how to better 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.

Results of the planning process conducted by Extension administrators, program leaders, and planning ambassadors were used to drive refinements to state-level logic models in order to strategically and collectively focus programs on the priority issues affecting Illinois citizens.

Brief Explanation of what you learned from your Stakeholders

In FY 2016, there were a number of changes implemented by the College of ACES regarding programming at several of our off-campus research and education centers. These adjustments occurred in response to serious state funding declines in Illinois that have been in progression for the past decade. As resources supporting historical programming have grown more scarce, hard decisions have been made that curtailed some long-standing field research activities. However, as these changes have been implemented we have also modified research programming at some off-campus locations to deliver new and relevant information to our stakeholders.

Customer satisfaction surveys indicate that Extension stakeholders who serve as Extension volunteers remain strong supporters of 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. Their comments and recommendations are an essential part of an ongoing focus on quality improvement and serve as a "pulse check" to assure that emerging needs are effectively surfaced.

Entering FFY 2017 we continued to communicate with stakeholders, particularly in the agricultural production sector about reductions in some research activities at off-campus centers in response to budget restrictions. At the same time, we worked to advance the idea that this circumstance created an opportunity to strategically assess the kinds of activities that would continue to provide relevant information to our stakeholders. We continued to carry on conversations and correspond with the Illinois Farm Bureau and with commodity organizations [such as 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 stations, particularly in agronomy and in some areas of applied food animal science [primarily beef cattle production]. We have maintained a very strong presence in beef cattle systems at our off-campus sites in response to stakeholder priorities.

While cropping systems research has been reduced in terms of direct activities at our off-campus stations, we have expanded or rejuvenated other directions to conduct research of regional importance. We are conducting more and more research with farmers in several parts of Illinois [and in international locations in some cases]. We have invested in innovative infrastructure at other sites to address questions of increasing importance [such as the installation of a unique field tile drainage system to facilitate water quality and nutrient management research at the Dudley Smith Research Farm]. We are also in the process of investing resources and partnering with U of I Extension to rejuvenate facilities used for horticulture research at the Dixon Springs Agricultural Center. 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.

For the Department of Animal Sciences key recommendations from stakeholders 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 that stakeholders have given us feedback on include 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 growth enhancers as they affect meat quality in swine. Stakeholders for the Department of Food Science and Human Nutrition called for more funding in the areas of food quality, nutrient quality, and foundational areas of food science and nutrition to allow investigators to explore the most important topics. For the Department of Natural Resources and Environmental Sciences: [1] Growers, consultants, and certified crop advisors provided information regarding the resistance and spread of resistance in relation to ecology and management of arthropods in corn; [2] Participants at various outreach events learned of dynamic soil properties research to determine critical indicators of sustainability; [3] Consumers provided information related to preference of the presentation of GM information in food package labels; and [4] Farmers, breeders, and consumers participated in a workshop and two field days to gather input on attributes of interest and challenges and opportunities for high value specialty grains grown in Illinois.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{No Data Entered}	{No Data Entered}	{No Data Entered}	{No Data Entered}

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	5746734	0	7707556	0
Actual Matching	5746734	0	7707556	0
Actual All Other	43226807	0	39607413	0
Total Actual Expended	54720275	0	55022525	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	5746734	0	1359081	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	20%		15%	
133	Pollution Prevention and Mitigation	20%		15%	
141	Air Resource Protection and Management	0%		10%	
315	Animal Welfare/Well-Being and Protection	0%		10%	
401	Structures, Facilities, and General Purpose Farm Supplies	20%		10%	
402	Engineering Systems and Equipment	0%		10%	
403	Waste Disposal, Recycling, and Reuse	20%		10%	
404	Instrumentation and Control Systems	0%		10%	
405	Drainage and Irrigation Systems and Facilities	20%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.0	0.0
Actual Paid	0.3	0.0	13.7	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
10328	0	667986	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
10328	0	667986	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
77684	0	2491897	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included an effort to improve the efficiency of liquid agricultural chemical application systems through the development of a real-time droplet size monitoring system for low-pressure field sprayers, work to improve our understanding of Cyclospora [an emerging food safety pathogen serving as the culprit of several outbreaks in leafy green vegetables], research with the long-term goal of refining and improving the practice of denitrifying bioreactors to mitigate agricultural drainage nitrogen losses for societally-desired clean water outcomes, 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 [achieving this aim will permit more informed and cost-effective watershed management decision making], and a study that will quantify the changes in streamflow, sediment load, nutrient concentration, and fish population in the **Fort Cobb Reservoir Experimental Watershed** due to changes in climate, land use, and different land management activities.

Activities also included work on a variety of projects aimed at increasing corn yield by aiding the breeding process using an agricultural engineering perspective, a project that uses unmanned aircraft systems [UAS] as agricultural monitoring tools in cost and resource constrained environments, the development of a new way of studying clinical and subclinical mastitis in dairy cows that will allow for better antibiotic decision-making [this technology has led to a new collaboration with the U.S. Army Center for Environmental Health Research to look at the impact of contaminants on gut microbiota in soldiers in the field], research that seeks to develop decision support tools for agricultural producers that improve agroecosystem performance by both economic and environmental measures, work to develop a new satellite-based algorithm for measuring crop productivity including Gross Primary Production [GPP], plant autotrophic respiration [Ra], Net Primary Production [NPP], and crop yield using sun-induced fluorescence from the NASA OCO-2 satellite, and further refinement of the FANS [**Fan Assessment Numeration Systems**] measurement system for in-situ testing of ventilation fans directly [this system allows interested users the ability to measure the flow rate through fans running in greenhouses or other agricultural structures].

Conference presentations included the American Society for Agricultural and Biological Engineers, University of Illinois Crop Sciences International Agronomy Day, Monmouth Research Farm 36th Annual Field Day, American Society of Agronomy, Soil Science Society of America, Crop Science Society of America, Nutrient Research and Education Council, International Conference on Robotics and Automation, American Geophysical Union, and the National Center for Atmospheric Research Community Earth System Model Workshop on Joint Societal Dimensions and Land Model Working Groups.

In the state of Illinois, there are legislated requirements for the design, construction, and operation of

livestock management and livestock waste-handling facilities. Extension's **Certified Livestock Manager Program** continues to provide training and certification to enable producers to satisfy requirements in the State's Livestock Management Facilities Act. The training curriculum is available through both online sessions and in-person workshops. Extension offered eight [8] sessions certifying two hundred nineteen [219] people through the Illinois Department of Agriculture. In addition, thirty [30] people certified through online training offered as an option to maximize the use of distance technology and expand access to training. Topics in the 2017 **Certified Livestock Manager Program** covered Farmstead and Occupational Safety, Best Management Practices for Livestock Operations, Updates to the Illinois Environmental Protection Agency Concentrated Animal Feeding Operations Rule and Illinois Nutrient Loss Reduction Strategy, and Nutrient Management Planning Principles.

Extension has continued to expand outreach in this planned program through websites and workshops designed to meet the needs of agricultural producers across Illinois. The new **Livestock Facilities and Manure Management** website provides a coordinated portal to resources such as ventilation training and composting workshops, other agricultural engineering programs and capabilities such as the **Bioenvironmental and Structural Systems** [BESS] fan test laboratory, and links to other websites such as **EZRegs** and **Manure Share**. **EZregs,** one of the most regularly visited websites with 98,666 page views in 2017, provides a platform for users 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. **Manure Share** is 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. New online tools include an updated calculator for estimating manure values for swine, beef/dairy solid manure w/bedding, and turkey litter.

To promote technology transfer in the area of agricultural safety, the **Agriculture Safety and Health** website provides access to fact sheets and resources that address safety practices and information for individuals who have disabilities resulting from an agriculture related accident. Through the **Illinois AgrAbility Unlimited** program, comprehensive assistance is provided to individuals and their families engaged in farming or a farm related activity in Illinois and who have been affected by a disability, aimed at increasing self-sufficiency and independence. **AgrAbility Unlimited** staff also directed effort toward free health screenings, information, and resources on farm safety and overall health in a booth at the **2017 Farm Progress Show**.

Operation S.A.F.E. Fly-ins were conducted in five [5] locations throughout Illinois by an Extension Outreach Specialist in the Department of Agricultural and Biological Engineering who serves as an Operation S.A.F.E. Fly-ins analyst. In that role, he conducted fly-ins, interpreted spray deposition data, and advised pilots on nozzle configuration changes when applicable.

All other Extension efforts related to natural resources, soil drainage and tillage, pesticide application, indoor air quality/ventilation, and bio-based energy production and use are noted in other planned program sections [see Sustainable Energy, Natural Resources and the Environment, and Food Safety and Food Security].

2. Brief description of the target audience

Members of the target audience included agricultural commercial applicators, agricultural chemical application equipment manufacturers, Extension specialists, researchers, conservationists, farmers, scientists and engineers who are working to develop practical nitrate treatment technologies for agricultural effluents and drainage water, conservation professionals such as those working for the USDA Natural Resources Conservation Service and for soil and water conservation districts, watershed organizations involved in meeting nutrient loss reduction goals, drainage contractors and crop advisers, environmental agencies, policymakers, students, researchers in both agricultural robotics and crop

sciences, unmanned aircraft system developers and engineers, agronomists, growers, scientists investigating crop yield estimation at large scales and the applications of novel satellite products in agriculture domains, and engineers and horticulturalists working in greenhouse technology as well as other ventilation engineers and designers.

Extension target audiences included crop producers, certified crop advisers, livestock producers, custom manure haulers, landscapers, and individuals with 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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	764	2524	1900	0

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

Patent Applications Submitted

Year:	2017
Actual:	1

Patents listed

[2016-233-01] Adaptive Cyber-Physical System For Efficient Monitoring Of Unstructured Environments

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	32	32

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2017	1

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 Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This Hatch project has focused on a variety of projects aimed at increasing corn yield by aiding the breeding process using an agricultural engineering perspective. Each project increases in complexity, and builds on knowledge gained from previous work. The four projects are named EarBot, FieldBot, RootBot and PollBot.

What has been done
We have finalized the development of the FieldBot; it is currently being used to determine the quality of turfgrass in terms of playability and safety. This robot goes beyond the typical machine-vision based phenotyping robot in that it not only uses imagery to determine the texture of

turfgrass, but it also measures mechanical friction in a linear and rotary fashion. We hope that this robot will not only have an impact on agriculture, but also in sport fields, where the current evaluation of playability and safety is primitive to say the least. Allthough we have not siginificantly improved the handling of corn ears, we have refined the algorithms that allow for determination of morphological parameters of individual corn kernels, and we have published a paper showing root maps [scrolls] that experts claim to have never been seen before.

Results
We have also furthered the corn root quality assessment method significantly. In 2017 we have collected 1,500 corn roots that we evaluated in three ways: [1] We have collected traditional images; [2] Three human evaluators then estimated the Root Top Angle [RTA]; and [3] The same evaluators estimated the RTA using the imagery on a computer screen [conceivably in a coffeeshop]. We call this the FCC project which stands for Field/Coffeeshop/Computer method. The aim is to show universities and companies alike that there are major advantages in imaging plant phenotypes and evaluating traits either using a computer algorithm [if available] or by human observers. We are working together with Dr. Aaron Benjamin who is a professor in cognitive psychology.

We have also made significant progress in attempting to quantify lodging from root images. We are working with the USDA's Dr. Marty Williams and we have defined various new methods to quantify lodging in roots and we will cross correlate the data with lodging scores from the field. We anticipate several papers from this effort, where the first will be an engineering methods-oriented paper followed by a second paper where we compare sweet corn and field corn in terms of lodging potential and possibly other traits.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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

2017 75

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 20,485 accesses this past year. Two hundred and nineteen [219] individuals attended the Certified Livestock Manager Training programs. In response to a survey taken at the training, 80% [165 of 208 respondents] indicated they had a manure management plan and 35.7% [75 of 210 respondents] indicated their plans were written and updated annually and constantly used. In response to other multiple-choice questions, 92% correctly identified organic nitrogen as the slow release form of nitrogen in manure, 62% indicated manure application was the most important record to keep, and 55% correctly 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

Reducing The Risks Associated With Bioactive Compounds In Wastewaters

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Microbial pathogens pose a direct health hazard to both humans and animals. According to the 2002 National Water Quality Inventory, pathogens have been regarded as the second leading cause of water quality deterioration for rivers and streams in the United States after sediments. In order to preserve safe water resources and sustainable agriculture by reducing runoff-mediated contamination of agricultural watersheds, best management practices for erosion, chemical, and pathogen control need to be developed and implemented.

What has been done
Despite years of dedicated implementation effort and study, it remains difficult to determine if pollution control measures like BMPs are really improving our environment. To answer this seemingly simple question requires complex tools and study methods [some of which have yet to be developed]. A major challenge with current models used for watershed management planning is that these models, in general, poorly simulate BMP performance. Consequently there is considerable uncertainty in model predictions and investments in water quality improvement activities almost always fail to achieve projected benefits.

Results
In a published paper, a ceramic pellet was manufactured using fly ash [mixed with clay and lime] for the removal of dissolved phosphorus. The results indicated that the developed pellets had the potential to treat contaminated water with high phosphorus concentration from both point and non-point sources. In a follow-up study we evaluated the efficacy of using woodchips and fly ash pellets in flow-through tests for their abilities to remove nitrate and phosphate from the agricultural runoff. The results of this study suggest that woodchip denitrification followed by fly ash pellet filtration can be an effective treatment technology for nitrate and phosphate removal in subsurface drainage.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
405	Drainage and Irrigation Systems and Facilities

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

Certified Livestock Manager Program

Two hundred and nineteen [219] producers, contractors, educators, and others participated and were certified at face-to-face Certified Livestock Manager [CLM] workshops held in 2017. Of the 219 certified, approximately 18 were producers who reported managing facilities with fewer than 300 animal units [AUs]. This was encouraging, given that the current statutory requirement for certification is for producers managing 300 AUs or more. In addition, 62 people signed up or accessed their accounts to take the new CLM online training modules. Of the 62, 30 completed and successfully passed all five training modules and were issued certificates in lieu of personally attending a CLM workshop. This is the third year where the majority of participants that completed the online program chose to use that as their certification mechanism. The feedback received again this season from producers regarding the new online course was very positive. Several made a point of noting their appreciation for the updated format and added content

Summary Observations:

This year, 70% of respondents [148 of 212 respondents] identified swine as their primary livestock, followed by beef [18.9%], dairy [4.7%] and other [3.8%]. About 46% [94 of 205 respondents] reported using composting or rendering [27%] or burial [17%] for mortality management. We learned from surveys that: [1] About 80% [165 of 208 respondents] report having a nutrient management plan; [2] This year, 35.7% [75 of 210 respondents] reported that their nutrient management plan is written, updated annually, and constantly used; [3] A majority of respondents [62% of 200 respondents] believe that manure application records are the most important records to keep; [4] Over one-half of respondents [107 of 194 respondents] correctly answered the question of how frequently perimeter tile must be sampled [correct answer is quarterly]; [5] 92% [178 of 193 respondents] correctly identified organic nitrogen as the slow release form of nitrogen in manure; and [6] 65% [117 of 181 respondents] correctly identified that 300 pounds of phosphorus per acre is the threshold for using a phosphorus-limiting application rate.

Key Items of Evaluation

The Certified Livestock Manager Program, offered through classroom-based and online methods, successfully translated knowledge of manure management best practices to individuals and revealed that 80% of participants have a written nutrient [manure] management plan. In addition, over one-third reported that their plan is written, updated annually, and constantly used.

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
601	Economics of Agricultural Production and Farm Management	25%		10%	
602	Business Management, Finance, and Taxation	5%		20%	
603	Market Economics	5%		10%	
604	Marketing and Distribution Practices	5%		0%	
605	Natural Resource and Environmental Economics	5%		0%	
606	International Trade and Development	0%		20%	
607	Consumer Economics	25%		10%	
610	Domestic Policy Analysis	10%		10%	
801	Individual and Family Resource Management	20%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.0	0.0
Actual Paid	2.7	0.0	14.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
92547	0	475763	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
92547	0	475763	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
696136	0	3592820	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities included an investigation into short-run forecasts in the soybean futures market to identify predictive content and the sources of forecast errors, an effort to combine educational and behavioral economics approaches to reduce food waste, a project that will allow us to identify the best ways to communicate nutrition information to consumers and determine which formats are most likely to influence consumers to make healthier food selections, the application of expertise in published research, institution building, mentoring, and training within the fast-growing emerging soybean markets of Brazil and Sub-Saharan Africa, and a study that expanded the knowledge base for those working in the agricultural sector in assessing crucial information provided in bankers' forecasts of farmland values [the ability to assess the validity and accuracy of forecasts of farmland prices allows those using the information for financial planning to have a deeper insight into the forecast numbers and may impact actions related to investment and marketing strategies in the highly volatile agricultural sector].

Activities also included work analyzing the local, state, federal, and international laws forming the legal environment for agriculture, research that seeks to develop a comprehensive and weighted measure of global financial inclusion and then test the robustness of this measure and the impacts that financial inclusion have on the financial stability and inclusive growth of households, businesses, and communities in developing countries [particular emphasis will be placed on the largest emerging economies - Brazil, China, and India], a project that will study 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, research focusing on the implications of climate change for agricultural policies and projects [with a focus on regions affected by civil conflict], and an analyses of survey data from Chicago and Portland on the values people place on improved aquatic habitat, water quality, and flood regime from stormwater management.

Activities also included work that seeks to provide new evidence on how households react to the investment incentives for energy efficiency improvements and speaks to the ongoing debate about the causes of the energy efficiency gap [many of the proposed market failures for energy efficiency improvements involve lack of information about energy costs], the development of greatly needed information on the causes, consequences, and likely future of farmland prices, work focusing on household financial decision making [starting with a focus on housing and credit decisions and later on student loan and retirement decisions], work to measure the impact on economic outcomes of policy changes and new technologies in the food and agricultural system [the research will explore both the consequences of such changes, measuring the impacts of those changes on issues of direct interest to food producers, consumers, and processors in the U.S. and abroad, and the causes of the changes, analyzing the political and social forces that bring them about], an ongoing evaluation of farm bill programs, and an effort to

collect and disseminate information on non-traditional lenders and non-reporting capital providers to agriculture.

Conference presentations included the Agricultural and Applied Economics Association at the Allied Social Science Association Annual Meeting, National Association of College and University Food Services, Society for Nutrition Education and Behavior, Institute of Sustainability, Energy, and Environment, XXIX European Congress of Agricultural Law, Chinese Academy of Financial Inclusion, Chinese Economists Society, 5th Seminar on Asia and Pacific Economies, Birmingham Financial Education Conference, Center for Financial Planning Board's 2017 Academic Research Colloquium for Financial Planning and Related Disciplines, Asian Development Bank Institute and Sogang University, Southern Regional Science Association, World Bank Annual Bank Conference on Africa, Centre for the Study of African Economies, Midwest International Economic Development Conference, Northeastern Agricultural and Resource Economics Association Workshop on Climate Change and Land Conservation/Restoration, Association of Environmental and Resource Economists Summer Conference, 18th Annual Bioecon Conference, Association for Financial Counseling and Planning Education, American Council on Consumer Interests, National Crop Insurance Services, Farm Foundation, American Agricultural Law Association, National Council of Farmer Cooperatives, Consultative Group for International Agricultural Research, United Nations Food and Agriculture Organzation, and the International Food Policy Research Institute.

Extension educators implemented consumer economics outreach efforts to engage participants across the lifespan, and across economic levels, to maximize personal and family financial capacity building.

Financial Planning for Young Adults, an online financial planning course co-developed by an Extension educator, was offered for a second year. This course provides an introduction to basic financial planning concepts for individuals who are interested in the field of financial planning. Over 11,000 learners accessed the course in 2017 and over 6,700 actively engaged in the online modules.

College students, as a targeted population, were the focus of additional educational programming. In 2017, 20 trained college student interns provided financial educational outreach through the **Financial Wellness Peer Educator Program** to 2,183 college students via presentations, workshops, displays, and one-on-on interactions. This program aims to help college students learn to manage their money effectively and make wise financial decisions. Over-half of these students attended an in-depth workshop or presentation. An additional 11,972 college students were reached via e-newsletters, social media, and other indirect contact methods. In an effort to capitalize on the social media savvy of college students, the trained student interns assumed responsibility for managing the program's Snapchat account to promote the program and teach how to set S.M.A.R.T [Specific, Measurable, Agreed upon, Realistic, and Timely] goals. Following this transition, over 3,000 snaps views were recorded and several college students subsequently reached out to peer educators for more information. Six [6] Illinois colleges collaborated to present and promote recorded and live webinars through the **Get $avvy: Grow Your Green Stuff** series, including four [4] new webinars delivered in 2017. Archived webinars reached up to 400 additional viewers beyond the live webinar reach of 15-30 participants per webinar.

Financial literacy efforts also targeted an even younger population of consumers to promote personal finance competencies. In 2017, 2,929 Illinois teens participated in **Welcome to the Real World**, a simulation that gives middle and high school level students an opportunity to experience the required skills and challenges associated with balancing income and expenses [discussed in further detail in the evaluation section of this planned program].

All My Money - Change for the Better, a train-the-trainer financial management curriculum, was delivered to professionals working with limited resource audiences. The curriculum is designed in a way that agency staff, social workers, and other educators can teach financial literacy topics without a formal financial management background. 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.

The **Money Mentor** program continued to expand the influence and impact of Extension through volunteer contributions. Trained volunteers provided local community financial education outreach through one-on-one financial mentoring as well as through group outreach projects. These volunteers work closely with U of I Extension staff to provide research-based, unbiased financial education. **Money Mentors** volunteers help community members create budgets, plan financial goals, build savings, manage credit and organize finances. Other activities by mentors, beyond one-to-one consultation with mentees, include community activities such as displays providing educational materials at community events and participating in **Money Smart Week**. In 2017, 540 volunteer hours were recorded by approximately one-half the active volunteers.

Social and other electronic media were used to promote financial retirement planning through the **Plan Well, Retire Well** blog and through online resources to promote awareness during **America Saves Week**.

The **Plan Well, Retire Well** blog continued to be a popular online resource with 15,000 page views and 33 new columns posted in 2017. Timely research-based resources, newsletters, and websites are regularly updated by Extension educators to promote on-demand access to financial literacy support.

Annie's Project, a multi-session farm management course for women**,** was delivered by Extension educators in four counties with 52 participants. Workshops utilized experts in production, financial management, human resources, marketing, and legal issues. Topics included sessions related to business plans, marketing, farm leases, insurance, estate planning, property titles, and financial management.

Five [5] regional **2017 Illinois Farm Economics Summits** were held and addressed the farm profitability outlook and management challenges from several perspectives, including the 2018 outlook for crop and livestock prices, soybean yield trends, an update on the next farm bill, the financial position of Illinois farms, habits of financially resilient farm operations, and crop economics for 2018.

Finally, the University of Illinois **farmdoc** [http://farmdoc.illinois.edu/] and **farmdoc daily** [http://farmdocdaily.illinois.edu/] websites continued to serve as a trusted resource 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. In addition to the latest news and research, users were able to view archived webinars, download useful tools to analyze their own business data, and download presentations from relevant statewide conferences.

2. Brief description of the target audience

Members of the target audience included academics in the agricultural economics and food and nutrition circles, policymakers, consumers, producers, food manufacturers, restaurants, researchers focusing on industrial marketing and economic processes, farmers, bankers, practicing lawyers and academic lawyers in the U.S. and abroad, government regulatory agencies, processors and retail distributors of agricultural inputs and products, government agencies, NGO's, foundations, world organizations, central banks, development banks, rural credit cooperatives, microfinance institutions, private sector enterprises interested in efforts related to national and global issues related to financial inclusion, water and land management agencies, public and private utility companies, and researchers and practitioners in the family and consumer science community.

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.

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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4410	11100	1063	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	46	46

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2017	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Page File Requests Made To Farmdoc

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	15300000

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 2017 15.3 million page requests and over 3.3 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.

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

Number Making Decisions To Reduce Risk In Agriculture Production

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Exploring The Impact Of Recent Commodity Market Developments On Market Efficiency

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Exploring The Impact Of Government Policy Decisions On Household Finance

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This project aims to address the following questions: What are the differences in household finance between U.S. and Chinese households? Does financial incentive play a role in better household finance? In particular, do households with access to HPF [Housing Provident Funds] have better financial planning than those without? Do they have higher incentives to save for buying a home? Can they afford more desirable homes with the HPF loans? Who will actually take the HPF loans, and what are the factors determining the choice between HPF loans and commercial loans? How does the annually-updated interest rate affect households' saving and mortgage payments? Does the uniform interest rate introduce different payment patterns among borrowers of different creditworthiness? Upon completion, this project will provide policy implications on housing and credit issues as well as suggestions for household finance. It will contribute to the household finance literature by publishing findings in academic journals.

What has been done
The first phase of this project focuses on household financial decision making, starting with a focus on housing and credit decisions and later on student loan and retirement decisions. In a single-authored paper published in Urban Studies, we showed that a savings and loan program that incorporates behavioral economics theories has successfully stimulated homeownership. The empirical evidence from a natural experiment in China suggests that automatic enrollment, tax-exempt savings, matching contributions, mental accounting, and self-discipline can help incentivize savings and promote homeownership. Our research suggests the importance of applying behavioral economics theories in policy designs.

A review of the literature suggests that credit accessibility is an important external factor for millennials' homeownership. Also important are lifecycle factors such as financial resources and student loans liabilities, and family decisions such as marriage and parenthood. In a paper forthcoming in Real Estate Economics, we investigated mortgage credit access in the presence of

environmental hazard arising from the growing energy sector. We show that lenders lowered origination rates in areas subject to pipeline infrastructure risks and especially after an incident happened. The lenders were more likely to deny low- to middle-income borrowers and securitize the loans for high-income borrowers, yet their ability to transfer the risk to the security market was tempered by the Great Recession.

Results
The second phase of this project integrates methods and theories from economics and psychology to understand individual differences in financial decision-making. In initial work published in the Journal of Economic Psychology, we found that the Big Five personality traits significantly predict young adults' financial distress, even after controlling for early life experiences, household income, and other demographic characteristics. In a household context, both the absolute value and relative strength of a couple predict the allocation of financial decision power, which is evidence for the comparative advantage theory of household power allocation. Inefficient power allocation is associated with lower household wealth. This research highlights the importance of personality traits as a non-cognitive factor in determining financial behaviors. In a paper published in the Journal of Economic Behavior and Organization we illustrate that financial distress is highly genetic and personality traits mediate such genetic influences. Moreover, we find evidence that environment and genes interact with each other to form individual financial behaviors. In particular, such genetic influences are the strongest among young adults whose parents are at the extremes of socioeconomic status.

4. Associated Knowledge Areas

KA Code	Knowledge Area
603	Market Economics
607	Consumer Economics
610	Domestic Policy Analysis
801	Individual and Family Resource Management

Outcome #7

1. Outcome Measures

Investigating The Communication Technologies Used To Share Information About Soy Protein Applications

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Number Of Youth, College Students, Or Adults That Increased Knowledge And Skills In Managing Income And Expenses

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1161

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 1,491 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 1,476 youth that responded to one or more financial management questions, 1,161 [79%] indicated that they learned at least one of the five skills with the largest number reporting learning how to balance income and expenses.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

Individuals Improving Financial Capability And/Or Adopting Consumer Behavior Skills

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	44

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Financial hardship and lack of preparedness for unexpected life events contribute to families' difficult financial times. Through University of Illinois Extension efforts in financial literacy, families can be better prepared to manage financial resources.

What has been done
The Money Mentor program trains volunteers to provide local community financial education outreach through one-on-one financial mentoring as well as group outreach projects. These volunteers work closely with U of I Extension staff to provide research-based, unbiased financial education. Money Mentors volunteers help community members create budgets, plan financial goals, build savings, manage credit, and organize finances. In 2017, 100 participants [mentees] were matched with mentor volunteers to address individualized goals associated with financial challenges like budgeting, saving money, and debt repayment.

Results
Twenty four [24] volunteer mentors were surveyed to report on progress toward goals their mentees set. Mentors provided information about the 64 mentee participants they consulted with over the prior year. Mentors reported that 69% [44] of mentees developed a budget, 54% [35] of mentees decreased their debt, and 45% [29] of mentees increased their savings. Individualized consultation provided by trained Money Mentors was an effective way for mentees to reach self-identified financial goals.

4. Associated Knowledge Areas

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

Outcome #10

1. Outcome Measures

Improving Our Understanding Of The Implications Of Climate Change On Agricultural Policies

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This project studied the implications of climate change for agricultural policies and projects, with a focus on regions affected by civil conflict. Civil conflict has been identified as one of the main obstacles to economic growth and poverty reduction. It has well documented negative effects on many indicators of human well-being and development including nutrition, health, and education. Perhaps as a result of these negative effects, fragile and conflict-affected countries have made much slower progress toward eradicating poverty than peaceful and stable developing countries. Not a single fragile or conflict-affected country has achieved the Millennium Development Goals.

Many of the world's poorest people live in the rural regions of conflict-affected countries. These people are often trapped in a vicious cycle in which poverty leads to violent conflict, which leads to insufficient investment in agriculture, which in turn leads to poverty. Climate change poses challenges for agriculture as well as for conflict resolution and therefore has the potential to severely exacerbate this vicious cycle. This project will explore the mechanisms through which climate change affects agriculture and civil conflict. Understanding these mechanisms is important for the design of adaptive policies that can limit the detrimental effect of climate change on agriculture and conflict.

What has been done
Effects Of Climate Change On Agriculture And Adaptive Policies:

The project will explore two main questions under this topic: 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.

Can Investments In Agriculture And Rural Economies Temper The Effect Of Climate Change On Civil Conflict?

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

The project has generated evidence that 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 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.

Finally, we have begun work on a new project that aims to use advanced remote sensing and machine learning methods to generate metrics of agriculturally-relevant climate shocks. We will use these metrics to explore the role of agriculture in linking climate change and conflict by testing whether agriculturally-relevant climatic shocks are a better predictor of conflict than non-agriculturally relevant ones. This exercise will allows us to determine whether staple crop production is a key mechanism through which climate affects conflict.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
603	Market Economics
604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics
606	International Trade and Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

At the end of the **Welcome to the Real World** simulation, evaluation forms were completed by 1,491 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 1,476 youth who responded to one or more money management skill questions, 1,161 [79%] indicated that they learned at least one of the five skills.

In addition, the post-program assessment asked participants to reflect on their opinions about financial and career relationship before and after the program. When asked "How much did you realize the importance of the following relationships BEFORE and AFTER participating in the program?", a higher proportion of youth responded "A Lot" at the end of the program in comparison to before the program. After participating in the program: [1] 70% realized the importance of the relationship between education and a job [compared with 36% before the program]; [2] 76% realized the importance of the relationship between a job and money [compared with 42% before the program]; and [3] 79% realized the importance of getting more education after high school [compared with 59% before the program].

Key Items of Evaluation

Simulations helped **Welcome to the Real World** youth participants recognize the challenges of independent living and impacted their knowledge of financial management.

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%		20%	
303	Genetic Improvement of Animals	0%		10%	
305	Animal Physiological Processes	0%		10%	
307	Animal Management Systems	20%		10%	
311	Animal Diseases	15%		15%	
315	Animal Welfare/Well-Being and Protection	25%		20%	
806	Youth Development	20%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	8.0	0.0
Actual Paid	0.8	0.0	30.0	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**
25978	0	1430853	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
25978	0	1430853	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
195407	0	9280542	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities included an effort to improve our understanding of the pathophysiology of osteochondrosis and facilitate early interventions for at-risk horses to help reduce risk of clinical disease, the development of a way to consistently identify cattle that are more attractive to flies [during warm months cattle are affected by several species of nuisance, biting, and disease-transmitting cattle flies], improvement of an animal model used to test the effects of early-life nutrition on cognitive development, work to develop efficacious drugs against C. parvum infections in livestock, work to address fundamental questions about the safety and efficacy of processed and stored equine amnion, research that seeks to identify gene networks involved in the regulation of HPA activity and stress-induced behaviors in these strains [identification of molecular pathways involved in regulation of hypothalamic-pituitary-adrenal [HPA] activity in foxes will ultimately provide new insights into regulation of stress-induced behaviors in other mammals], an effort to better understand the regulation of muscle development, growth, and metabolism and improve the efficiency of meat production, and the first report of cardiac MRI and transesophageal echocardiography being performed in neonatal foals [providing us with a unique opportunity to evaluate the clinical utility of these procedures].

Research activities also included a study with the ultimate goal of determining whether stem cell collection under general anesthesia and/or soon after death has any substantive influence on cell viability, proliferation, or differentiation capacity, the analysis of different manure treatment technologies to better understand the nutrient flows during the manure treatment process, work 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 has great potential for influencing disease pathogenesis and agricultural productivity], the conducting of experiments on the use of water-cooled perches for laying hens kept in heat stress conditions [by providing water-cooled perches for laying hens kept in heat stress conditions egg production performance will be improved], and research to determine the concentration of digestible energy and nutrients in soybean meal produced in the U.S. [this will make it possible to more accurately formulate diets for pigs, which will result in improved animal performance, reduced diet costs, and reduced excretion of nutrients to the environment].

Activities also included the development of a cooperative, multi-state 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 that seeks to improve the efficiency of cattle feeding systems by improving nutritional programs to adapt cattle to finishing diets, a study that seeks to characterize the chemical composition and nutritional adequacy of alternative and sustainable protein sources [this is of vital importance to creating viable solutions to feed livestock and to create nutritionally-adequate and complete diets for companion animals while maintaining

a sustainable food chain without direct competition with human food systems], a project with the goal of better understanding the impacts of environmental management on poultry [with the information gained, poultry housing environments can be improved by defining environmental conditions and management practices that will result in production systems which promote bird welfare and performance], an effort to generate an integrated view of the multiple adaptations of the cow to nutritional management and other environmental factors [such knowledge would be helpful in identifying targets that can be manipulated via nutrition or other means to decrease the risk of disease during the transition period], and the development of results that provide encouraging evidence that an efficacious intranasal ND-based sub-unit vaccine against porcine reproductive and respiratory syndrome virus is feasible.

Conference presentations included the 33rd World Veterinary Congress, XIV International Nidovirus Symposium, North American Porcine Reproductive and Respiratory Syndrome Symposium, 97th Annual Conference of Research Workers in Animal Science, Federation of the American Society for Experimental Biology, Equine Science Society, American Association of Equine Practitioners, American College of Veterinary Surgeons, Ninth International Conference on Canine and Feline Genetics and Genomics, Canine Science Conference, Intellectual and Developmental Disabilities Research Center, Veterinary Orthopedic Society, American Society of Agricultural and Biological Engineering, Conference of Research Workers in Animal Diseases, Psychoneuroimmunology Research Society, Clinical and Translational Neuroscience Workshop, American Society of Animal Sciences, International Embryo Technology Society, American Angus Association, American International Charolais Association, World Congress of Genetics Applied to Livestock Production, Western Dairy Management Conference, Kemin Europe Annual Seminar: Connecting the Dots of Amino Acid Nutrition - Nutrition to Maximize the Farm Efficiency, Four-State Dairy Nutrition and Management Conference, Hoards Dairyman Webinar Series, and the Form-A-Feed Professional Dairy Conference.

Two Commercial Agriculture Extension Educators located in research stations provided leadership for a number of programs that focused on beef production including the statewide **Beef Quality Assurance Certifications**, **Annual Beef Selection and Reproduction Management Seminar**, **Illinois Performance Tested Bull Sale**, **Illinois Forage Institute**, **Driftless Regional Beef Conference** [with the latter attended by participants from Illinois, Iowa, Minnesota, and Wisconsin], **Heart of America Grazing Conference** [hosted this year in Illinois with an annual rotation between states], **Northwest Illinois Grazing Conference,** and a **Beef Cattle Reproductive Technologies Workshop**. Other local and regional programs included pasture walks, winter cattle feeders meetings, and research farm field days [the evaluation section of this planned program features impact findings for the **Beef Cattle Reproductive Technologies Workshop** and the **Southern Illinois Beef Conference**].

Three **Dairy Summit** meetings, held throughout the state for dairy producers, included presentations on feeding strategies, role of genomics, transition cow guidelines, concentrated animal feeding operation [CAFO] changes, and economic measurements. An Extension dairy specialist was on hand to facilitate discussions at the **Northwestern Illinois Illinois Milk Producers Association Dairy Tech Showcase**. **Certified Livestock Manager Training Workshops,** targeting manure management best practices, were delivered by Extension staff at eight locations in the state to keep producers current on industry practices [see the Agricultural and Biological Engineering planned program for additional information].

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 Hippology Contests**, and speech contests again this year. 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 implemented the project in classrooms reaching 13,029 students during the 2016-2017 school year [see 4-H Youth Development planned program for evaluation findings]. In addition, 4,860 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. Additional youth-focused livestock programs included a **4-H Youth Livestock Conference** and **4-H Livestock Judging Contest** in 2017. Twenty two youth served as **Livestock Ambassadors**, a program established in 2016.

2. Brief description of the target audience

Members of the target audience included the scientific community focusing on animal health and infectious diseases, swine Extension services, pork producers, the pharmaceutical industry, research scientists working to develop new antiparasitic drugs, veterinarians, the animal health pharmaceutical community, graduate students, postdocs, faculty, horse owners, breeders, and trainers, dairy farmers, scientists engaged in mesenchymal stem cell research, agricultural engineers, researchers in the livestock industry, animal scientists, livestock producers, immunologists, virologists, animal health workers, neuroimmunologists, poultry Extension specialists and poultry researchers that deal with nutrition, environment, management, housing, and economic issues, nutritionists, integrators, producers, members of the scientific community in food and feed science, animal scientists working in the fields of nutrition, physiology, reproduction, and genetics, breed association representatives, beef cattle producers, and scientists involved in the development of vaccines and the stimulation of protective immunity in swine against porcine reproductive and respiratory syndrome virus.

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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4294	5783	16190	2479

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

Patent Applications Submitted

Year:	2017
Actual:	1

Patents listed

[2015-033-01] Device And Method For Spermatozoa Separation By Electrical Charge

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	48	48

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2017	11

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased Knowledge Of Livestock Care And Management
2	Improved Control Of Porcine Reproductive And Respiratory Syndrome
3	Improving Our Understanding Of The Role Of Nutrition On Fertility
4	Identifying Genes, Transcripts, And Pathways Associated With Health In Livestock
5	Improving The Health Of Dairy Goats Through The Development Of New Genetic Resources
6	Improving Control Methods Of Strangles Infection In Horses
7	Enhancing The Efficiency Of Feed Utilization In Beef Production Systems
8	Aspirations To Enhance Profitability Of Livestock Production And Management
9	Aspirations To Reduce Risks In Livestock Production
10	Reducing Losses From Porcine Epidemic Diarrhea Virus
11	Addressing The Safety And Efficacy Of Processed And Stored Equine Amnion
12	Identification Of Molecular Pathways Involved In The Regulation Of HPA Activity In Foxes
13	The Impacts Of General Anesthesia And Euthanasia On The Characteristics Of Stem Cell Populations Collected From Adult Horses
14	Identifying Embryos That Have The Highest Developmental Potential
15	Understanding The Molecular And Systemic Changes That Characterize An Acute Grain Feeding Challenge
16	Improving The Nutritional Management Of Pregnant Dry Cows

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
2017	121

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Priorities in livestock production focused 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
Three conferences addressing livestock care and management were evaluated in 2017: [1] Beef Cattle Reproductive Technologies Workshop [39 adult attendees] introduced the technologies through classroom-based and lab-based experiential activities; [2] Southern Illinois Beef Conference [30 adult attendees] brought together experts from the industry and the University of Illinois to meet educational needs of cow-calf producers in the region; and [3] 4-H Youth Livestock Conference [120 youth in 7th-9th grade] used a "barnyard mystery" to problem solve livestock management issues.

Results
At the end of each conference, participants were asked to respond to a post-program survey to assess knowledge change in livestock care and management as a result their program experience.

Southern Illinois Beef Conference: When asked "Was your knowledge of beef cow and calf management increased by attending this conference?", all [23 out of 23] respondents said "Yes".

Beef Cattle Reproductive Technologies Workshop: When asked "Overall, how much did you learn from this session?" most [29 out of 32] respondents rated a score of 4 or above on a 5-point scale

where 1 = "Nothing", 3 = "Some", and 5 = "A Lot".

4-H Youth Livestock Conference: When asked to respond with their level of agreement to the statement "I feel more prepared to respond to questions from the public about livestock and food production", almost all [69 out of 70 respondents] indicated that they "Agree" or "Strongly Agree".

The reported quantitative outcome is based on the 23 + 29 + 69 = 121 participants that reported changes in knowledge after participating in an educational event targeting livestock care and management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
307	Animal Management Systems
311	Animal Diseases
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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Intranasal immunization against viral respiratory infections is known to provide a superior level of protective immunity when compared to vaccines delivered by other routes. We investigated the efficacy of a novel porcine reproductive and respiratory syndrome virus [PRRSV] subunit vaccine

based on nanodisc technology. Nanodisc [ND] particles are soluble, stable, and reproducibly prepared discoid shaped nanoscale structures that contain a discrete lipid bilayer bound by two amphipathic scaffold proteins.

What has been done
Because ND particles permit the functional reconstitution of membrane/envelope proteins, we incorporated the envelope glycoproteins of PRRS virions into NDs [PRRSVglyco-ND] and investigated their immunogenicty and ability to confer protective immunity. The PRRSVglyco-ND vaccine was adjuvanted with a whole cell lysate of saprophytic Mycobacteria and was administered intranasally twice at a two-week interval. Sixteen days after the booster vaccination the animals were challenged intranasally with 2x104 TCID50 of virulent lineage 1 North American genotype PRRSV, of the same strain that was used to prepare the vaccine. For comparison, two groups of animals were similarly vaccinated using inactivated whole virions with or without the mycobacterial adjuvant.

Results
The presence of anti-GP5 IgA in the lung lavage was evident at the time of euthanasia [13 days after virus challenge] to a greater extent in PRRSVglyco-ND vaccinated swine as compared to swine vaccinated with the inactivated virions. Most notably, as determined by the substantial extent of gross-lung pathology observed in mock-vaccinated pigs at 13 days after the virulent virus challenge, the PRRSVglyco-ND vaccine reduced by >60% the extent of lung lesions, which was superior to the reduction observed in the lungs of animals vaccinated with intact virions with or without adjuvant. Although much work remains to be done, these results provide encouraging evidence that an efficacious intranasal ND-based sub-unit vaccine against PRRSV is feasible.

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

Improving Our Understanding Of The Role Of Nutrition On Fertility

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Identifying Genes, Transcripts, And Pathways Associated With Health In Livestock

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Three complementary and innovative approaches were used to identify single nucleotide polymorphisms [SNPs] associated with health and reproductive performance. Metritis is an important uterine disease that negatively impacts cow health and profitability. Single nucleotide polymorphisms [SNPs] associated with metritis status and time-to-metritis detection were detected using information on approximately 600,000 SNPs from 2,166 dairy cows in sixteen U.S. herds. The SNPs were evaluated using logistic and survival analysis procedures.

What has been done
On average, metritis was detected on 30.4% of the cows at 6.8 days postpartum. Metritis status and days-to-metritis were associated [P-value < 1.0x10-4] with 199 and 7 SNPs, respectively. Most of these SNPs were mapped to intergenic regions and within known genes. Information from these genetic variants can be applied in genomic selection programs to reduce the incidence of metritis and accelerate detection with the goal of improving the overall health of the herd and minimize costs. The association between genomic variation and reproductive efficiency in dairy cattle was studied. Phenotypic records from approximately 10,500 Holstein lactations across 16 herds were combined with information from over 570,000 single nucleotide polymorphisms. The probability of cyclicity [Pr_Cyc] and of pregnancy [Pr_Preg] were described using models that integrated pedigree and genomic information and analysed using restricted maximum likelihood and Bayesian approaches. Heritability estimates were approximately 0.15 and 0.09 for Pr_Cyc and Pr_Preg, respectively. A single step genomic BLUP [best linear unbiased predictor] analysis enabled the identification of five chromosomal regions that explained > 8% of the genetic variation. Genes proximal to these regions were enriched for cytokine receptor activity and membrane organization. These promising regions can be incorporated into genomic evaluations programs to accelerate improvement for fertility performance in cattle.

Results
Genetic selection in dairy cattle have been successfully applied to increase milk production. Further understanding of the genetic and non-genetic factors related to disease and reproduction will support progress in these traits. In this study, two response variables were evaluated: [1] Disease problems encompassing diseases typically caused by pathogens such as metritis, clinical endometritis, mastitis, and respiratory disorders; and [2] Fertility problems identified indicators of reproductive performance. The models used to describe disease and fertility problems included the fixed effects of season, U.S. region, body condition score at 35 days in milk, calving problems, and metabolic problems. These variables were significant with disease and fertility problems. Results showed that disease-related explanatory variables were associated

with fertility problems in cows. Heritability estimates were 0.05 and 0.07 for fertility and disease problems, respectively. The genetic parameter estimates can be used in selection programs.

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
315	Animal Welfare/Well-Being and Protection

Outcome #5

1. Outcome Measures

Improving The Health Of Dairy Goats Through The Development Of New Genetic Resources

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Improving Control Methods Of Strangles Infection In Horses

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Enhancing The Efficiency Of Feed Utilization In Beef Production Systems

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Aspirations To Enhance Profitability Of Livestock Production And Management

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Aspirations To Reduce Risks In Livestock Production

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

Reducing Losses From Porcine Epidemic Diarrhea Virus

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
During epidemics, porcine epidemic diarrhea virus [PEDV] causes up to 100% mortality in young pigs and results in significant economic losses to the pork industry. Recent information suggests that PEDV might suppress type I interferon [IFN] reproduction during infection and modulates the innate immunity of pigs. Innate immunity is critical for the first line of host defense, and IFN-alpha/beta are the major components of the innate immunity. In turn, many viruses have evolved to suppress the innate immunity during infection, and thus, the suppression of innate immunity by PEDV is significant for disease process and viral pathogenesis.

What has been done
During the reporting period, we accomplished two major objectives: [1] Molecular basis of the PEDV nsp1 protein on the suppression of IFN response; and [2] The viral regulation of nuclear factor [NF]-kappa B [kB]. We developed a gene-based reporter assay system and an IFN bioassay using vesicular stomatitis virus [VSV] expressing green fluorescence. Using these assays, we found that type I IFN response was indeed suppressed during infection, and at least 10 PEDV proteins were identified as IFN suppressors. Among these proteins, nsp1 appeared to be one of the most potent IFN antagonists, and further studies revealed that nsp1 inhibited the enhanceosome assembly by degrading CREB-binding protein [CBP]. This study is important

since nsp1 can be a target protein for antiviral development.

Results
We then examined the role of NF-kB during PEDV infection. Using porcine epithelial cells, we found that PEDV inhibited both NF-kB activity and proinflammatory cytokine production. PEDV blocked the activation of p65 subunit in virus-infected cells and suppressed the NF-kB activity. Of the total of 22 PEDV proteins, nine proteins were identified as NF-kB antagonists, and nsp1 was the most potent suppressor of proinflammatory cytokines. Nsp1 interfered the phosphorylation and degradation of IkB and thus blocked the p65 activation. Based on the predicted three-dimentional structure of nsp1, mutations were introduced to the nsp1 gene and mutant proteins were generated. We then showed that highly conserved residues of nsp1 were essential for suppression of NF-kB activation. Our study demonstrated that PEDV inhibited NF-kB activity and that nsp1 was a potent NFkB antagonist for suppression of both IFNs and early production of proinflammatory cytokines. We have provided a novel understanding of the role of PEDV nsp1 for innate immune modulation and the viral strategy for host immune evasion during infection.

4. Associated Knowledge Areas

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

Outcome #11

1. Outcome Measures

Addressing The Safety And Efficacy Of Processed And Stored Equine Amnion

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Deep and chronic wounds in horses, particularly of the distal limbs, are a major challenge to treat and manage. Evidence suggests that equine amnion is an effective and economical wound dressing, but there is a dearth of information regarding appropriate processing and storage protocols. The output of this research is intended to directly and immediately impact equine

veterinarians treating deep and chronic wounds by offering evidence-based recommendations for the preparation and storage of equine amnion prior to use as a wound dressing.

What has been done
The work outlined in this project addressed fundamental questions about the safety [level of bacterial contamination] and efficacy, as defined by utility as a structural scaffold and potential biological activity [protein content], of processed and stored equine amnion.

Results
Importantly, we evaluated processing and storage methods that would be reasonable for a field practitioner to implement. Results from this work have been disseminated to general equine practitioners and specialist equine surgeons as podium talks at two national meetings. We expect that the results of this work will also indirectly benefit horse owners and trainers as practitioners implement our evidence-based recommendations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
305	Animal Physiological Processes
315	Animal Welfare/Well-Being and Protection

Outcome #12

1. Outcome Measures

Identification Of Molecular Pathways Involved In The Regulation Of HPA Activity In Foxes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Domesticated species exhibit a suite of behavioral, endocrinological, and morphological changes referred to as domestication syndrome. These changes may include a reduction in reactivity of the hypothalamic-pituitary-adrenal [HPA] axis, specifically reduced adrenocorticotropic hormone [ACTH] release from the anterior pituitary. Experimentally domesticated [tame] foxes provide a

novel model for studying the HPA regulation in domesticated animals. Differences in ACTH concentrations in blood samples of foxes from tame and aggressive lines have been demonstrated. In this study, we found that differences between the two lines may lie in regulation of ACTH release through exocytosis rather than regulation of ACTH synthesis and processing.

What has been done
Examination of gene expression through sequencing of anterior pituitary mRNA demonstrated differences in formation of pseudopodia and in signaling by cAMP. Pseudopodia formation have been implicated in release of pituitary hormones, such as lutenizing hormone, into blood vessels and in the formation of regulatory networks for coordinating hormone release by endocrine cells, while cAMP is a major regulator of exocytosis.

Results
We have demonstrated here for the first time the possibility that genes in networks related to cAMP regulation, cell adhesion, and pseudopod formation may have been targeted in selection for the domesticated phenotype. Although our findings are in the experimentally domesticated fox, the similarity of phenotypes across domesticated species suggest the possibility of selection on a shared set of gene pathways. Therefore, our findings may provide new avenues for investigation of the biological differences between domesticated and wild species.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
305	Animal Physiological Processes
307	Animal Management Systems

Outcome #13

1. Outcome Measures

The Impacts Of General Anesthesia And Euthanasia On The Characteristics Of Stem Cell Populations Collected From Adult Horses

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
We will clarify the impacts of general anesthesia and of euthanasia on the characteristics of stem cell populations collected from adult horses. This issue is critical to the clinical application of stem cell therapies, since it is often convenient to collect specimens for stem cell isolation from patients while they are under general anesthesia and cadavers have been suggested as a convenient and plentiful source of stem cells for allogeneic applications.

What has been done
Stem cells will be collected from horses under sedation, then under general anesthesia, and finally soon after euthanasia. The cell yields, cell proliferation, and osteogenic capacities of stem cells from bone marrow aspirates and from adipose tissues will be assessed using standard in vitro assays. Our ultimate goal is to determine whether stem cell collection under general anesthesia and/or soon after death has any substantive influence on cell viability, proliferation, or differentiation capacity.

Results
The study determined that general anesthesia and euthanasia both progressively reduced the viability of mesenchymal stem cells [MSC] in primary bone marrow aspirates during the initial primary cell isolation and expansion phase of culture, but that subsequent passage populations were relatively unaffected by the donor status during collection. Osteogenic capacities of passage in three MSC populations were not affected by donor status during collection. No consistent effect of donor status at the time of collection [sedation, general anesthesia, or recent euthanasia] was detected in the expansion and subsequent osteogenic differentiation of adipose-derived MSCs. These outcomes indicate that MSCs can be reliably isolated and expanded from anesthetized and, more notably, recently euthanized horses, with transient initial impacts on bone marrow MSC viability that resolves after in vitro passage.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #14

1. Outcome Measures

Identifying Embryos That Have The Highest Developmental Potential

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The ability to identify those embryos that have the highest developmental potential from a cohort would significantly increase the chances of achieving pregnancy. Metabolic analysis is a well-established analytical approach in biological systems. Starting from this idea, we chose to use high-resolution nuclear magnetic resonance [1H-NMR] spectroscopy. The aim of this study was to determine if it was possible to select viable embryos after 48 hours of culture using metabolic activity as the parameter.

What has been done
We evaluated embryo metabolism after the first 48 hours of culture and compared the activity of cleaved embryos that became blastocysts to cleaved embryos that did not develop to blastocysts and in vitro fertilized [IVF] blastocysts and parthenogenetic-activated [PA] blastocysts. Our results show that citrate, pyruvate, myoinositol and lysine have great impact on predicting embryo development.

Results
When we compared IVF and PA blastocysts we found that acetate and phenylalanine concentrations are excellent parameters for evaluating blastocyst quality. Combining all these results, we were able to create a formula that predicts zygote development after two days of culture. In conclusion, we found that it is possible predict the future development of in vitro produced bovine embryos after only two days of culture using 1H-NMR.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
305	Animal Physiological Processes
307	Animal Management Systems

Outcome #15

1. Outcome Measures

Understanding The Molecular And Systemic Changes That Characterize An Acute Grain Feeding Challenge

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Long-term feeding of high-grain diets to dairy cows often results in systemic inflammation characterized by alterations in acute-phase proteins and other biomarkers, both in plasma and in immune-responsive tissues like the liver. The molecular and systemic changes that characterize an acute grain feeding challenge remain unclear.

What has been done
The current study involved six Holstein and six Jersey cows in a replicated two × two Latin square. Periods [10 days] were divided into four stages [S]: S1, days 1 to 3, served as baseline with total mixed ration [TMR] ad libitum; S2, day 4, served as restricted feeding, with cows offered 50% of the average daily intake observed in S1; S3, day 5, a grain challenge was performed, in which cows were fed a TMR ad libitum without [CON] or with an additional pellet wheat-barley [1:1; HIG] at 20% of dry matter intake top-dressed onto the TMR; and S4, days 6 to 10 served as recovery during which cows were allowed ad libitum access to the TMR. Among the 28 biomarkers analyzed in blood 12 hours after grain challenge on day 5, the concentrations of fatty acids and bilirubin increased in HIG Holstein but not Jersey cows. In Holsteins, feeding HIG also increased total protein and albumin while decreasing ceruloplasmin, myeloperoxidase, and alkaline phosphatase concentrations.

At the molecular level, hepatic genes associated with inflammation [IL1B, IL6, TNF, TLR4, MYD88, and NFKB1] were upregulated in Holstein cows fed HIG versus CON. Despite such response, expression of the acute-phase proteins SAA and HP in Holsteins fed HIG compared with CON was markedly downregulated. In Holsteins fed HIG versus CON, the marked downregulation of SCD, ELOVL6, and MTTP along with upregulated CPT1A, ACOX1, and APOA5 indicated alterations in fatty acid and lipoprotein metabolism during grain challenge.

Genes related to ketogenesis [HMGCS2 and ACAT1] were upregulated in Jerseys, and

gluconeogenic genes [PDK4 and PCK1] were upregulated in Holstein cows fed HIG, suggesting alterations in ketone body and glucose production. Expression of phosphorylated p70S6K1, RPS6, and 4EBP1 proteins, as well as total mechanistic target of rapamycin [mTOR] protein, decreased in Holsteins fed HIG, whereas phosphorylated mTOR and 4EBP1 proteins increased in Jerseys fed HIG.

Results
From a metabolic and inflammatory biomarker standpoint, data indicate that Jersey cows better tolerated the acute grain challenge. Alterations in mTOR signaling proteins in both Jerseys and Holsteins fed HIG suggest a potential role for exogenous AA in the hepatic adaptations to grain challenge. It remains to be determined if these acute responses to a grain challenge can elicit long-term liver dysfunction, which could negatively affect welfare of the cow.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
305	Animal Physiological Processes

Outcome #16

1. Outcome Measures

Improving The Nutritional Management Of Pregnant Dry Cows

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Feeding a higher-energy diet by increasing cereal grains at the expense of forage during the last three to four weeks prepartum is a traditional approach to help the rumen "adapt" to the traditional diets fed at the onset of lactation. Increasing grain/concentrate in the diet changes ruminal fermentation and in sheep and goats elicits marked changes in mRNA expression of immune-related genes in ruminal epithelium. Whether such changes at the epithelial and systemic levels occur in dairy cows when the dietary energy content increases at a fixed level of concentrate is unknown.

What has been done

Fourteen nonpregnant, nonlactating Holstein cows were fed a control lower-energy [CON, 1.30 Mcal/kg of dry matter] diet to meet 100% of estimated nutrient requirements for three weeks, after which half of the cows were assigned to a higher-energy diet [OVE, 1.60 Mcal/kg of dry matter] and half of the cows continued on CON for six weeks. Levels of forage and concentrate for CON and OVE were 80 and 79% and 20 and 21%, respectively. Plasma samples were collected one day before slaughter to examine biomarkers of metabolism, liver function, inflammation, and oxidative stress. The reticulo-rumen mass was recorded at slaughter, and samples of epithelium were harvested from all cows. The expression of 29 genes associated with tight junctions, immune function, and nutrient transport [volatile fatty acids, urea, and trace minerals] was examined. Overfeeding energy led to consistently greater dry matter intake over time, and lowered plasma concentrations of haptoglobin, paraoxonase, bilirubin, fatty acids, and myeloperoxidase [secreted by neutrophils]. In contrast, OVE resulted in greater hydroxybutyrate and cholesterol concentrations. A greater reticulo-rumen mass in cows fed OVE did not alter genes associated with tight junctions [CDLN1, CDNL4, OCLN, TJP1], immune function [IL1B, IL10, NFKB1, TLR2, TLR4, TNF], oxidative stress [SOD1, SOD2], or most nutrient transporters. However, feeding OVE upregulated the acute-phase protein SAA3 by 3.5-fold and downregulated a volatile fatty acid transporter [SLC16A1] and a Fe and Cu transporter [SLC11A2].

Results

The lack of effect on mRNA expression along with lower plasma concentrations of inflammation biomarkers indicates that long-term intake of a higher-energy diet ad libitum was not detrimental to ruminal epithelium integrity. In that context, a protective function of SAA3 could be envisioned with a role in opsonizing gram-negative bacteria that produce endotoxins. The long-term control of volatile fatty acid absorption and trace minerals from the rumen in cows overfed energy does not seem to be controlled at the gene transcription level. The relevance of these findings to the nutritional management of pregnant dry cows merits further research.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
305	Animal Physiological Processes

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

At the completion of the **Beef Cattle Reproductive Technologies Workshops**, 32 out of the 39 participants completed an end-of-program evaluation to provide feedback and measure self-reported knowledge gained overall and for specific aspects of reproductive technology covered during the conference. Overall, on a scale from 1 = "Nothing" to 5 = "A Lot", nearly all [29 out of 32] respondents self-reported a rating of 4 or higher reflecting an overall moderate to high self-reported knowledge gain.

Based on the retrospective report of knowledge before and after the program on key aspects of reproductive technology, there were dramatic increases in those reporting moderate to high knowledge [4 or higher on the 5 point scale] levels after the program compared to knowledge levels before the program. The following changes in knowledge level were self-reported by participants: My understanding: [1] Of finding the inseminator's target = 22% before and 91% after [**69% difference**]; [2] Of estrus synchronization and timing of AI = 25% before and 91% after [**66% difference**]; [3] Of reproductive anatomy = 28% before and 91% after [**63% difference**]; [4] Of reproductive diseases and prevention = 22% before and 84% after [**62% difference**]; [5] Of bovine estrus cycle and heat detection = 35% before and 94% after [**59% difference**]; and [6] Of semen handling and tank management [lab session] = 25% before and 81% after [**56% difference**].

At the end of the **Southern Illinois Beef Conference**, 23 out of the 23 participants completed an end-of-program evaluation. All respondents reported that their knowledge of beef cow and calf management increased by attending the conference. In addition, when asked what management technique they would likely implement as a result of what they learned, the two most commonly identified actions were related to nutrient management and EPDs/genetic testing. Participants reacted very positively to the speakers with average ratings at a mean score of 4.5 [on a 5-point scale from 1 = "Poor" to 5 ="Excellent"].

At the conclusion of the **2017 4-H Youth Livestock Conference,** 70 out of 120 participants completed an end-of-program evaluation. With respect to their conference experience, all 70 participants who completed an evaluation agreed that they both "gained knowledge and skills related to animal science" and "felt more prepared to respond to questions from the public about livestock and food production". All but one [69] youth agreed or strongly agreed that they learned more about livestock genetics and DNA.

Key Items of Evaluation

Knowledge gains were demonstrated for educational interventions targeting both youth and adult livestock management audiences.

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%		20%	
802	Human Development and Family Well-Being	0%		15%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	15%		10%	
805	Community Institutions, Health, and Social Services	15%		15%	
806	Youth Development	25%		40%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.0	0.0
Actual Paid	19.2	0.0	5.6	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
668969	0	156237	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
668969	0	156237	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
5031974	0	794636	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included research to generate information about how immigrant Latino parents living in rural and non-metropolitan communities negotiate the challenges of parenting adolescents in the U.S., work focusing on the multiple cultural identities of youth in non-metropolitan communities in the Midwest [and how juggling these multiple identities may be associated with psychological well-being and attitudes towards other cultural groups], efforts to explicate the role of different types of violence in different patterns of judicial involvement among divorcing mothers with and without a history of violence [findings will inform efforts to appropriately match legal interventions and services to the diverse needs of divorcing parents], research that seeks to improve adult leadership education not only by illustrating how this population understands the concept of leadership in general and their own practices in particular, but also by providing a structural bridge to inform the practices of educators in helping support the leadership development of these students who participate in formal organizations, work to identify the types of challenges and dilemmas that leaders encounter and the strategies experienced leaders used to address these dilemmas [the aim is to generate knowledge to help new program leaders better support youth's learning processes], and an examination of the implications of global promotion of youth participation at the global, national, and local scale [more than ever, youth are promoted as leaders not just in their local communities but also on a global scale].

Conference presentations included the Society for Research in Child Development, National Council on Family Relations, Ohio Youth-Led Prevention Network, Howland Symposiums, Association for Cultural Studies Meeting, International Sociological Association, and the Association for Asian American Studies.

Extension activities included a wide variety of methods focused on community planning, building entrepreneurial communities, leadership development, and workforce development. While the focus of the efforts vary, the one commonality is that all activities are directed toward impacting systems and individuals who play a pivotal role in creating change far beyond the focus of the intervention.

Extension educators with a focus in community development provided comprehensive assistance to counties and communities through economic development initiatives and customized strategic planning. For communities with no formal economic development organizations, educators provided essential services that bring research-based community and economic development practices to even the smallest communities. An example in 2017 was a new **Community Innovation Center [CIC]** launched in a small Illinois town [under 10,000 population] to assist entrepreneurs and small business owners with the knowledge and tools to take a concept from the "idea" phase all the way to a complete prototype. This incubator was the result of Extension's collaboration with the Illinois Marketplace and Maker Literacy Program and local organizations within the targeted community. For larger communities, educators worked

collaboratively with existing networks to use university research to augment existing economic and community development efforts and support municipal or county economic development departments, economic development organizations, and chambers of commerce. Services and programs included customized planning and visioning, disaster mitigation planning for businesses and non-profits, proposal development, community engagement programs, and survey design and research.

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.

An Extension educator devoted effort to helping 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.

Building Entrepreneurial Communities continued to be a focus associated with economic development and workforce preparation and outreach efforts, supplemented by a blog that was updated with 23 entries in 2017. 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**.** One such program, **Teacher Tuesdays**, reached 273 professional educators representing 112 schools and out-of-school organizations to foster peer support, introduce new resources, and provide networking with businesses and organizations promoting STEM education.

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 Education Webinars**, a 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 26 county-elected and appointed officials including county board members and administrators.

2. Brief description of the target audience

Members of the target audience included South-East Asian adolescents in the non-metropolitan U.S., educators who focus on the leadership development of youth, adolescents, and emerging adults in the world of agriculture, youth program administrators and front line practitioners such as 4-H staff members, and academics and researchers.

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, professional educators, 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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	34748	1873714	23851	208190

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	14	14

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2017	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number Of Individuals Reporting New Leadership Roles And Opportunities Taken
2	Number Of Plans Developed, Adopted, Or Adjusted By Communities Through Resident Engagement
3	Number And Dollar Value Of Volunteer Hours Invested In Community-Related Projects
4	Number Of Community Or Organization Programs Or Activities Initiated
5	Improving Programs For High School Students Through A Better Understanding Of The Strategies Used By Effective Program Leaders
6	Exploring The Extent To Which Different Types Of Intimate Partner Violence Are Associated With Different Patterns Of Judicial Involvement, Interventions, And Legal Outcomes
7	Examining The Complex Relationships Between Family Socioeconomic Conditions And Child Development
8	Dollar Value Of Resources Leveraged/Generated For Communities
9	Improving Our Understanding Of The Social Practices And Implications Of The Promotion Of Youth Participation At A Global Scale

Outcome #1

1. Outcome Measures

Number Of Individuals Reporting New Leadership Roles And Opportunities Taken

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increasing the capacity of local decision-makers in the areas of communication, decision-making, teamwork, and learning-management will enhance community vitality and improve the quality of life in rural and urban areas.

What has been done
The Leadership Academy was developed by University of Illinois Extension in partnership with the United Counties Council of Illinois [UCCI] to provide leadership training on issues important to elected and appointed county officials. The curriculum is designed for county officials who want to explore new ideas and learn practical responses to current issues, challenges, and opportunities. The five instructional sessions allow participants to learn, share, and apply skills on a variety of practical and pertinent topics. Topics addressed in the academy include leadership fundamentals, improving your management skills, change management, managing conflict, fiscal management, developing strategies for economic development, data-driven decision making, parliamentary procedure, leadership in crisis situations, and crisis communications. Twenty six [26] participants graduated from the UCCI Leadership Academy in 2017.

Results
UCCI Leadership Academy participants were invited to complete an end-of-program evaluation to solicit feedback about their experience. Twenty two [22] participants completed the survey. When asked if they have assumed any new roles as a result of their participation, 6 of the 15 respondents who provided an answer shared an example of a new leadership role they have assumed. A significant majority [95%] indicated that they would be "Very Likely" to recommend the UCCI Leadership Academy to others.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Number Of Plans Developed, Adopted, Or 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
2017	36

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 36 action plans to guide the future of their municipality, county, or region.

Results
Disaster Preparedness Plans were finalized for fifteen not-for-profit agencies in the Quad Cities Area, with fourteen of the agencies receiving funds to implement their plans. The Community Foundation of the Great River Bend granted a total of $36,184 for the plan implementation. One of the agencies that submitted their plan did not request funding, but did implement the plan. The Hancock County Multijurisdictional Hazard Mitigation plan was also completed during 2017. Approval for the plan was received in October of 2017. The Grundy County Multijurisdictional Hazard Mitigation Plan completed its fifth annual update, and noted that 55% of the plan had been implemented since its adoption in 2012.

Community planning projects continue to be developed and monitored with the assistance of

Extension throughout the state. As the plans become operationalized, Extension also continues to be engaged with the communities to monitor and update the plans, as well as document the plan status. Impacts noted throughout the year included not only the Grundy HMP referenced above, but also items such as the completion of the Accessible Playground from the Oquawka Parks Plan, Bus Stop indicators in Raritan, and disaster exercises in Henderson County. Alpha has also completed a new community website and a homebuyers grant award program based upon their community plan.

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

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

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number Of Community Or Organization Programs Or Activities Initiated

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Adolescents in the 21st century need to develop career and life skills [like strategic thinking, responsibility, and initiative] for navigating complex and unstructured real-world situations. Organized programs for high-school-aged youth, such as 4-H programs and other community programs, help youth learn these skills by engaging them in large individual or group projects that require them to set goals, plan, and deal with real-world challenges. The question of this research is how program leaders can best support youth's learning in these projects. Given that program members are taking on novel, often unstructured projects, how do leaders provide the right amount of help and structure to facilitate youth's learning? How do you help them develop skills to navigate complex real-world tasks on their own? Our objective is to identify the types of challenges and dilemmas that leaders encounter and the strategies experienced leaders used to address these dilemmas. The aim is to generate knowledge to help new program leaders better support youth's learning processes. This study will draw on data from a larger research project focused on positive youth development among high-school-aged youth.

What has been done
We conducted interviews with leaders [97 total interviews] and conducted 28 observations of the leaders in action. This sample of leaders was chosen to be approximately similar to the 25 leaders of programs for high-school-aged youth for whom we already had data [the Pathways sample]. The two samples of programs come from the same three regional locations and have similar range of content [leadership, arts, and STEM]. The two samples of leaders are similar in ethnicity and serve approximately the same ethnic and socioeconomic status mix. These additional leader interviews doubled the sample size for our analyses of leader practices, which greatly strengthened our ability to inform the field of youth practice. It also allows us to compare the practices and pedagogical strategies leaders employ in running programs for younger versus older adolescents. Analyses have been conducted and reports written on the five major topic areas listed below.

Results
Adolescents' Development of New Skills for Prospective Cognition: Learning To Anticipate, Plan and Think Strategically: Our findings demonstrate how leader support facilitates youth's learning to anticipate the particularities of the contexts and people involved in reaching a goal and learning general "meta" concepts and strategies that apply across situations such as formulating plans that take uncertainties into account.

Why Youth's Trust in Program Leaders Matters: We found that trust: [1] Increased youth's confidence in leaders' guidance in program activities; [2] Increased youth's motivation in these activities; [3] Increased youth's use of leaders for mentoring on personal issues; and [4] Provided a useful model of a well-functioning relationship.

How Trust Grows: Teenagers' Accounts of Forming Trust in Youth Program Staff: Theoretical analyses across the processes led to four propositions about how youth's trust grows. First, project-based programs provide rich varied affordances for leaders to foster youth's trust-growth.

Second, trust-growth often stems from leaders' attuned responses to situations when youth experience vulnerability. Third, trust develops when leaders' actions align with youth's goals and empowerment. Fourth, youth's appraisals of trustworthiness involves discerning assessments of leaders over time; these included youth compiling evidence from multiple experiences and employing multiple criteria. The findings lead to recommendations on how staff can cultivate youth's trust within authentic learning relationships.

The Art of Restraint: How Program Leaders Use their Authority to Support Youth's Agency: Analyses showed that these veteran leaders experienced - and enacted - a more nuanced relationship between authority and youth agency. They limited their use of authority but also employed it in intentional ways aimed at strengthening youth's agency and skills for agency.

Leaders Responses to Cultural Challenges Going Full-Right-In vs. Avoidance: The analysis identified three types of responses: [1] Proactive engagement; [2] Limited engagement; and [3] Disengagement. Proactive engagement corresponds closely with best practices identified by research in education. These findings are important because they identify the types of cultural issues that should be included in staff training. They also indicate that this training should help trainees develop not just skills, but also the emotional comfort to address these cultural issues directly.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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 #6

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 #7

1. Outcome Measures

Examining The Complex Relationships Between Family Socioeconomic Conditions And Child Development

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Dollar Value Of Resources Leveraged/Generated For Communities

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Improving Our Understanding Of The Social Practices And Implications Of The Promotion Of Youth Participation At A Global Scale

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This research investigates the ideological assumptions behind and the practices that constitute the promotion of youth participation and empowerment. There are three main objectives: Objective One investigates the impact of youth participation imperatives and actual practices of youth participation at both UN high-level events and of its affiliated agencies and non-governmental organizations and the various actors that carry out such mandates. Objective Two examines the discourses and policies aimed at promoting youth participation by the UN and its affiliated agencies and NGOs. Objective Three is to produce a book-length manuscript and several articles in refereed journals derived from this research. Expected outcomes include academic and practice-oriented presentations, journal articles, and a book manuscript.

What has been done
This study examined the social practices and implications of the promotion of youth participation at the global scale. This promotion was evidenced in providing speaking roles for youth in various UN processes, the staging of annual global youth conferences, the establishment of Youth Strategy Plans by UN agencies, and the advent of new national youth policies. This study was achieved through qualitative methods of ethnographic participant observations and interviews. It

also included critical analysis of archival and contemporary polices and programs. Specifically, this was a multi-sited ethnographic study of the burgeoning youth empowerment movement initiated by the UN, its member states, and its agencies to target global elite youth from around the world. This study also attended to the work of five international and regional youth organizations and how they negotiated these newfound global opportunities.

Results
The major impact of this project was the change in knowledge. Some major changes in knowledge include: [1] The young people invited to partake in youth empowerment projects are a select group of global elites in their twenties who are educated, english-speaking, savvy world travelers who live and work in a country other than the one they hold citizenship, and who are knowledgeable about the international policy norms and protocols that inform UN-related meetings; [2] These efforts to include youth enact the current norm in global governance to incorporate the participation of multiple stakeholders in the agenda-setting of international policies; and [3] This research found that while these global youth initiatives may enable more equitable representation and democratic participation, they also work to normalize youth agency within the well-defined terrain of international protocols found in the international politics.

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

No evaluation studies were conducted for this planned program.

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	10%		10%	
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	10%		10%	
504	Home and Commercial Food Service	15%		0%	
701	Nutrient Composition of Food	0%		10%	
702	Requirements and Function of Nutrients and Other Food Components	0%		5%	
703	Nutrition Education and Behavior	0%		10%	
704	Nutrition and Hunger in the Population	25%		10%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	10%		10%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	20%		10%	
806	Youth Development	10%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.0	0.0
Actual Paid	23.9	0.0	11.5	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**
833358	0	938346	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
833358	0	938346	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
6268501	0	2361514	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities included work to improve the safety of Hispanic-style fresh cheeses, the development of effective management of X. cucurbitae in pumpkins, a project with the goal of developing and applying novel analytical methods based on state-of-the-art instrumentation for the identification of trace level potent odorants in foods, food ingredients, and other complex matrices, an investigation into the impact of amorphization method on the physicochemical properties and heat-induced and moisture-induced crystallization behaviors of amorphous sucrose [this research will produce advanced scientific knowledge useful for enhancing the stability of amorphous containing food and pharmaceutical products], a study of the potential for agroforestry systems to contribute to food production while also providing additional ecosystem services, an effort to determine how context effects created from environment and sample differences impact the results of acceptability testing of food products, the development of new tools that apply engineering and statistical approaches to problems in food safety microbiology, research focusing on the safety of botanical estrogenic dietary supplements on breast cancer metastasis, and an effort to better understand the interplay between breast cancer metastasis and frying oil consumption.

Activities also included an investigation into the use of acoustic energy as a physical bio-fortification method to enhance the endogenous nutritional values of food crops, a study that seeks to provide an effective labeling system for consumers who have health concerns related to sodium and fat to aid in making healthy food choices, an effort to better understand the material conditions that reduce or reproduce household food insecurity, an examination of food microstructures and evaluating 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], research that seeks to describe transport mechanisms and thermomechanical behavior 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], and the use of dynamic infrared imaging to provide a relatively simple, robust means of ensuring seal, bond, and weld integrity to improve food system safety in packaging, distribution, and storage.

Conference presentations included the Reciprocal Meats Conference, American Society of Animal Science Midwest Section, American Society for Horticultural Science, 2nd International Conference on Plant Physiology and Pathology, American Phytopathological Society, Ecological Society of America, North American Agroforestry Conference, International Congress on Hazelnut, Peanut and Tree Nut Processors

Conference, Global Food Safety Initiative, Institute of Food Technologists, Korean Society of Food Science and Technology, and the International Union of Food Science and Technology.

Extension offered food safety training for employees of establishments, foodbank managers, and volunteers that prepare or serve food to the public. The 8-hour **Food Handlers** course was conducted to meet the five-year certification requirements for food service sanitation managers. **Serve it Safely** served volunteers who handle food for fundraisers, community organizations, and family events. 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.

In 2017, an Extension educator with the Local Foods-Small Farms team completed a nationwide instructor training to serve as a lead trainer and teach Illinois food growers important agricultural sanitation practices legislated by the Food Safety Modernization Act Produce Rule of 2011. In 2017, 66 food growers attended a **Food Safety Modernization Act Produce Rule** training offered at one of four locations throughout Illinois, using required educational material designed to reduce microbial contamination on the farm. Two [2] additional Extension educators will offer **FSMA Produce Rule** training within their areas in 2018.

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. The annual **Crop Management Conferences** [held in 4 locations throughout the state] served 410 crop producers, certified crop advisors, and other agricultural professionals who farm, manage, or consult upon a total of 8.8 million acres [see evaluation section of this planned program]. For those who were confronting the challenges of organic crop farming, two [2] Extension educators conducted a webinar to address **Disease Management in Organic Crops**.

Extension's **Pesticide Safety Education Program** reached 1,108 private [farmer] pesticide applicators and 9,409 commercial applicators this past year, providing information on proper and safe use of pesticides that is vital to Illinois residents with respect to food safety and quality.

The Bulletin, an online series, remained an important source of integrated pest management information provided by entomologists, agronomists, and plant pathologists. Thirty nine [39] articles were posted this past year. Extension educators and specialists also developed 20 biweekly online issues of the **Fruit and Vegetable News**, covering research-based information relevant to commercial fruit and vegetable growers, regional reports from around Illinois, and announcements for upcoming programs offered by Extension. The **University of Illinois Plant Clinic** provided diagnoses for 86 commercial and home fruit and vegetables samples submitted in 2017.

Extension educators delivered conferences reaching 324 fruit and vegetable producers in 2017 [see the evaluation section of this planned program] including the **Southern Illinois Commercial Tree Fruit School**, **Southwestern Illinois Commercial Fruit School**, **Stateline Fruit & Vegetable Growers Conference**, **Gateway Small Fruit & Vegetable Growers School**, **Northern Illinois Berry Schools** [delivered in three separate locations], and the **Backyard Tree Fruit School**. Extension also provided leadership and delivered educational sessions for the **Illinois Specialty Crops, Agritourism and Organic Conference** that targeted specialty crop growers and small farm owners to promote best management practices, marketing techniques, pest management, food safety, and production practices. The 2017 program featured nearly 100 speakers and 60 trade show exhibitors.

For the fifth year, Extension educators on the Local Food Systems and Small Farms team 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 delivered in two locations throughout the state to help people

identify a number of economically-viable alternatives for farming small acreage. Fifty individuals attended one of the two programs [see the evaluation section of this planned program]. Both programs offered a plant track and an animal track for learners. The **Small Farms Webinar** series of 10 weekly one-hour webinars directed at small farm owners or operators drew over 1,200 sites [in many cases, multiple participants linked in from a single site]. Following live delivery, the webinars were archived on Extension's **Local Food Systems and Small Farms** website.

Now in its second year, the **Master Urban Farmer Training Program** has trained 65 participants in Cook County [the largest county in Illinois] to visualize a business plan and use research-based information to move forward with their urban farming goals. A one year follow up evaluation with a small subset of program graduates from 2016 revealed that all were actively urban farming and/or were farming commercially.

In response to food insufficiency needs, Extension staff and Extension-trained volunteers supported nearly 500 community gardens throughout Illinois. A recent survey reports that these gardens donated 60,000 pounds of produce to food pantries in the last year. A pilot initiative to further develop garden-sourced food donations and expand food access by partnering local Master Gardeners and SNAP-Ed educators was launched in four locations this summer and will be expanded to additional locations in 2018. The **Illinois 4-H Feeding & Growing Our Communities** program also addresses food insufficiency through meal packaging events held throughout the state. In 2017, 4-H members and their volunteers packaged, paid for, and distributed 315,000 soy-rice casserole meals to families in need through community food pantries

Local responses to food insufficiency included youth stepping up to assure that donated food could reach the people who need it. One county's **4-H Hunger Ambassadors** worked with adult volunteers and local community organizations to organize and run a mobile food pantry that distributed over 70,000 pounds of food [including fresh produce and other healthy shelf-stable items] in 2017.

Extension **Expanded Food and Nutrition Education Program** [EFNEP] and **Supplemental Nutrition Assistance Program - Education** [SNAP-Ed] staff members provided programs 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 536,000 direct education contacts were made through the **SNAP-Ed** program and 9,700 direct education contacts were made through **EFNEP** in 2017. 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 cucurbit growers, personnel in the seed and chemical industries, breeders, Extension educators, home gardeners, students, food producers, processors, ingredient manufacturers, flavor companies, agroecologists, geographers, agroforestry scientists, food science professionals who work in the area of sensory science, product developers seeking to enhance health benefits using microencapsulation technologies, researchers in the fields of economics, public health, and nutrition, policymakers charged with improving the well-being of low-income Americans, program administrators overseeing food assistance programs, health care professionals, research scientists in nutrition, cancer biology, and breast cancer, and breast cancer survivors.

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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	48369	826488	52022	206622

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

Patent Applications Submitted

Year:	2017
Actual:	5

Patents listed

[2016-009-01] Engineered Microorganisms For Conversion Of Oligosaccharides Into Functional Sweeteners; [2016-038-01] Transgenic Microorganisms With Mixed Sugar Utilization; [TE10116-04] Methods Of Flavor Encapsulation And Matrix-Assisted Concentration Of Aqueous Foods And Products; [TE13036-03] Stabilized Compositions And Methods Of Manufacture; [2015-047-01] Methods Of Anthocyanin Extraction From Colored Corn Cultivars

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	28	28

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual

2017 6

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 Growers, Producers, And Employees Completing GAPS, GMPs, HACCP, Food Safety Certification, And Onfarm BMP Programs To Increase Food Safety
5	Development Of Fortification Technologies For Developing Countries
6	Enhancement Of Microbial Safety In Fresh Produce
7	Development Of Effective Methods For The Investigation Of Potent Odorants In Foods
8	Incorporating Protein Into Extruded Or Puffed Snack Foods
9	Developing New Varieties Attractive To U-Pick Produce Consumers
10	Increased Knowledge Of Fresh Fruit And Vegetable Production Practices
11	Increased Knowledge Of Small Farm Production Options
12	Enhancing The Stability Of Amorphous Containing Food And Pharmaceutical Products
13	Providing A Fundamental Understanding Of Probiotics Delivery Systems
14	Improving Labeling To Encourage Consumers To Make Choices That Align With Nutrition Therapies
15	Evaluating The Effects Of Dietary Equol [±] With Genistein On Human Estrogen Dependent Tumor Growth
16	Improving Our Understanding Of The Effects Of Thermally Abused Frying Oil Consumption And The Progression Of Breast Cancer

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
2017	216

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 2017 settings addressed managing nutrients, soil, and water and integrated pest management. Presentations highlighted management practices to reduce nitrate loading, weed management strategies, predicting insect pressure through surveys and web based tools, and revisiting crop diseases in 2016.

A total of 435 participants included those primarily employed in agri-business [81%], as certified crop advisers [68%], and crop producers [39%] and those who advised, farmed, or managed farmland. These 435 participants received an e-mail request to complete an online evaluation following the conferences. Two hundred thirty [51%] completed the survey.

Results
Nearly all [216] of the 230 Crop Management Conference evaluation respondents reported that attending the conference increased their knowledge of new crop management techniques and 142 [63%] planned on implementing something that they learned during the 2017 growing season. Of those who attended the 2016 Crop Management Conference [132], as a result of their attendance, 72% increased use of herbicides from more than one site-of-action family and 67% practiced multiple, layered applications of residual herbicides. In terms of reported actions taken regarding nitrogen management for water quality, 61% adjusted nitrogen application timing, 43% planted a cover crop, and 51% adopted or increased use of nitrogen stabilizers.

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
2017	4000

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 2017, 1,700 youth and adult volunteers provided 3,000 hours of service directed toward solutions to the problem. Through individual and collective efforts, the Illinois 4-H Feeding & Growing Our Communities 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 4,000 pounds of fresh produce with an economic value of

nearly $6,000 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 provided 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 315,000 soy-rice casserole meals that were packaged, paid for, and distributed to families in need through community food pantries. Counties raised more than $19,000 to purchase the ingredients for the meals. More than 100 food pantries in Illinois received meals in 2017 from the 4-H Feeding and Growing packaging events. 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 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 #5

1. Outcome Measures

Development Of Fortification Technologies For Developing Countries

Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

   Enhancement Of Microbial Safety In Fresh Produce

   Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

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

   Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

   Incorporating Protein Into Extruded Or Puffed Snack Foods

   Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

   Developing New Varieties Attractive To U-Pick Produce Consumers

   Not Reporting on this Outcome Measure

Outcome #10

1. **Outcome Measures**

   Increased Knowledge 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
2017	75

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
Eight [8] one-day Extension schools/conferences for commercial fruit and vegetable producers were held throughout Illinois, as well as in conjunction with neighboring states: [1] Southern Illinois Commercial Tree Fruit School; [2] Southwestern Illinois Commercial Fruit School; [3] Stateline Fruit & Vegetable Growers Conference; [4] Gateway Small Fruit & Vegetable Growers School; [5,6, and 7] Northern Illinois Berry Schools [delivered in three separate locations]; and [8] the Backyard Tree Fruit School. Extension educators and specialists contributed by organizing, promoting, and teaching the latest research findings related to production, pest management, marketing, and safe food handling. Attendees were also able to visit with vendors and exhibitors.

Results
The approximately 324 attendees at these schools were asked 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 two Southern Illinois schools provided information on actions taken using information from the previous year's schools. A total of 75 program participants completed an evaluation across the programs offered in 2017.

All of the 75 fruit and vegetable producers who responded checked at least one topic as a 4 or 5. Knowledge gain associated with Fire Blight was rated as 4 or higher among 94% of respondents who attended the two Commercial Tree Fruit Schools, closely followed by 92% who reported a knowledge gain of 4 or higher for Apple Insect Management. Topics rated highest in knowledge gained by Stateline Fruit and Vegetable Conference respondents included Vegetable Insect Management [80%], Basic Post Harvest Handling from Farm to Fork [77%], and Management of Cucurbit and Tomato Diseases [64%]. Topics rated highest in knowledge gained at the Gateway Small Fruit and Vegetable Conference were Blueberry Growth and Development [100%] and Soil-Based to Soilless Culture Production in Greenhouses for Tomatoes [100%].

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

Outcome #11

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
2017	33

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 Putting Small Acres to Work, a one-day program was offered to help people who have a few acres learn ways that they can put them to use. Fifty [50] individuals attended one of two workshops held. An end-of-workshop evaluation form was distributed and collected from 33 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 changed around ways to put their small acres to work. Using a scale from one to five [1 = "No Change" to 5 = "Greatly Improved"], the average score for the 33 who responded ranged from 4.00 to 4.48. Greatest reported improvements [rated 4 or 5] were in ability to develop goals for their property [94%], ability to effectively find and access resources to support their small acreage systems [87%], knowledge about land stewardship and resource management [81%], understanding about farming practices [81%], knowledge of concepts and principles of managing small acreage [77%], confidence in using small acreage management principles [74%], and preparedness to start a farming enterprise [68%].

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
503	Quality Maintenance in Storing and Marketing Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #12

1. Outcome Measures

Enhancing The Stability Of Amorphous Containing Food And Pharmaceutical Products

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Amorphous sugars, including sucrose, are essential ingredients in food and pharmaceutical products due to their encapsulation abilities, high dissolution rates, and high solubility. However, amorphous sugars are highly susceptible to undesirable heat-induced and moisture-induced physical changes, including stickiness, caking, and recrystallization. These undesirable changes are detrimental to product quality attributes including texture, taste, aroma retention, drug efficacy, and shelf-life. Though the physical stability of amorphous sugars has been extensively researched, comparatively few studies have examined the impact of different amorphization methods [such as freeze-drying, spray-drying, ball milling, melt-quenching, and spin-melt-quenching] on the physicochemical properties and stability of amorphous solids formed from the same starting material. Therefore, the goal of this research is to investigate the effect of amorphization method on the physicochemical properties and heat-induced and moisture-induced crystallization behaviors of amorphous sucrose. This research will produce advanced scientific knowledge useful for enhancing the stability of amorphous containing food and pharmaceutical products.

What has been done
Interest has grown in studying amorphous materials prepared by different amorphization methods because preparation method has been demonstrated to influence the physicochemical properties of the resulting amorphous state. The research accomplished during this reporting period focused on characterizing the physicochemical properties of amorphous sucrose prepared by freeze-

drying [FreD], spray-drying [SprayD], ball-milling [BallM], melt-quenching [MeltQ], and spin-melt-quenching [SpinMeltQ]. A variety of instrumental techniques, including differential scanning calorimetry [DSC], scanning electron microscopy [SEM], powder X-ray diffraction [PXRD], and high-performance liquid chromatography [HPLC], were employed to detect potential differences in amorphous sucrose prepared using the aforementioned amorphization methods. All amorphous sucrose samples exhibited a glass transition. However, the glass transition temperature [Tg] was found to decrease with increasing sample moisture content, with SprayD having the lowest Tg and highest moisture content. In addition, FreD, SprayD, BallM, and SpinMeltQ exhibited an exothermic cold crystallization [Tc] peak, but MeltQ did not. In samples that exhibited Tc, differences in the peak shape and associated Tc parameters were also noted. SEM images indicated that sample morphology and estimated particle diameter differed. FreD, SprayD, BallM, and SpinMeltQ formed distinct particles or strands, while MeltQ formed a single mass with few surface folds or cracks. PXRD data confirmed that BallM was partially crystalline, while FreD, SprayD, MeltQ, and SpinMeltQ were completely X-ray amorphous. However, the number of broad peaks present in the diffraction patterns of the X-ray amorphous samples differed: FreD, SprayD, and SpinMeltQ exhibited two peaks, while MeltQ exhibited one. HPLC analysis revealed that thermal decomposition components, glucose, fructose, and 5-HMF were present in BallM, MeltQ, and SpinMeltQ, but not in FreD and SprayD.

Results

Overall, this research provides evidence that sucrose is a material whose physicochemical properties are strongly influenced by amorphization method. This finding raises key questions about possible differences in the quality and long-term stability of differently amorphized sucrose and underlines the importance of selecting processing methods based on end product quality and stability in addition to economic considerations. This research provides the food and pharmaceutical industries with pertinent results that could aid in selecting the processing method that is most suitable for their amorphous sugar-based applications.

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
702	Requirements and Function of Nutrients and Other Food Components

Outcome #13

1. Outcome Measures

Providing A Fundamental Understanding Of Probiotics Delivery Systems

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Probiotics are known to provide various health benefits to humans such as prevention of various causes of diarrhea. However, probiotics need to survive passage through the upper GI tract in order to reach the colon alive and exert benefits. Probiotics often are killed during manufacturing, food storage, and after ingestion depending on conditions for manufacturing and storage as well as types of food matrix. It is important to protect the probiotics until they reach the large intestine so thtat the initial load of probiotics in the food matrices can be reduced, the food products containing probiotics can be expanded, and ultimately so more consumers can benefit from probiotics consumption. It is also critical to understand how effective the probiotic delivery systems are in digestive systems to design various products with valid probiotic concentrations. By successful completion of this project, the investigators will be able to provide fundamental understanding of probiotics delivery systems. Based on the understanding obtained on the efficacy of the delivery system, the investigators will be able to provide improved and economical means to deliver probiotics. The improved delivery system will allow significant expansion of probiotic applications to various types of food matrices so that eventually consumers will exploit the health benefits of probiotics through an expanded choice of products.

What has been done
We have demonstrated that microencapsulated tributyrin [TB] in gamma-cyclodextrin [GCD] could lead to minimal TB losses during processing that could be utilized in functional food applications for intestinal health. Also, from a sensory study using an R-index method, GCD-TB complex processed by oven drying method showed promising bitterness masking capability.

Intestinal release and butyrate production capabilities of the various tributyrin [TB] microcapsules were assessed using TB encapsulated in whey protein isolate [WPI]-based and gamma-cyclodextrin [GC]-based materials. Using an in vitro digestion and fermentation model, microcapsules containing TB were monitored for their release and production of butyrate in vitro. All samples containing TB showed limited butyrate release [<5%] during oral and gastric stages. In the small intestinal phase, all microcapsules containing TB released approximately 75% of their total butyrate with no significant differences [$p>0.05$] across formulations. During the fermentation phase, GC-based microcapsules produced significantly more butyrate [$p<0.001$] than all WPI-based microcapsules. Butyrate production increased significantly [$p<0.001$] over each time interval with GC-based microcapsules the highest occurring in the 12th hour of fermentation.

Results
The GC-based TB encapsulation systems were able to effectively deliver butyrate to the small intestine and generate butyrate in the large intestine. These microcapsules may, therefore, be beneficial for the maintenance of intestinal health and improvement of disease states across all areas of the gastrointestinal tract.

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
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior

Outcome #14

1. Outcome Measures

Improving Labeling To Encourage Consumers To Make Choices That Align With Nutrition Therapies

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Consumers with hypertension are advised to consume food products with decreased quantities of dietary sodium and fat. Labeling information is important in order for consumers to make choices that align with nutrition therapies. However, labeling information may not cause consumers to purchase lower sodium and fat products due to consumer expectations for taste. The study objective was to relate prior perceptions of nutritional labels, actual sensory acceptability, and nutrition labeling formats.

What has been done
Ninety panelists participated in a five-part study utilizing a model creamy tomato soup system with three levels of fat and sodium: regular, reduced, and low. The five-part study included: [1] A survey to determine prior perception of nutritional labels; [2] Consumer acceptability testing of soup samples with and without nutrient content information; [3] Expected consumer acceptability testing of soup samples based solely on nutrient content information; [4] Comparative evaluation of labels with verbal and visual nutrient content information; and [5] Sorting activity of nutrient content information using verbal and visual labels.

Results
Study results indicated that presenting nutrient content information along with the actual soup sample did not impact consumer sensory acceptability. However, when labeling information displays lower amounts of sodium and fat content and the food product is not tasted, the average expected liking reported by the consumers was decreased. There was no difference in comprehension of verbal and visual labels for nutrient content. Study findings demonstrate that consumers are willing to consume processed food products lower in sodium and fat, which supports the direction toward food reformulations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #15

1. Outcome Measures

Evaluating The Effects Of Dietary Equol [±] With Genistein On Human Estrogen Dependent Tumor Growth

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Many postmenopausal women are using dietary phytoestrogens as a perceived "safe" or "natural" alternative to prescription hormone replacement therapy [HRT]. Equol, a metabolite of daidzein from soy, and a metabolite of formononetin from red clover, is gaining in popularity and there is little data on the interaction of dietary equol with dietary genistein. Experiments were conducted to evaluate possible effects of dietary equol [±] with genistein on human estrogen dependent tumor growth in ovariectomized [OVX] athymic nude mice. We have previously reported, and expand our evidence here, that both genistein and equol [+] increased MCF-7 breast cancer cell proliferation at physiological concentrations [10-8 to 10-5 Mu] in vitro.

What has been done
Additionally, our prior work has shown that dietary equol did not stimulate estrogen-dependent MCF-7 tumor growth. It is not known if there are any interactive effects of equol in combination with dietary genistein. This work evaluates the in vivo effects of equol at three relevant dietary dose levels [250, 500 and 1,000 ppm] in combination with genistein at 500 ppm compared with genistein only [500 ppm] on MCF-7 tumor growth using ovariectomized [OVX] athymic nude mice [n=12]. All mice were implanted with a pellet containing two mg E2 and eighteen mg cholesterol three days prior to MCF-7 dorsal, subdermal cell injection. Estrogen-dependent tumor growth was allowed to occur until the average tumor size was 35 mm squared. Mice were then randomly assigned to one of four treatments plus negative [placebo diet] and positive controls. E2 pellets were removed from all mice except the positive control group and dietary intervention occurred over the subsequent eighteen weeks.

Results
All combinations of Equol and genistein at physiological concentrations stimulated MCF-7 cell proliferation in vitro in a dose dependent manner. All four dietary treatments stimulated MCF-7 tumor growth in OVX athymic mice similarly during the eighteen weeks of treatment. There was no significant difference [p>0.1] on the final tumor sizes and mammary terminal end buds numbers among all dietary treatment groups, which means equol [±] did not significantly alter the stimulation effects induced by genistein. These results suggest that dietary equol does stimulate E-dependent MCF-7 tumor growth and does not alter the estrogenic effects of dietary genistein.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
704	Nutrition and Hunger in the Population

Outcome #16

1. Outcome Measures

Improving Our Understanding Of The Effects Of Thermally Abused Frying Oil Consumption And The Progression Of Breast Cancer

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Deep-frying is a popular form of food preparation used globally and throughout the United States. Each time dietary oils are heated to deep-frying temperatures, they undergo chemical alterations which result in a new matrix of lipid structures. Since these lipid products include triglyceride dimers, polymers, oxidized triglycerides, and cyclic monomers, this raises nutritional concerns about associations between these lipid products and heightened health risks.

What has been done
Reports of associations between thermally abused frying oil and health risks currently exist, yet there is little information concerning the effects of thermally abused frying oil consumption and the progression of breast cancer. This study used a late-stage breast cancer murine model and in vivo bioluminescent imaging [BLI] to monitor the metastasis of 4T1 tumor cells in animals consuming fresh soybean oil [SBO] and a thermally abused frying oil [TAFO].

Results
Bioluminescent and histological examinations demonstrated that TAFO consumption resulted in a marked increase of metastatic lung tumor formation compared to SBO consumption. Further, metastatic lung tumors in the TAFO treatment group displayed a 1.40 fold increase in proliferation. These findings indicate the consumption of TAFOs as a risk factor for breast cancer metastasis and emphasizes a critical need to understand the interplay between breast cancer metastasis and frying oil consumption.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Southern Illinois Commercial Tree Fruit Schools

Two **Southern Illinois Commercial Tree Fruit Schools** were attended by 112 individuals this past year. Evaluations were distributed at both locations and completed by 47 participants. Using a 5-part rating scale anchored by 1 = "None/Already Knew" and 5 = "Learned a Great Deal", the following topics were rated 4 or higher by the majority of participants:

- Fireblight [94%]
- Apple Insect Management Update [92%]
- Updates on Peach Insect Management [87%]
- Thinning Strategies for Return Bloom [87%]
- Apple: Fruit Rots and Management [83%]
- Stone Fruit: Fruit Management Updates [76%]
- USDA Farm Storage Facility Loan Program [63%]
- Brown Marmorated Stink Bug [59%]

For those who reported attending a 2016 **Southern Illinois Commercial Tree Fruit School** [15], all respondents indicated implementing a practice over the past year as a result of what they learned that day. Actions reported over the prior year included: [1] Controlled or monitored a fruit pest using spraying and chemical handling recommendations [73%]; [2] Implemented chemical changes or spray schedules when controlling for diseases in your orchard[s] [73%]; [3] Made changes in your orchard based on recommended orchard fertilization techniques [33%]; [4] Incorporated biofix dates when planning for insect control [27%]; and [5] Obtained updated or additional crop insurance for your orchard[s] [7%].

Stateline Fruit and Vegetable Conference

Fifty four [54] participants attended the **Stateline Fruit and Vegetable Conference** in 2017. Evaluations were distributed and completed by 16 participants. Using a 5-part rating scale anchored by 1 = "None/Already Knew" and 5 = "Learned a Great Deal", the following topics were rated 4 or higher by the majority of participants:

- Vegetable Insect Management Update [80%]
- Basic Post Harvest Handling from Farm to Fork [77%]
- Management of Cucurbit and Tomato Diseases [64%]

Putting Small Acres to Work

Extension sponsored two workshops in 2017 to help people who have a few acres learn ways that they can put them to better use. A total of 50 individuals attended one of the two workshops. An end-of-meeting evaluation form was distributed and collected from 33 of the participants.

Respondents to the 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 1 = "No Change" to 5 = "Greatly Improved", the average scores across all topical areas ranged from 4.00 to 4.48. The areas of self-reported improvement included: [1] Ability to develop goals for their property [4.48 average group score; 94% rated 4 or 5]; [2] Ability to effectively find and access resources to support their small acreage systems [4.38 average group score; 87% rated 4 or 5]; [3] Knowledge of concepts and principles of managing small acreage [4.35 average group score; 77% rated 4 or 5]; [4] Knowledge about land stewardship and resource management [4.28 average group score; 81% rated 4 or 5]; [5] Understanding about farming practices [4.22 average group score; 81% rated 4 or 5]; [6] Confidence in using small acreage management principles [4.10 average group score; 74% rated 4 or 5]; and [7] Preparedness to start a farming enterprise [4.00 average group score; 68% rated 4 or 5].

When asked if their personal objectives for attending this workshop were met, 29 respondents provided a rating using a five-part scale [1 = "Not Met", 3 = "Satisfactorily Met" and 5 = "Extremely Met"]. All 29 [100%] chose a rating of 4 or 5, indicating a high degree of satisfaction with the workshop.

Key Items of Evaluation

Fruit and Vegetable School Key Findings

Participants across fruit and vegetable schools reported a high level of knowledge gained with all evaluation respondents [75] reporting a gain of 4 or higher on a 5 point scale for at least one topic covered. For those who reported attending a **Commercial Tree Fruit School** in the prior year, the majority [73%] reported having implemented a new practice as a result of their attendance including controlling or monitoring a fruit pest using spraying and chemical handling recommendations and implementing chemical changes or spray schedules when controlling for diseases in your orchard[s].

Putting Small Acres to Work Key Findings

Primarily motivated by the desire to seek information about options for using small acreage, all of the 33 **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 that their participation increased their ability to develop goals for their property, effectively find and access resources to support their small acreage system, and their knowledge of concepts and principles of managing small acreage.

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%		15%	
704	Nutrition and Hunger in the Population	20%		15%	
724	Healthy Lifestyle	10%		15%	
801	Individual and Family Resource Management	10%		10%	
802	Human Development and Family Well-Being	10%		15%	
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%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.2	0.0	10.0	0.0
Actual Paid	37.2	0.0	48.2	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**
1295758	0	1455900	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1295758	0	1455900	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
9746665	0	3664758	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities included the development of key findings illustrating that the transition to marriage had a number of short-term and long-term consequences for individuals in romantic relationships [notably, facets of individual and relational well-being improved over the transition to marriage], an evaluation of the tissue-selective activities of botanical estrogen dietary supplements taken by postmenopausal women to determine how they affect health and to determine whether dietary factors impact quality of life and resilience to obesity and cardiovascular disease, a research program 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], and the development of results that will provide a better understanding of the mechanisms regulating human fat sensory perception and its role in the physiological processes that regulate fat metabolism [this information could be important in understanding the role of fat taste in energy balance and obesity, which could ultimately lead to new and more effective strategies in food design as a therapy for obesity].

Research activities also included a study investigating how parental involvement in young adolescents' social and academic lives and youths' psychological and physiological receptivity to parenting may provide further insight about how to promote youths' adjustment within these domains, work to improve our understanding of how individual genetic material interacts with the environment to promote or delay metabolic effects that result in excessive weight gain or related diseases [the **GET-UP KID**S project envisions that in this genomic era it is possible to establish and recognize the basis of predictive, preventive, and personalized interventions to achieve healthy individuals and communities], a study that seeks to assess children's stress regulation at multiple levels of analysis [brain, body, and behavior] as potential mechanisms linking qualities of the parent-child relationship to children's subsequent social and emotional functioning, a project with the long-term goal of characterizing the relationship between irritable bowel syndrome and the fueling strategies of endurance athletes in order to help ease their gastrointestinal distress during training and competition, ongoing work under the **Child Development Laboratory Research Database Project**, and an examination of how the recent recession has affected children's cognitive, socioemotional, behavioral, and physical health over time within the context of their families, schools, and communities.

Activities also included an examination of the potential for family mealtime practices to moderate biological risk for childhood obesity in the first year of life, the development of individualized and targeted dietary interventions for breast and head and neck cancer survivors that will ultimately improve the prognosis and quality of life associated with these diseases, longitudinal research that found that without intervention the quality of sibling interactions tends to be relatively consistent over the course of childhood and

adolescence [thereby leaving siblings with poor quality relationships to be disadvantaged and at risk for poor developmental outcomes such as low self-worth], an examination of the health, well-being, and economic opportunities available to LGBT persons in rural Illinois, a project that seeks to determine the intention and actual use of diabetes-related apps by diabetes clinicians, and interviews conducted 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.

Activities also included the design, evaluation, and implementation 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 [technologies will be low-cost, stealth or culturally accepted, simple to use, adaptable to current deficiencies, of limited energy input, and environmentally friendly], findings that whole egg consumption was more effective for the postprandial stimulation of muscle protein synthesis rates during recovery from resistance exercise when compared to the ingestion of iso-nitrogenous amounts of egg whites [our data supports the concept that eating protein within its natural food matrix is an optimal strategy for muscle mass maintenance], efforts to develop a systematic approach that combines what we know about nutrition, healthy eating, and physical activity related to energy balance into an integrated approach to teach parents about their role in obesity prevention for their children, the development of data that will enable nephrologists to make more informed decisions regarding the safety and efficacy of meal feeding during dialysis, the development of research findings that will improve our understanding of the mechanisms of soy products that reduce colon cancer risk [leading to future development of dietary strategies to significantly reduce both incidence and mortality of colon cancer], and a mixed methods study examining educator stress and resilience.

Conference presentations included the National Council on Family Relations, Carle Cancer Symposium, Jensen Symposium on Breast Cancer, American Association for Cancer Research, Federation of American Societies for Experimental Biology Conference on Rapid Signaling and Genomic Hormone Action in Health and Disease, Gordon Conference on Hormone Dependent Cancers, National Institutes of Health Future Research Leaders Conference, Society for Research on Adolescence, Academy of Leisure Sciences Annual Conference on Research and Teaching, American Sociological Association Meeting, VII International Conference of Work and Family, Society for the Study of Ingestive Behaviors, Benjamin Franklin Lafayette Seminar, Experimental Biology, Society for Neuroscience, Biennial Meeting of the Society for Research in Child Development, Institute of Food Technologists Conference, Maryland Academy of Nutrition and Dietetics, Florida Academy of Nutrition and Dietetics, American Society for Nutrition, National Association for the Education of Young Children Professional Learning Institute, National Recreation and Park Association, American Education Research Association, International Congress of Qualitative Inquiry, National Head Start Association, American Society of Nephrology, American Society for Biochemistry and Molecular Biology, American Society for Nutrition, American Oil Chemists Society, International Society for Agricultural Safety and Health, and the North American College Teachers of Agriculture.

For ten years, Extension programming on brain health continued to expand and remains a major focus of Extension Family Life Educators. The **Brain Health Series** was offered as a three-part series. Each session informs about brain health research, while using engaging strategies and exercises to challenge participants. The series includes: [1] **Hold That Thought!**, which addresses the memory process and what researchers say contributes to brain health, as well as strategies for helping with everyday forgetfulness; [2] **FITWITS: Fostering Improved Thinking While Incorporating Training Strategies**, which covers ways to keep people's brains healthy and engaged; and [3] **Head Strong: Exercise Strategies to Enhance Memory and Thinking,** in which participants learn about memory and aging and explore several exercise strategies to enhance thinking.

In 2017, Extension's Family Life team organized a new series of **Aging Summits** around the state that offered three main programs: [1] **Eating Well as You Age**; [2] **Hold That Thought** [referenced above]; and [3] **Avoid Financial Scams**. Each summit was interdisciplinary with subject matter representing multiple areas of health and wellness for older adults. Eight [8] summits were held, in which 29 different sessions were delivered, producing 773 direct education contacts [see evaluation section of this planned program].

As resources have continued to contract, Extension educators in this area have developed creative partnerships to maximize programming. Through collaboration with partners such as the Illinois Municipal Retirement Fund [IMRF] and the Illinois Association of Home and Community Education, programming and travel costs were subsidized. IMRF supported multi-session workshops, held in seven locations, reaching over 400 participants with engaging programs like **Who Gets Grandma's Yellow Plate?** and **Superpowers, Your Wishes Done Right** addressing issues relevant to older adults such as preparing for transfer of inheritance and the importance of discussing Powers of Attorney with family members.

Wellness programs that appeal to a broad age range of adults were offered again in 2017. Examples include **Being Mindful in a Busy World**, focused on defining and identifying the benefits of mindfulness and purposeful attention. **Simplify Your Life: Clear the Clutter and Your Stress** workshops were conducted for multiple groups throughout Illinois as was **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 170 individuals in ten locations statewide [see evaluation section of this planned program].

Programming targeted at parenting and early childhood training and caregiving included **Getting Ready to Read and Write**, part of a webinar series delivered to parents and preschool staff, addressed the importance of effective early literacy instruction. **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 programming targeted to childcare providers, such as **I am Moving, I am Learning**.

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 536,000 direct educational contacts who were taught healthy eating choices and 9,700 who were reached through EFNEP in 2017. In addition to direct education, staff focused on policy, systems, and environmental [PSE] interventions with other organizations. 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 2017, partnerships where direct education and/or PSE was implemented included 436 Kindergarten through 12th grade schools, 436 Early Childhood programs, 324 food pantries, and 855 community organizations.

Extension educators responsible for **ABC's of School Nutrition**, a grant partnership with the Illinois State Board of Education, provided training and technical assistance to 1,728 school nutrition professionals, representing 378 school districts and completed 274 **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. The program hosts an active website that featured nine online mini-

courses completed by 947 learners and received 150,341 page views in 2017.

For a fourth 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 through the **Junior Chef** program. The **Junior Chef** and **Health Jam** programs were delivered by 98 4-H Teen Teachers with 4,419 youth participants. **Health Jam** focused on exercise, wellness, nutrition, and health careers information. 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 1,309 youth [see evaluation section of this planned program].

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. Through Extension's bilingual obesity prevention program for Hispanic audiences, **Abriendo Caminos**, educators have trained 16 Spanish-speakers as health educators who have reached 160 families with health education and wellness lessons. 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 young adults and women in midlife, nutrition and dietetics professionals, cancer survivors, public health professionals and public policy groups, practitioners interested in improving child health, scientists interested in how early nutrition influences gut development, basic and applied students and researchers in the areas of human obesity and animal production, members of the general public, nutrition Extension specialists, graduate and undergraduate students, school district administrators, scientists and graduate students specializing in the fields of child development, family studies, linguistics, and psychology, nutrition and dietetics professionals who work with endurance athletes, nutrition educators, child development specialists, family scientists who provide outreach to parents of young children, breast cancer survivors, researchers in the areas of obesity, nutrition, and child development, families with young children and professionals working with children and families, LGBT individuals and their families who reside in rural communities and community leaders and providers who work with or serve those families, nutritionists formulating diets for children, patients with kidney failure undergoing chronic hemodialysis therapy, the scientific community, governmental organizations, students, commodity groups, and elementary school teachers.

Extension target audiences included individuals at-risk for or coping with diabetes, obesity, or heart disease as well as families living in low-income and high-risk neighborhoods. Other target audiences included school nutrition professionals, retirees, aging adults and their caregivers, childcare providers, grandparents responsible for young children, and youth.

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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	34748	1873714	23851	208190

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	73	73

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2017	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
10	Translating Scientific Energy Balance Evidence And Parenting Styles Into Practical Recommendations For Training Extension Educators
11	Investigating The Ability Of Dietary Tomato Powder To Reduce The Progression Of Prostate Cancer
12	Determining How Prenatal Choline Alters Neurodevelopment
13	Improving Our Understanding Of The Strategies Used By Effective Program Leaders
14	Reducing Obesity Through Improved Utilization Of Nutrition Information
15	Improving Our Understanding Of Social-Emotional Development Among Children From Rural And Suburban Communities
16	Number Of Youth That Increased Knowledge Of Bullying And Actions To Take In Dealing With A Bullying Situation
17	Preventing Adult Obesity Among Women

18	Characterizing The Relationship Between Irritable Bowel Syndrome And The Fueling Strategies Of Endurance Athletes
19	Exploring The Short-Term And Long-Term Individual And Family Health Benefits Of Nature-Based Activities
20	Promoting The School Readiness Of Low-Income African American And Latino/a Children
21	Formulationg Diets That Can Alleviate Amino Acid Malnutrition In Children And Lactating Women
22	More Informed Decisions Regarding The Safety And Efficacy Of Eating During Dialysis
23	Assessing Nutrition Status And Maximizing Nutrition Delivery
24	Increased Knowledge Of Consequences Of Risky Behavior On Youth Health And Wellbeing
25	Increased Knowledge Of Ways To Maximize Wellness Among Older Adults
26	Increased Knowledge Among School Nutrition Professionals To Improve School Lunchroom Environments

Outcome #1

1. Outcome Measures

Number Of Research Projects Utilizing The Child Development Laboratory Research Database

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	16

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, thus enhancing the types of questions they are able to address in their studies.

What has been done

There are four beneficiaries of this project during the current reporting period. First, the systematic procedures used to create this unique database of information on children's behavior across multiple developmental domains allows researchers and instructors to use this data for both historical and projective analyses that focus on child development and outcomes resulting from interactions in high quality early childhood environments. Second, the continuation of the CDL Research Database Project facilitates long-term, interdepartmental, and cross-departmental faculty and student collaborations that provide opportunities for creative investigations of children's development. Third, UIUC undergraduate and graduate students have opportunities for enhanced learning experiences as they draw on information contained in the CDL Research Database to support class activities designed to demonstrate the connections between theory, research, and practice. Finally, children and families throughout Illinois and the U.S. have benefited from the knowledge being generated through research projects being conducted as part of this project.

A total of 16 research projects were conducted at the CDL during the current reporting period. Twelve of the 16 studies accessed information from the CDL Research Database project as part of their data collection. These 16 projects represent a diverse array of disciplines [Human Development and Family Studies, Advertising, Anthropology, Landscape Architecture, 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, physical growth, and health]. Four of the projects were investigations conducted by graduate students working under the direction of a faculty advisor, while 12 of the projects were faculty-led investigations.

Results

In addition to the research supported, the CDL Research Database also played an integral role in facilitating teaching activities taking place within the program. During the current reporting period a total of 4,187 student observations in support of 28 different courses, 1,272 student class projects in support of 19 different courses, and 77 student internship placements took place at the CDL. Instructors for these different course experiences accessed information from the CDL Research Database to provide background and demographic information on enrolled children that

informed and guided the experiences of students.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle
801	Individual and Family Resource Management
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

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

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

Not Reporting on this Outcome Measure

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
2017	231

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 in 2016 on brain health that addresses techniques in maintaining one's memory. The Family Life Educators continue to provide the workshop throughout Illinois. In 2017, 269 participants attended one of the 16 Hold That Thought workshops held in various locations in Illinois. At the end of the program, participants were asked to complete a one-page evaluation consisting of seven questions including three open-ended questions.

Results
Using a five-part scale [with 1 = "Nothing", 3 = "Some", and 5 = "A Lot"], participants were asked to indicate how much they learned related to brain health and techniques in retaining one's memory. Of the 231 participants who answered the question, all 231 [100%] checked a rating of

"3" or higher indicating a moderate to high level of knowledge adoption.

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	40

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A common concern raised by parents is how to help their children get along. Parents frequently report sibling conflict to be a matter of high concern that negatively impacts the quality of family life. Therefore, the current investigation will address these concerns by developing and testing an evidence-based set of resources for parents who aim to improve sibling relationship quality among their four to eight year-old children.

Evidence is mounting that children who experience more positive relationships with a sibling are also more likely to enjoy better developmental outcomes. Conflicts among siblings are a prime source of dissatisfaction for most parents and children. Although a certain amount of conflict appears to be "normal" for siblings, these disputes can be disruptive to family life due to both their frequency and qualitative characteristics. In addition to being the most common type of family strife, sibling conflicts may be quite aggressive and even violent. Intractable conflictual relations among young siblings have been shown to be predictive of later difficulties such as antisocial and disturbed behaviors in adolescence and adulthood. These factors have led some investigators to refer to sibling relationships as potential "training grounds" for violence and for establishing chronic coercive interactions with others.

What has been done
Longitudinal research has revealed that without intervention, the quality of sibling interactions tends to be relatively consistent over the course of childhood and adolescence, thereby leaving siblings with poor quality relationships to be disadvantaged and at risk for poor developmental outcomes such as low self-worth. Thus, a key challenge is to help siblings develop positive relationships so that they can more fully reap the advantages of sibling support. Meeting such a challenge requires a clear understanding of the factors that promote supportive sibling relationships as well as knowledge of evidence-based strategies that have strong potential for enhancing sibling relationships during early childhood. Few validated tools currently exist to help parents promote positive relationships among their offspring.

Results
The online More Fun with Sisters and Brothers Program for parents is complete and is now being utilized by more than forty parents who have children in the target age range of four to eight years as well as forty comparison parents who are serving as a waitlist control group. Evaluation results indicate that the online program is reported by parents to be effective for improving the quality of their children's sibling relationship, particularly in terms of increasing children's positive interactions and decreasing instances of unmanaged conflict.

The More Fun with Sisters and Brothers online program for parents is now available to parents from diverse locations, with no geographical, time, or financial constraints. Families from rural locations, and those who live at a distance from a major university or health center, can benefit. To date, enrolled parents come from 18 U.S. states and 4 countries. Thus, the outcomes of this project are being broadly disseminated.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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 #8

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #10

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 #11

1. **Outcome Measures**

Investigating The Ability Of Dietary Tomato Powder To Reduce The Progression Of Prostate Cancer

2. **Associated Institution Types**

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Epidemiological data and experiments in animal models support the hypothesis that greater tomato consumption is associated with a reduced risk of prostate cancer [PCa]. However, few studies have examined the effects of dietary tomato on both the development and progression of castration-resistant prostate cancer [CRPC], which accounts for the majority of PCa mortality.

What has been done
We questioned whether the protective effects of dietary tomato in PCa might extend to CRPC, and whether the timing of initial exposure would alter efficacy. TRAMP mice [n=85] were

castrated at 12-13 weeks of age to induce CRPC. Dietary treatments were introduced at four weeks of age and consisted of AIN-93G control [n=28], lifelong tomato paste [10% w/w, 20.1 ± 2.3 Mu g/g lycopene; n=30], or 10% tomato paste initiated after castration [n=27]. Beginning at ten weeks of age, all mice were monitored with ultrasound for in vivo tumor detection and growth measurements. At thirty weeks of age, dietary treatments had no effect on tumor incidence [72% overall] or histopathological cancer incidence [94% overall]. However, any length of tomato exposure significantly decreased in vivo tumor growth, reduced prostatic epithelial Ki-67 staining, reduced lung metastasis, and lowered regional lymph node metastasis weight. Additionally, we identified phenotypic differences in tumoral response to castration, which predicted the growth-inhibitory effectiveness of dietary tomato.

Results
This is the first report to demonstrate inhibition of disease progression with dietary tomato in an autochthonous preclinical CRPC model. Dietary tomato may represent a safe and effective complement to ADT for men with metastatic PCa. The primary findings of this study have been submitted for publication. At this time, a second CRPC study is underway to compare and contrast the differential impact of dietary tomato powder with lycopene fed following castration at twelve weeks of age. The diets were formulated to have similar levels of total lycopene in each of the intervention groups.

4. Associated Knowledge Areas

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

Outcome #12

1. Outcome Measures

Determining How Prenatal Choline Alters Neurodevelopment

Not Reporting on this Outcome Measure

Outcome #13

1. Outcome Measures

Improving Our Understanding Of The Strategies Used By Effective Program Leaders

Not Reporting on this Outcome Measure

Outcome #14

1. **Outcome Measures**

Reducing Obesity Through Improved Utilization Of Nutrition Information

Not Reporting on this Outcome Measure

Outcome #15

1. **Outcome Measures**

Improving Our Understanding Of Social-Emotional Development Among Children From Rural And Suburban Communities

Not Reporting on this Outcome Measure

Outcome #16

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #17

1. **Outcome Measures**

Preventing Adult Obesity Among Women

2. **Associated Institution Types**

- 1862 Research

3a. **Outcome Type:**

Change in Condition Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	26

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 the 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 six 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. 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 three, six, nine, and twelve [all $P<0.01$] and non-meat protein sources at month three [$P<0.001$].

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.

Results
A group of young adult women and women in midlife 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 women and women in midlife to prevent body weight gain. Moreover, characteristics of young adult women and women in midlife who do not continue with a weight gain prevention intervention have been described so that dropout risk may be monitored and evaluated to tailor intervention strategies to maximize continued participation and compliance with Dietary Guidelines for Americans as related to body weight regulation and weight gain prevention.

4. Associated Knowledge Areas

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

Outcome #18

1. Outcome Measures

Characterizing The Relationship Between Irritable Bowel Syndrome And The Fueling Strategies Of Endurance Athletes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
While some studies have linked the types of symptoms experienced by athletes with those characteristic of IBS, to the best of our knowledge there are no studies that look at actual IBS diagnoses among endurance athletes or evaluate their symptoms based on IBS diagnostic criteria. This knowledge would help determine if current IBS-mitigating strategies may be implemented in the endurance athlete population to help reduce GI symptoms and which groups may benefit from this type of nutritional modification. Additionally, the proposed work marks the first time that a GI and IBS questionnaire has been validated and used in an endurance athlete population. This is particularly important given the transient nature of IBS and IBS-like GI symptoms.

What has been done
Promising initial support for the application of a low FODMAP [fermentable oligosaccharides disaccharides monosaccharides and polyols] diet in the modification of athlete GI symptoms displays the need for additional and continued research in this area. To date, there have not been large-scale assessments of FODMAP levels of endurance athlete diets, either habitually or surrounding and during exercise bouts. This novel research will be helpful in determining whether habitual low FODMAP diets would be needed to reduce endurance athlete GI symptoms or if it would only be necessary within a period of time surrounding exercise. Additionally, while a FODMAP database does exist for many common foods, the FODMAP content is likely still unknown for many sports nutrition specific products. It therefore becomes necessary to analytically determine these levels in order to more accurately analyze athlete's diets for FODMAPs. With this critical knowledge, we can be closer to designing dietary interventions specific to individual endurance athletes, helping to improve their performance and overall quality of life.

Results

Our findings showed that IBS is underdiagnosed and ineffectively treated within an endurance athlete population consisting of marathon, ultra-marathon, half-distance triathlon, or full-distance triathlon athletes. Additional athletes experienced symptoms, yet did not fit IBS diagnostic criteria. A total of 68.1% and 55.8% of athletes reported at least one lower GI symptom at a frequency of sometimes, often, or always during training and competition, respectively. GI issues at least sometimes interrupted or prevented training and competition for 18.6% and 11.6% of athletes, respectively. Athletes used a variety of strategies to manage their symptoms including nutritional modifications [45.8%], over-the-counter medications [21.6%], exercise modifications [10.2%], and stress management techniques [7.9%], yet many still experienced issues.

4. Associated Knowledge Areas

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

Outcome #19

1. Outcome Measures

Exploring The Short-Term And Long-Term Individual And Family Health Benefits Of Nature-Based Activities

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This project will explore the short-term and long-term individual and family health benefits of nature-based activities using Attention Restoration Theory which shows how certain types of behavioral settings have different effects on restored attention, and Routines and Rituals Framework which predicts greater developmental benefits of certain types of ritualized experiences over one-time experiences. The project will investigate the relationship between the natural environment and family health over three years in two complementary studies. Study One will determine if there is a relationship between participation in a family-based nature activity and individual and family outcomes. Study Two will explore the patterns of participation in nature-

based activities among rural families and examine links with indicators of individual and family health and well-being. This research will advance our understanding of the processes that contribute to both individual and family health and well-being and will have implications for policies and practices focused on promoting health at the individual, family, and community levels.

What has been done

Although studies reveal that family leisure time can contribute to improved family functioning, family resilience, and increased satisfaction with family life, little is known about the health benefits of family leisure in nature. Past research on family outdoor recreation primarily focused on therapy and adventure challenge programs, and is not well represented in peer-reviewed journals. Family-based nature activities [FBNA] refers to outdoor recreation, utilization of natural environments, and family vacations in natural areas with two or more family members. Further examination of the relationship between FBNA and health is needed as FBNA may have the potential to contribute to increased family cohesiveness more so than other types of leisure contexts.

Furthermore, the majority of research in the last few decades has focused on the health benefits of nature-based activities for individuals in urban populations, which has contributed to the current national push for increased access to nature in urban communities through efforts such as the "Cities Promoting Access to Nature" initiative and "Nature in the City" programs. There has been little research or practice focused on the health benefits of nature exposure for rural populations. Rural populations are more likely than urban residents to experience health disparities, especially in regards to chronic health conditions. Because access to green spaces can play a vital role in reducing health inequalities, it is increasingly important to study rural families' use of natural environments.

Results

The first goal was accomplished. Study One found that exposure to nature was more cognitively restorative than exposure to indoor settings for mothers, which replicated previous results of studies of individual exposure. The effect of settings for daughters was not significant; walking in any setting with mothers restored cognitive functioning equally. Interactions between mothers and daughters were more cohesive and positive following exposure to nature compared to interactions after exposure to indoor settings. Progress is being made on the second goal. Survey instruments have been designed for Study Two, and two field sites have been identified. Extension staff in two sites will assist in recruiting participants.

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
806	Youth Development

Outcome #20

1. Outcome Measures

Promoting The 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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
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. The proposed investigation 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. A critical piece of this collaboration is understanding low-income, African American and Latino/a parents' views of school readiness competencies and abilities, and the related practices they use to promote them, as well as the beliefs and expectations of teachers.

What has been done
We conducted qualitative interviews with African American mothers [caregivers] of preschoolers transitioning to kindergarten. Our interviews explored mothers' beliefs about school readiness, home based literacy practices, neighborhood resources, and the role of Head Start in preparing children for kindergarten. We included 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. Analysis of the qualitative data was an ongoing process. The goals of our analyses were descriptive and entailed an iterative approach. We used the concurrent processes of coding, developing data displays, and memoing.

Results
Our analyses focused on family literacy practices. We examined the home based literacy practices of low income African American mothers of preschoolers attending Head Start and who were transitioning to kindergarten. We found that literacy activities were carried out in teams of extended kin members who worked together to promote children's school readiness competencies. Key members included mothers, as well as fathers, grandmothers, aunts, uncles,

and siblings. The complement of family members expanded the literacy resources available to low income children living in impoverished neighborhoods. Further analyses revealed key strategies that mothers used to facilitate children's transition to kindergarten. They assessed children's readiness, noting children's strengths and weaknesses. Home based activities were used to address perceived academic or socio-emotional weakness. Mothers also engaged in one on one conversations with preschoolers to allay fears and to engender excitement about this impending transition.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
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 #21

1. Outcome Measures

Formulationg Diets That Can Alleviate Amino Acid Malnutrition In Children And Lactating Women

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Due to the importance of amino acid nutrition in humans it is imperative that knowledge about AA digestibility is generated because that will allow formulation of diets that can alleviate AA malnutrition [specifically in children and lactating women]. To accomplish this, it is necessary to prepare meals that provide all AA in the required quantities, but that is not possible unless DIAAS [digestible indispensable amino acid scores] values for the individual food proteins are known.

What has been done
An experiment was conducted to characterize the AA concentration and DIAAS value in raw pork loin and to determine the effect of different processing [roasting, frying, or grilling] on AA

concentrations and DIAAS values in pork loin. DIAAS scores were calculated based on ileal digestibility of amino acids [AA] in pigs for raw pork loin, roasted pork loin, grilled pork loin, fried pork loin, and casein. Six ileal-cannulated barrows were allotted to a six × six Latin square design with six diets and six periods during which ileal effluent samples were collected to determine AA digestibility. A N-free diet was formulated to determine basal endogenous losses of amino acids and crude protein [CP] and to enable the calculation of standardized ileal digestibility [SID] of AA. The remaining diets were formulated with each test ingredient as the sole source of AA. Using the determined SID of AA values for the ingredients and established reference protein patterns, DIAAS values were calculated.

For DIAAS calculated for children birth to six months, fried pork had the greatest [P < 0.05] values followed by grilled pork with the next greatest [P < 0.05] score, which was followed by roasted pork, which had a greater [P < 0.05] score than raw pork, which finally had a greater [P < 0.05] score than casein. For DIAAS calculated for children from six months to three years, DIAAS were greatest [P < 0.05] for both grilled and fried pork and least [P < 0.05] for raw pork. The DIAAS of roasted pork was greater [P < 0.05] than that of casein. For DIAAS calculated for children older than three years, there were no differences between the DIAAS of grilled pork, fried pork, or casein, but these three ingredients had greater [P < 0.05] DIAAS than roasted pork, which in turn had a greater [P < 0.05] DIAAS than raw pork.

Results
Results of the present research and our previously published data for cereal grains make it possible to calculate DIAAS values for a meal rather than for individual food proteins. Additionally, results of this research highlight the differences among cooking procedures on protein quality. Results of this experiment also highlight the fact that even among high-quality animal protein sources there may be variation in quality.

4. Associated Knowledge Areas

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

Outcome #22

1. Outcome Measures

More Informed Decisions Regarding The Safety And Efficacy Of Eating During Dialysis

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The corporations that manage the vast majority of U.S. hemodialysis clinics have placed severe restrictions on eating in their clinics, making the U.S. virtually the only country in the world that does not allow their patients to eat during treatment. There is a clear relationship between mortality and markers of nutritional status, so regulations prohibiting eating during dialysis may indeed contribute to the excessively high mortality rates in U.S. dialysis patients. This research will allow us to collect pilot data that could potentially cast doubt on two of the primary reasons for not allowing patients to eat while dialyzing: [1] That it will reduce dialysis efficiency; and [2] That it will produce dangerous drops in blood pressure. From a public policy perspective, intradialytic nutritional supplementation, either alone or in combination with endurance exercise training, represents a low-cost, easy way to administer treatment strategy that could potentially improve the health and quality of life of HD patients. Data from this work will enable nephrologists to make more informed decisions regarding the safety and efficacy of meal feeding during dialysis, and could change the standard of care in U.S. dialysis clinics.

What has been done
The purpose of this project is to investigate 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 and to examine potential mechanisms for these effects. We have three primary aims: [1] Determine if eating during a hemodialysis session affects the efficiency with which dialysis removes solutes from the blood; [2]
Determine the hemodynamic response to eating during dialysis; and [3] Determine if exercise can prevent this transient drop in blood pressure following eating during dialysis.

Results
We have found that eating during dialysis does not impact the efficiency of the dialysis treatment, and that it has only a transient effect on blood pressure. These are important findings because eating is often restricted during treatment for these hypothesized concerns [reduced efficiency and low blood pressure/intradialytic hypotension]. However, our data indicates that there is no rationale for these restrictions on eating during treatment. By contrast, our data provides evidence that eating during treatment is safe, and should be encouraged to help offset some of the catabolic effects of dialysis therapy. We were also able to demonstrate that exercise during dialysis does not exacerbate the effects of intradialytic feeding. In other words, exercise does not cause additional hemodynamic stress during treatment.

4. Associated Knowledge Areas

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

Outcome #23

1. Outcome Measures

Assessing Nutrition Status And Maximizing Nutrition Delivery

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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 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
Our work has shown that bioactives from oregano essential oil [OEO] can reduce the infectivity of C. parvum in vitro. A compounded problem of addition of these bioactives in feed and foods is their pungent flavor, limiting their direct consumption. Thus, we proposed to encapsulate OEO and carvacrol using cyclodextrines.

Results
This encapsulation method proved useful to completely reduce flavor issues associated with OEO. Also, the encapsulated materials were protected during two-stage simulated in vitro digestion conditions. After sensory evaluations with rural women, mothers of young children and college students in India, we found that there were no additional changes detected by these populations due to the addition of encapsulated OEO in a lipid-based nutrition supplement.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

704	Nutrition and Hunger in the Population
724	Healthy Lifestyle
801	Individual and Family Resource Management

Outcome #24

1. Outcome Measures

Increased Knowledge Of Consequences Of Risky Behavior On Youth Health And Wellbeing

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	393

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Recent statistics confirm what parents, teachers and other concerned adults suspect that 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 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. 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 1,309 youth participants completed the full 10 hours of required training. One hundred and eighty-eight [188] participants 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 agreement after the program and then provide a rating of their agreement before the program. The highest level of knowledge change [a 30% increase in agreement from pre-program to post-program] was associated with the statement that "Using drugs can ruin my

relationship with my family and friends". By applying a 30% increase associated with knowledge of risks associated with drug use, it can be presumed that 30% of the 1,309 participants [393] demonstrated an increase in knowledge. There was a 25% increase from pre-program to post-program in agreement with "If a friend wanted to try drugs, I can talk them out of it" [efficacy to convey positive peer pressure]. In response to the final set of four questions regarding program satisfaction and experience, over 93% of respondents reacted favorably to the materials and activities, the staff, and felt they "Learned a Lot During the Training".

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
806	Youth Development

Outcome #25

1. Outcome Measures

Increased Knowledge Of Ways To Maximize Wellness Among Older Adults

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	495

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the U.S. Census Bureau, there are more than 47 million adults over the age of 65 in the United States and that number is expected to double by 2050. That same population currently accounts for 14.6% of Illinois citizens. Because chronic disease, health decline, and financial stability present greater risks as people grow older, many adults today actively seek strategies and methods to age better.

What has been done
The University of Illinois Extension Family and Consumer Sciences [FCS] team developed Aging: Everybody's Doing It!, a "Healthy Aging Summit" concept to reach out to older Illinoisans and present them with a day of wellness education. In 2017, 773 participants attended one of the eight summits through 29 separate sessions. The sessions, with a special focus on older adults, primarily included topical areas addressing nutrition, brain health, and avoiding financial exploitation. Additional options or substitutions were provided at some locations as dictated by

local assessments, though all sessions focused on some aspect of health and wellness for older adults. A total of 771 participants completed the post-session evaluation.

Results
Using a five-part scale with 1 = "Low" to 5 = "High", participants were asked to indicate how much they learned related to the health and wellness topic covered at the session they attended. Of the 771 participants who completed an evaluation, 495 [65%] indicated a change in knowledge as a result of their participation. With respect to the most frequently implemented sessions, 71% of respondents reported that their skill increased to avoid financial scams, 66% reported an increase in awareness of memory strategies and techniques, and 52% reported an increase in understanding of how to make healthy food choices.

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
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #26

1. Outcome Measures

Increased Knowledge Among School Nutrition Professionals To Improve School Lunchroom Environments

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	637

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Health and wellness are influenced by the places in which people live, learn, work and play. School food-service professionals can benefit from training that helps them understand ways to make the cafeteria environment more appealing to encourage healthy eating and reduce waste.

What has been done

Extension educators responsible for ABC's of School Nutrition, a grant partnership with the Illinois State Board of Education, provided training and technical assistance to 2,123 school nutrition professionals, through 159 on-site trainings and completed 280 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. The program hosts an active website that featured nine online mini-courses completed by 947 learners and received 150,341 page views in 2017.

Results

Every on-site training included an opportunity for participants to complete a short [5 question] feedback form. The respondents were asked to rate their knowledge of the topics discussed both after and before the program. Using 6-part scale [1 = "Very Low", 2 = "Low", 3 = "Somewhat Low", 4 = "Somewhat High", 5 = "High", and 6= "Very High"], a total of 2,175 participants provided a before program rating and 2,151 participants provided an after program rating. Level of knowledge about the session's topic PRIOR to the program was rated as a 3 or above for 68% of respondents [1,487]. Level of knowledge about the session's topic AFTER the program was rated 3 or above for 98% of respondents [2,112] respondents. This represents a 30% increase in the proportion of respondents reporting knowledge of the topics from pre- to post-program. It can therefore be estimated, that 30% of the 2,123 participants [637] increased their knowledge of session topics offered through the ABC's of School Nutrition program.

In addition, 37% of respondents "Strongly Agree" and 45% of respondents "Agree" with the statement "Because of the training today, I intend to make a change directly related to what I learned".

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
805	Community Institutions, Health, and Social Services

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Hold that Thought

University of Illinois Extension Family Life Educators developed a new workshop in 2016 on brain health that addresses techniques in maintaining one's memory. The Family Life Educators continue to provide the workshop throughout Illinois. In 2017, 269 participants attended one of the 16 **Hold That Thought** workshops held in various locations in Illinois. At the end of the program, participants were asked to complete a one-page evaluation consisting of seven questions including three open-ended questions.

Using a five-part scale [with 1 = "Nothing", 3 = "Some", and 5 = "A Lot"], participants were asked to indicate how much they learned related to brain health and techniques in retaining one's memory.

Of the 231 participants who answered the question, all 231 [100%] 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", 226 [84%] of participants answered at least one additional question.

Regarding awareness of memory strategies and techniques [n = 237], 179 [76%] responded with "1", "2", or "3" before the program and 224 [95%] responded with a "4" or "5" after the program.

Regarding knowledge of different types of memories [n = 226], 179 [79%] responded with "1", "2", or "3" before the program and 216 [96%] responded with a "4" or "5" after the program.

Regarding understanding of lifestyle choices that contribute to brain health and function [n = 236], 153 [65%] responded with "1", "2", or "3" before the program and 229 [97%] responded with a "4" or "5" after the program.

When participants were asked to "list one action you intend to take as a result of this program" the most frequently mentioned action items included to focus on one thing at a time, pay attention, practice memory exercises that were shared during the program, verbalize and repeat things out loud, write notes or journaling, and try new and challenging activities.

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

Health Rocks

4-H Health Rocks! is 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. In addition to learning the facts about drugs and the consequences of use, the educational activities encompassed building life skills such as showing concern for others, making healthy lifestyle choices, managing stress, and developing refusal skills.

Over 60% of participants were middle school age [6th, 7th, or 8th grade] and 10% identified as Hispanic/Latino ethnicity. The majority [87%] were living in an urban environment. One hundred eighty-eight [188] of the 1,309 youth participants in **4-H Health Rocks**! completed a retrospective pre-post evaluation tool comprised of seventeen items. Thirteen of the 17 evaluation items were statements about drug use and life skills which asked youth to rate their agreement on a scale from 1 to 4 [with 1 = "Strongly Disagree" and 4 =

"Strongly Agree"]. The youth were instructed to provide a rating that reflected their agreement with a series of statements after the program and then provide a rating of their agreement with the statements before the program. The proportion of youth that reported they "Agree" or "Strongly Agree" with each statement before the program was compared to the proportion of youth that reported they "Agree" or "Strongly Agree" with the statement after the program in order to observe changes in knowledge and skills resulting from program participation. Increases ranging from 12% to 30% were observed from pre-program to post-program with respect to all measures of drug knowledge: [1] "Using drugs can ruin my relationships with my family and friends": knowledge increased by 30% [from 63% agreement pre-program to 93% agreement post-program]; [2] "People who use drugs sometimes see or hear things that are not really there": knowledge increased by 28% [from 63% agreement pre-program to 91% agreement post-program]; [3] "Once you start smoking, it is hard to stop": knowledge increased by 17% [from 72% agreement pre-program to 91% agreement post program]; and [4] "People who smoke can die from lung cancer": knowledge increased by 12% [from 86% agreement pre-program to 98% agreement post-program].

The highest level of knowledge change [a 30% increase in agreement from pre-program to post-program] was associated the statement that "Using drugs can ruin my relationship with my family and friends". Based on this 30% increase associated with knowledge of risks associated with drug use, it can be estimated that 30% [393] of the 1,309 participants gained knowledge as a result of their participation.

In response to the final set of four questions regarding program satisfaction and experience, 93% felt the training was interesting, 98% agreed that the staff members were friendly, 94% agreed that they actively participated in the training, and 93% agreed that they learned a lot during the training.

Key Items of Evaluation

Hold that Thought

In 2017, 269 participants attended one of the 16 **Hold That Thought** workshops held in various locations in Illinois. Substantial increases were observed from pre-program to post-program for all measures of knowledge and awareness. Participant feedback suggests that the series successfully addressed ways to improve awareness and knowledge of how memory can be maximized to maintain quality of life throughout the aging process.

Health Rocks!

An estimated 393 youth increased knowledge in their agreement with at least one of the evaluation statements regarding drug facts, consequences of use and building life skills such as showing concern for others, making healthy life styles choices, managing stress, and developing refusal skills. In addition, youth participants were highly satisfied with the program activities and staff.

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	20%		10%	
111	Conservation and Efficient Use of Water	10%		5%	
112	Watershed Protection and Management	5%		10%	
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%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		5%	
405	Drainage and Irrigation Systems and Facilities	5%		10%	
605	Natural Resource and Environmental Economics	5%		10%	
806	Youth Development	30%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.0	0.0
Actual Paid	9.4	0.0	43.2	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**
328258	0	769611	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
328258	0	769611	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
2469150	0	4418703	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities this year included work highlighting how crop insurance programs reduce the incentive to adapt to climate change, the use of input-output techniques to demonstrate the irrational behavior of water-scarce places that export water-intensive goods such as agriculture, work utilizing eDNA to transform the routine monitoring of organisms at low population abundances [whether for the early detection of invasive species or for the management and conservation of imperiled species], research that seeks to improve our understanding of the chemical inputs resulting from atmospheric deposition [this is critical to understanding nutrient cycling in both crop and forest systems], a project with the overall goal of documenting phosphorus input and output budgets in constructed wetlands receiving tile flow from adjacent corn and soybean farm fields in central Illinois, work to improve our understanding about the response of insects to naturally-occurring pathogens that are fed to the hosts [similar to how they might encounter the pathogens in nature], the conducting of an experiment to test journalistic techniques that stand a greater chance of changing people's knowledge, attitudes, and behavior about controversial topics related to agriculture, and work to improve management recommendations to avoid undesirable wetland restoration outcomes.

Activities also included research that seeks to improve our understanding of the influence of environmental conditions and time since invasion on forests ecosystem structure and function [this is imperative for anticipating how forests will change in the future and knowledge of how best to manage invasions is needed to protect forest resources], a study that seeks to build on our existing knowledge of the factors that govern the formation of methylmercury in agricultural watersheds so that efforts aimed at mitigating other water quality problems, such as excess nutrients, will not inadvertently worsen the problem of Hg pollution, a study with an overarching objective of advancing knowledge as to the varying factors that influence how anglers are contributing to biological invasions [the regional focus of this work will shed new light on how environmental planners and managers can more effectively curb the impacts incurred from the unintentional transport of aquatic invaders in the Great Lakes], ongoing support for graduate students in the **Program In Ecology, Evolution and Conservation Biology** with research assistantships and research support, and a project building on past efforts related to indicator use and development [results are expected to benefit farmers who might use decision tools or enroll in government programs that are informed by our efforts, as well as the general public that depends upon soils' provisioning services].

Activities also included research that seeks to advance knowledge of the socio-economic contribution forests and trees on farms have made in the past and may make in the future in the U.S. and globally, work that seeks to define the impacts of climate-related stressors, stressors related to agricultural land use, stakeholder use patterns, and invasive species on individual fish and on fish populations, an effort to characterize the suite of weed-associated microbial taxa that respond in the short-term and long-term to

cover crop and green manure management [this project seeks to uncover the microbial ecology behind cover crop-based and green manure-based weed suppression, and because these are organic inputs their adaptation will improve the sustainability of U.S. agriculture and food systems by reducing the need for herbicide application], an effort 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, an effort to gain a better understanding of how grassland birds select habitats within agricultural landscapes, work to estimate the values of natural resources and environmental amenities to guide resource management decisions, design environmental policy, and evaluate the costs and benefits of policies that are proposed, ongoing work under the **National Atmospheric Deposition Program** to monitor the nation's precipitation for a range of chemical constituents and to determine whether spatial and temporal trends in concentration and wet deposition are present, and research with an overall goal of evaluating the performance of conventional drainage, drainage water management, and combination drainage/sub-irrigation systems under projected climate scenarios [this information will then be used to make recommendations on the most effective mid-century and end-of-century drainage designs for a specified soil in a given county in Illinois].

Conference presentations included the Beltwide Cotton Conferences, Western Agricultural Economics Association, American Agricultural Economics Association, North American Native Fishes Association, Society for Freshwater Science, Society of Invertebrate Pathology, Bulgarian Academy of Sciences, Union of Bulgarian Scientists, Entomological Society of America, Society of Invertebrate Pathology, Africa Agri-Biotechnology and Biosafety Communication Symposium, U.S. International Association of Landscape Ecology, Illinois Invasive Species Symposium, Illinois Prescribed Fire Symposium, American Fisheries Society, Great Lakes Fishery Commission, Ecological Society of America, Association for Tropical Biology and Conservation, American Association of Zoos and Aquariums, Midwest Ecology and Evolution Conference, International Turfgrass Research Conference, Champaign County Soil and Water Conservation Society, Iowa Invasive Species Conference, American Association of Geographers, Food Security Symposium: Commercial Agriculture in the Tropical Environments, International Congress for Conservation Biology, Illinois Department of Natural Resources, Northeastern Agricultural and Resource Economics Association Workshop on Climate Change and Land Conservation/Restoration, National Ambient Air Monitoring Conference, Asia Pacific Mercury Monitoring Meeting, Center for Atmospheric Sciences of the National Autonomous University of Mexico, and the International Conference on Mercury as a Global Pollutant.

The 2017 **Soil Fertility Seminar** was offered in 18 County Extension Offices through a webinar format. It provided university research-based information on issues related to soil fertility, crop yields and profitability and nutrient losses, management, and environmental stewardship. In addition, an intensive program for new and experienced mid-scale to large-scale composting operators called the **Bi-State Compost School** was offered to promote the adherence to regulations and to insure compost quality. Extension staff contributed to three **Conservation Cropping Seminars** sponsored by the Illinois Department of Agriculture.

The **Illinois-Indiana Sea Grant** program staff maintained focus on expanding medicine collection programs to keep pharmaceutical and personal care product disposal from impacting water quality. The number of permanent collection programs has reached a total of 51.

The **Illinois Master Naturalist** [ILMN] program celebrated its tenth year of statewide implementation. The 862 Illinois Master Naturalists were actively engaged in a wide variety of projects as environmental stewards and educators. These Master Naturalists invested 76,127 volunteer hours of which 10,878 were devoted to educational program delivery and 46,625 hours were devoted to natural resource stewardship activities. 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 $24.14 from the Independent Sector, Master Naturalists' volunteer service reflects an estimated value of

$1,837,705.

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 1,672 youth in 3rd grade through 5th grade [see evaluation section of this planned program]. In order to independently explore the environment, more than 36,000 4-H youth across the state enrolled in environmental stewardship projects.

An Extension educator on the Energy and Environmental Stewardship team posted twelve timely updates to the **An Illinois River Almanac,** including topics related to alternative energy, the role of pollinators in keeping habitats healthy, radon testing, and trench composting. Workshops to educate the public about radon testing and how to reduce radon levels at home were offered through a partnership with the Illinois Department of Public Health.

Local Extension unit efforts to promote environmental awareness included celebration of annual Stewardship Week, organizing an event with 1,398 kindergarten through 6th grade students from 22 schools across 11 Illinois counties. **Sustainability in the Home Landscape**, a six-part series created by a unit Extension horticulture educator, was delivered to 40 participants who learned about sustainable landscape practices along with a hands-on "lab" component that simulated a design studio. By the end of the series, each participant had a landscape plan following sustainable principles. Another unit organized and delivered a **Gateway Green Industry Conference** with a keynote on establishing a successful prairie meadow and sixteen breakout sessions covering topics ranging from pest management to forestry to native landscape designs. Finally, the **Conservation@Home Cook County** program was launched in 2017. A partnership of Forest Preserves of Cook County and Extension, this program recognizes and certifies properties that demonstrate environmentally sound landscape practices. A total of 42 properties were certified in Cook County during the initial program year.

2. Brief description of the target audience

Members of the target audience included ranchers, farmers, state and federal fish and wildlife management and natural resource conservation agencies [including the Illinois Department of Natural Resources, the U.S. Forest Service, and the U.S. Fish and Wildlife Service], scientists, policy makers, graduate students, post doctoral researchers, Extension specialists, industry staff and scientists, apiculturists and users of commercial bumble bees, science reporters, journalists, representatives of government and non-governmental organizations, academic ecologists, land managers, restoration practitioners, government agency personnel involved in planning, implementing, and regulating wetland restoration programs, professional scientists conducting research into bioaccumulation of toxic trace elements in aquatic food webs, natural resource managers, stakeholders in the Great Lakes basin, technical service providers, researchers and policy makers interested in using dynamic soil properties as indicators of soil health, conservation practitioners and managers, environmental non-profits, environmental consulting companies, the World Bank, conservation biologists, and land improvement contractors.

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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	17302	946956	74528	946956

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	64	64

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2017	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	Improved Development Of Conservation Strategies Through An Improved Understanding Of How The Presence Of Social Cues Affects The Occupancy And Density Of Grassland Birds
4	Estimating The Value Of Natural Resources And Environmental Amenities To Guide Resource Management Decisions
5	Number Of Pesticide Applicators Making A Decision To Avoid Harming The Environment
6	Actions Taken By Program Participants To Protect The Environment [Water Quality, Air Quality, Soil Loss, Wildlife, Natural Vegetation]
7	The Design And Evaluation Of Resource Management Policies That Are Cost-Effective And Maintain Or Improve Environmental Conditions
8	Exploring The Mechanisms Through Which Climate Change Affects Agriculture
9	Evaluating Habitat Quality Restoration And Success
10	Highlighting How Crop Insurance Programs Can Reduce The Incentive To Adapt To Climate Change
11	Improving Management Recommendations To Avoid Undesirable Wetland Restoration Outcomes

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
2017	498

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 included three tracks in 2017: [1] Worms; [2] Butterflies; and [3] Birds. 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, and 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 1,672 youth this past year.

Results
Of the 1,672 youth who attended one or more of the I Think Green program tracks, 573 completed an end of program evaluation. The ten question evaluation tool included statements about the environment and about the program and asked respondents to mark "Yes", "No", or "Not Sure" to signify their agreement with each statement. Across all tracks, 498 respondents [88%] agreed with the statement "I would like to get involved in food composting, recycling, or other activities to help take care of the environment in my community", 410 respondents [72%] agreed with the statement "I am more excited about helping to care for the environment" and 376 respondents [66%] agreed with the statement "I have more ideas about ways that I can help care

about the environment" as a result of participating in I Think Green.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
211	Insects, Mites, and Other Arthropods Affecting Plants
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 Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1269000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Scientists at State Agricultural Experiment Stations [SAES] recognized the need for a national network to assess the magnitude, geographic extent, and temporal variations in the deposition of acidic substances and nutrients in precipitation. In 1977, the SAES's North Central Region established a regional project, NC-141, to address this need. NC-141 grew from a network of 22 stations in 1978, to a network with over 300 stations currently. SAES National Research Support Project-3 is the basis for the current monitoring program, the National Atmospheric Deposition Program [NADP].

The goal of the NADP is 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. This project will provide for: [1] The management, coordination, chemical analysis, and site support of NADP's precipitation networks; and [2] Quality assurance and quality control activities to ensure consistent operation and adherence to standard operational procedures.

What has been done

Precipitation samples are collected using standard wet-dry precipitation collectors. Standard chemical methods are used to measure free acidity [as pH], conductance, calcium, magnesium, sodium, potassium, sulfate, nitrate, chloride, and ammonium. Total mercury is measured using EPA Method 1631. Most samples are collected on a weekly basis. Observations of gaseous ammonia and gaseous mercury fractions are also collected to estimate the dry deposition component of these gases. Expected outcomes include: [1] Freely available data; [2] Reports to site operators, supervisors, and sponsors of the precipitation chemistry data; [3] Site operator training; [4] Support of the field equipment; [5] Progress reports to the NADP community; and [6] Databases of information to be used by other researchers for publication, education, and research support. Anticipated benefits include monitoring the deposition of specific chemical constituents to the nation's ecosystems, detection of trends in the deposition of these constituents, and research findings to be published by others.

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. From September of 2016 through August of 2017 NADP data were cited in over 350 peer-reviewed publications, dissertations, theses, and agency reports. Data from the NADP's five monitoring networks were downloaded over 23,640 times by approximately 33,000 registered data users. These data users represent federal and state agencies [40% of users], universities [36%], K-12 students and educators [16%] and others [8%]. Each year, NADP data is 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 STEM curricula on the elementary, secondary, and post-secondary level. All data are available free of charge at http://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

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The objective of this research is to gain a better understanding of how grassland birds select habitats within agricultural landscapes. One of the more interesting findings was that the cover crops provide potentially important habitat for migrating birds. Cover crops are becoming more common across the Midwest. In the area we worked the amount of acreage in cover crops increased thousands of acres per county each year. We found that cereal rye, the primary cover crop used, is a preferred habitat for many migratory bird species whose populations have been declining. While the primary benefit of cover crops is for soil health and nitrogen management, an additional benefit is for wildlife. In addition, we found that birds use various cues to select grasslands in which to breed and in different parts of their life cycle they use different grassland habitats. This information is critical to management to provide direction on how to manage grasslands in order to achieve the greatest conservation value.

What has been done
We worked in eight agricultural landscapes in Illinois, and while it was clear that more grasslands resulted in more grassland birds, we found great variation in terms of bird species diversity and abundance between landscapes that had similar landscape characteristics. The lack of clear patterns led us to focus more on the second part of the objective: How the presence of social cues impacted occupancy and settlement. This line of research led to our having a better understanding of how grassland birds in agricultural landscapes select habitats. We conducted an experimental study to determine that a rapidly declining grassland bird [Grasshopper Sparrow] can readily locate newly created grasslands [via farm bill programs]. However, the distribution of Grasshopper Sparrows and the density of sparrows at sites is based on the presence of conspecifics. This was one of the first studies to use newly created habitats to determine the relative impact of social and habitat cues in determining settlement patterns of birds.

Results
We continued this line of research studying the habitat selection of birds for cover crop fields, how young grassland birds select habitats to use, and what cues are used by birds when selecting these habitats. In the case of cover crops we found that many species of migratory grassland birds prefer to stop over in cover crop fields while migrating. While cover crops are generally used to improve soil quality and sequester nitrogen, an additional benefit is that they provide habitat for migratory birds and migratory birds appear to prefer these fields. We suspect that birds were selecting these fields because of the lack of grasslands and the food and shelter available in cover crop fields. Our work with young grassland birds found that at first young birds move to dense areas within grasslands, likely to hide from predators. After approximately three weeks the

young are capable of sustained flight and begin to group with conspecifics and move to more open areas where they forage. Finally, work with Field Sparrows has shown that they respond to conspecific calls at night, while it is likely that this is not associated primarily with habitat selection, but rather due to finding individuals for extra-pair copulations. In summary, we have improved our basic understanding of how birds select breeding habitats and this understanding has led to more effective management practices of grasslands birds.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife

Outcome #4

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Forests and trees on farms contribute to human well-being in a variety of ways. They provide goods ranging from fruit to timber, fodder to firewood, and services such as pollination, hydrological regulation, and carbon sequestration that support the livelihoods of millions of people around the world. Globally, the formal forest sector employs more than 13.2 million people and generates a gross value added of just over $600 billion or about 0.9 percent of global GDP annually. In the United States, the forest products industry alone accounts for approximately 4 percent of the total U.S. manufacturing GDP and forests and trees on farms provide a variety of other benefits to the millions of people around the country. Illinois is no exception, where forests cover more than 13% of the state's total land area, providing more than 36,000 jobs in the forest products industry alone and generate an estimated $620 million annually. Despite the benefits of forestry and agroforestry, however, public recognition remains lacking in many contexts. This research project will therefore help advance knowledge of the socio-economic contribution forests

and trees on farms have made in the past and may make in the future in the U.S. and globally. Specifically, it will undertake literature reviews and other systematic analysis to document the relationship between forests and on-farm trees and socio-economic well-being and increase understanding of the effectiveness of different types of forestry and agroforestry interventions in enhancing such well-being over the long term.

What has been done

The largest impact this past year is a change in knowledge of the overall effectiveness of funding for forest conservation and biodiversity more generally at a global scale. We published a paper in the journal Nature that found that the almost $15 billion spent on biodiversity conservation globally in the decade after the 1992 Earth Summit prevented a 29% decline in threatened bird and mammal species. This is a major finding that resonated widely. For example, our paper ranks in the top 5% of all research outputs scored by Altmetric, a widely used ranking for the amount of attention scientific research receives. Besides this topline finding, our article has made an impact because it presents a highly accurate model that can be used as a practical policy tool to set international conservation funding goals, adjusting funding amounts needed according to intensity of threats to biodiversity and cost on a country-by-country basis. USDA-NIFA funding under this project was pivotal to facilitating this work as it allowed the lead author of the study to bring the paper to completion as a visiting scholar at the University of Illinois.

Results

Two other knowledge impacts are worth highlighting. First, we have published a protocol and finalized a database compiling information from all the studies assessing how forest management and conservation globally contributes to poverty alleviation. This will result in an important change in our knowledge about when and how forests can contribute to reducing poverty and bringing about prosperity. This work is undertaken in concert with the World Bank, a key policy audience that we are seeking to influence. We expect to publish results in 2018 and will also make them available through an interactive web portal freely available to the public.

Second, we published the first peer-reviewed description of the idea of predictive proxy indicators [PPIs]. PPIs are measures that can be tracked over the short term but have the potential to predict the longer-term social-ecological impacts of forest conservation and management interventions. Through wide consultation and feedback we increasingly see how important PPIs can be as a tool for decision-makers in the forestry sector who must justify use of funds to various stakeholders. The reason the tool is useful is that it can provide credible near-term information about the likely benefits of a given intervention even though the benefits may not fully accrue until a longer time has passed. Funding under this project was crucial to realizing both of these results.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation
134	Outdoor Recreation
605	Natural Resource and Environmental Economics

Outcome #5

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #6

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
2017	24330

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. 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, the Illinois-Indiana Sea Grant program provided technical assistance to two Illinois communities on how to start a permanent medicine collection "take-back" program and purchased the collection boxes.

Results
This brings the number of permanent collection programs assisted by Illinois-Indiana Sea Grant to a total of 51. Altogether, these programs collected and properly disposed of 24,330 pounds of unwanted medication, protecting water quality, wildlife, and human health.

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 #7

1. Outcome Measures

The Design And Evaluation Of Resource Management Policies That Are Cost-Effective And Maintain Or Improve Environmental Conditions

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Exploring The Mechanisms Through Which Climate Change Affects Agriculture

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Evaluating Habitat Quality Restoration And Success

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The objective of this research project is to demonstrate the usefulness of sub-lethal, physiological metrics in assessments of habitat quality and restoration success. This has the potential to provide restoration practitioners with another suite of tools and techniques that can be helpful in

assessing the success or failure of restoration projects.

What has been done
Previous work within this project focused on the development of physiological stress markers that can be used to link habitat quality and restoration with animal condition in the field. Collectively, this work has demonstrated links between land use and habitat quality on the physiological properties of both native fishes and native mussels as well as the usefulness and value in using sub-lethal physiological tools to quantify the health and condition of fishes in the field as related to habitat quality and restoration activities. Together, this work has provided conservation practitioners and restoration managers with a novel suite of tools that can be used to quantify how habitat characteristics are influencing resident organisms beyond simple presence, absence, or abundance.

Results
While the development of physiological and/or stress markers is valuable and powerful, these metrics can receive some criticism as they can be regarded as either transient or not ecologically relevant. Recently, efforts within this project focused on the development of markers to quantify reproductive output and reproductive potential. Reproductive potential and/or reproductive output is one of the ultimate variables that can be used to quantify population growth or decline, and these tools allow practitioners to better link population-parameters with habitat variables in the field. The tools that were developed included histological assessments of gonad development, as well as hormonal profiles to quantify reproductive potential. The development of these tools allows practitioners to better quantify not just if animals are present in different habitat areas, but if there is potential for them to spawn and/or experience positive population growth. Rarely have these kinds of tools been used in a field setting, providing a novel and important set of tools to practitioners.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

Outcome #10

1. Outcome Measures

Highlighting How Crop Insurance Programs Can Reduce The Incentive To Adapt To Climate Change

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
While there is little controversy about whether the climate is changing, significant uncertainty exists with respect to the impact of future climate conditions on the economy and, more especially, on agriculture as it is the sector that is the most sensitive to such changes. Understanding climate change and the associated extreme weather events, such as drought and extreme precipitation, is vital for the U.S. as agriculture occupies up to 42% of its territory and the losses associated to extreme weather events are enormous. For instance, 178 weather and climate-related natural disasters costing more than $1 billion in damages each took place in the U.S. since 1980. Furthermore, the consequences of the above two processes can be exacerbated if one does not monitor and mitigate the impact of economic activities on our environment, such as in terms of water use and emission production. The current water restrictions imposed in California are, in that regard, a reminder that many more efforts are needed to improve the way the country's environmental and adaptation strategies are designed.

The above concerns have led to a surge of studies measuring the socio-economic impact of climate change and of natural hazards, but little attention has been paid to the spatial and intersectoral externalities that take place in the interactions between climate and economics. Yet, it is widely recognized that similarity in weather and soil conditions, water run-offs, aquifers shared for irrigation water, and the social network farmers build lead agricultural production in one locality to depend, to some extent, on the one experienced in nearby localities. Furthermore, agriculture is so intertwined with other economic sectors through its sales and purchases that a deterioration of its output has consequences far beyond the rural areas. This problem can be exacerbated by the usual transportation network disruption that follows such events.

What has been done
Research accomplished this year has highlighted that crop insurance programs reduce the incentive to adapt to climate change. Furthermore, we have investigated the role of inter-regional dependence in a Ricardian framework further. While the traditional spatial econometric literature bases spillovers on geographical proximity, we claim that inter-regional trade flows as well as upstream-downstream surface water flows used for irrigation are a more important form of dependence. These spillovers demonstrate that the actual marginal effect of a covariate such as temperature on the dependent variable is a function of both local and inter-regional effects.

Results
We are also working on an article that seeks to demonstrate the hierarchical nature of the weather variables we commonly rely on. Based on recent econometric techniques for hierarchical

modeling, we demonstrate that the largest part of the variance in the weather conditions across U.S. counties comes from the variance across the nine climate regions defined by NOAA. Furthermore, this approach allows us to measure marginal effects which are specific to each climate region. Compared to the usual, nation-wide measurements that the current literature offers, our results show that each climate region should expect less damage from future climate conditions. As such, these location-specific marginal effects capture the local adaptation capacity better than nation-wide measurement.

Finally, we have used input-output techniques to demonstrate the irrational behavior of water scarce places that export water-intensive goods such as agriculture. We focused on Arizona for which we could access detailed data. We also used input output techniques to measure the economic losses associated with a flood. The event we chose is the Chehalis river flood that took place in December 2007 and affected three rural counties.

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
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

Improving Management Recommendations To Avoid Undesirable Wetland Restoration Outcomes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Our goal is to determine the level of homogenization among restored wetlands relative to natural reference wetlands. We predict that restored wetlands will have low taxonomic and functional group beta diversity compared to randomly-selected natural wetlands.

What has been done
During Summer 2014 and 2015, we established standardized permanent plots in 38 restored wetlands in Illinois. In restored forested wetlands, vascular plants were sampled within 30 0.25 square mile quadrants distributed along three 50 meter transects. Additionally, a 0.1 hectare 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 hectare 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-based 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

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

In 2017 a total of 1,672 youth participated in the **I Think Green** program. A ten-question evaluation was completed by 204 Worms track participants, by 237 Butterflies track participants, and by 132 Birds track participants. The ten question evaluation tool included statements about the environment and about the program and asked respondents to mark "Yes", "No", or "Not Sure" to signify their agreement with each statement. There was a common set of survey items across all tracks and also a set of items unique to each track.

Environment Related Questions - **I Think Green** [N=573]

67% reported having more ideas about ways they could help care for the environment
75% reported being more excited about helping to care for the environment
88% reported that they would like to get involved in food composting, recycling, or other activities

Participation Related Questions

84% reported that the **I Think Green** activities were fun to do
80% reported that they would like to do more activities like the ones in **I Think Green**
67% reported that they would like to help with a community garden project

Butterfly Track Specific Questions [N=237]

67% reported that they were encouraged to ask questions about butterflies and the environment
84% reported that the activities helped them learn about butterflies and how they grow
62% reported that the activities help them to learn how butterflies interact with other living things
61% reported that the activities help them learn how butterflies contribute to the environment

Worms Track Specific Questions [N=204]

58% reported that they were encouraged to ask questions about worms and the environment
88% reported that the activities helped them learn about worms
76% reported that the activities help them to learn how worms interact with other living things
78% reported that the activities help them learn how worms contribute to the environment

Bird Track Specific Questions [N=132]

67% reported that they were encouraged to ask questions about birds and the environment
96% reported that the activities helped them learn about birds
83% reported that the activities help them to learn how birds interact with other living things
78% reported that the activities help them learn how birds contribute to the environment

Key Items of Evaluation

The majority of the youth participants [over 80%] reported that the **I Think Green** activities helped them learn about worms, butterflies, and birds. Even more youth [88%] agreed that they would like to get involved in stewardship activities to help take care of their community.

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	20%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		15%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		10%	
206	Basic Plant Biology	0%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	20%		10%	
212	Pathogens and Nematodes Affecting Plants	20%		15%	
213	Weeds Affecting Plants	20%		10%	
214	Vertebrates, Mollusks, and Other Pests Affecting Plants	0%		10%	
216	Integrated Pest Management Systems	20%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	10.0	0.0
Actual Paid	8.4	0.0	36.3	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**
292053	0	1535089	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
292053	0	1535089	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
2196814	0	10822474	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities included work to improve our understanding of how E. amylovora infects hosts and causes disease [allowing us to develop strategies for disease control and to reduce the economic losses; this knowledge could also be extended to other enterobacterial systems such as E. coli and Salmonella which are great threats to human health and food safety], the use of a combination of microscopy and molecular biology to determine how plant-parasitic nematodes are able to complete their life-cycles in diverse environments and devise economically-practical and environmentally-sound strategies for their control, the development of additional methods for control of H. glycines to supplement existing control strategies, the testing of waterhemp and Palmer amaranth plants for resistance to glyphosate and to herbicides that inhibit the PPO [protoporphyrinogen oxidase] enzyme, the identification of pathogenesis proteins from major diseases of corn, soybean, and wheat with the goal of making better recommendations for the deployment of disease-resistant varieties and chemical controls, and research that seeks to gain a better understanding of plant-soil relations as influenced by farming management practices [gained knowledge will ultimately contribute to improved efficiency, productivity, and quality of grain produced to satisfy needs of local food markets].

Activities also included research that seeks to contribute information for a better understanding of the origin and evolution of adaptive traits in agronomic weed species, a project examining a subset of topics that are closely related to resistance in corn rootworms including the genetics of Northern Corn Rootworm and Western Corn Rootworm resistance, the biology of moving and dispersing rootworm adults, the geography of resistance, and the efficacy of Integrated Pest Management/Insect Resistance Management strategies and tactics [new knowledge derived from these studies will form the basis for Extension and outreach materials, including workshops and presentations, designed to educate the public about relevant rootworm biology and make improved, sustainable management strategies accessible to wide audiences], the monitoring of seasonal and year-to-year patterns of pest abundance to produce valuable records of pest occurrence, ongoing genomic selection breeding efforts, the identification of leaf traits and the genes that control these traits in maize and related grasses that alter photosynthesis and transpiration, and the development of practical and easy-to-implement strategies that help address nitrogen leaching and N2O emission concerns in Illinois [through Extension and education efforts, the primary benefactors of this research will be crop producers, agricultural consultants, and state agricultural and environmental agencies who will be able to implement nitrogen management practices that reduce the economic and environmental costs of inputs while maintaining productive and profitable farming systems].

Activities also included work to develop improved winter wheat varieties adapted to Illinois, efforts to quantify and document the occurrence and distribution of herbicide-resistant weed populations in Illinois, an ongoing soybean breeding program focused on developing knowledge, technology, germplasm, and

varieties that will increase the productivity, profitability, and sustainability of soybean production in Illinois and throughout the U.S., efforts to attract more customers to the farm by helping growers identify rootstocks that will reduce tree height without compromising fruit quality, the utilization of next-generation DNA sequencing to measure changes in a diverse set of Soybean Cyst Nematode populations, the evaluation of new plant materials and germplasm with the objective of improving the variety and quality of plants in the landscape trade, the compilation of years of data from field research on soybeans exposed to elevated carbon dioxide and/or ozone, research seeking to improve domesticated Asian rice with genes from its wild relatives O. longistaminata and O. rufipogon, and a rigorous assessment of the effects of crop rotation and tillage on soil properties and crop yields [this information is needed to help move producers to more profitable and sustainable crop production sequences and practices].

Conference presentations included the Korea Ocean Research and Development Institute, Korea Polar Research Institute, Society of Nematologists, American Phytopathological Society, Maize Genetics Conference, Entomological Society of America, Cold Spring Harbor Plant Genomes, Soybean Breeders' Workshop, Brazilian Plant Breeders, Illinois Specialty Growers Conference, and the Institute of Food Technologists.

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 6,591,035 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 again offered by the Extension Horticulture Educators Team via webinars at Extension offices throughout the state. Following live broadcast, the webinars were archived on YouTube and made available through links posted on the Extension website.

Extension Master Gardeners gave countless hours in providing horticulture information to the public. This past year, there were 3,019 active Master Gardeners in Illinois who contributed more than 215,000 volunteer hours. Based on the value of a volunteer hour of $24.14 from the Independent Sector, Master Gardner's volunteer service reflects 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.

Extension staff and Extension-trained volunteers support nearly 500 community gardens throughout Illinois. These gardens serve many functions, including education and demonstration at schools and in communities, therapeutic settings in hospitals and other places for special populations such as court-assisted children and assisted living residents, environmental stewardship supporting pollinators and other beneficial insects, developing life and work skills at correctional facilities, and expanding food access through food donations.

For the second year, **Pollinator Pocket Program** was delivered through a collaboration between the Master Gardeners and Master Naturalists Extension programs. Trained volunteers promote development of gardens dedicated to pollinators such as bees and butterflies in their own communities and train other gardeners in how to plan a space dedicated to pollinators in their yards as well as in common areas of subdivisions. The **Pollinator Pocket Program**, now with 154 registered gardens [including one in Missouri and one in Michigan], also features a website that includes original landscape designs, links to national pollinator resources, and a blog called "What's in Your Pocket?" The site can be found at http://web.extension.illinois.edu/cfiv/pollinators/.

Using hands-on activities, 1,638 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. **Beekeeping** was a new 4-H project in 2017 and more than 1,300 4-H members began learning how to protect this important pollinator.

The **University of Illinois Plant Clinic** provides 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. The **Plant Clinic** Facebook page is one of the top 10 most viewed University of Illinois Extension statewide social media accounts with 1,722 followers who are interested in breaking news regarding plant pests. In 2017, the Plant Clinic processed 3,662 samples and provided diagnoses and management recommendations. In addition, staff provided technical assistance through 2,250 phone, e-mail, and walk-in consultations. The Plant Clinic provides two types of analytic services to Illinois producers, agribusinesses, and crop advisors analyzing seed mix samples. In partnership with the Illinois Crop Improvement Association and the Illinois Department of Agriculture, the Plant Clinic provides analysis identifying any pathogens present in support of state-issued phytosanitary certificates in seed production fields. In 2017, the Plant Clinic provided phytosanitary certificate support for 588 fields representing over 15,000 acres of seed production. This year, in cooperation with a faculty member from the Department of Crop Sciences, the Plant Clinic developed a cost effective, rapid turnaround procedure for the molecular identification of Palmer amaranth in mixed seed samples in response to it being found in pollinator seedlots widely used by Illinois producers. One hundred eight [108] samples were submitted for Palmer amaranth molecular identification in 2017.

Clinic staff also assisted with seven [7] **Illinois First Detector** workshops, reaching 239 participants in 2017. In its fifth year, this program was 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]. The goals of the program are to: [1] Increase participants awareness of current and emerging invasive plants, pathogens and 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. According to the post-program evaluation completed by 200 of the 239 attendees, a secondary audience of up to 37,050 could be reached based on the number of people they encounter in regards to tree care.

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, growers, practitioners of weed management, farmers, retail herbicide applicators, farm consultants, the seed industry, researchers working on reducing the impact of plant pathogens, commercial entomology and crop protection/pest management professionals, Extension personnel, agricultural biotechnology company representatives, college students in agricultural sciences, breeders, quantitative geneticists, computational biologists, plant scientists working on wheat and disease resistance in wheat, agronomic commodity organizations, professional weed science societies, agricultural media organizations, vegetable growers, scientists in the seed and agrochemical industries, custom applicators of crop protection chemicals, members of the commercial nursery industry, breeders and growers of rice [especially those interested in cultivars with new genes for abiotic and biotic stress-tolerances], crop producers, agribusiness personnel, other agronomic scientists, and graduate students.

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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	26504	126628	7111	0

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	71	71

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2017	12

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Herbicides remain the most effective and economically feasible alternatives for weed control. However, the evolution of herbicide resistance in weed populations threatens the continued effectiveness of herbicides, and thus our ability to maintain a cheap and abundant food supply. Waterhemp is among the worst weeds for Illinois crop producers, and largely drives weed management decisions. As waterhemp populations continue to evolve multiple resistance, there will be continued demand by weed management clientele for rapid herbicide-resistance diagnosis in populations of this species.

What has been done
During the project period, we continued to provide support for testing of waterhemp and Palmer amaranth plants for resistance to glyphosate and to herbicides that inhibit the PPO enzyme.

Results
Resultant information was provided back to farmers, enabling them to make site-specific weed management decisions. We also identified and published two new mutations conferring resistance to PPO-inhibiting herbicides and developed rapid, DNA-based tests for detecting these

mutations. Finally, we developed and optimized DNA-based tests for the identification of Palmer amaranth and waterhemp. The test for Palmer amaranth, in particular, was rapidly adopted for use in detection of this species' seed as a contaminant in seed planting mixtures.

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #3

1. Outcome Measures

Development Of New Soybean Breeding Lines

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The soybean breeding program is focused on developing knowledge, technology, germplasm, and varieties that will increase the productivity, profitability, and sustainability of soybean production in Illinois and throughout the U.S. Most of the breeding effort is done in a non-GMO genetic background because there is a lack of non-GMO varieties available to growers that are developed by the private sector. During the past five years, an accomplishment was the improvement in our understanding of the impact of aphid resistance genes on seed yield and aphid colonization.

What has been done
The program used this and other information we previously generated to breed two major aphid resistance genes into high yielding varieties. Based on this research progress, seven aphid resistant varieties were released and are being marketed to soybean farmers or are being increased for sale. Another accomplishment is in mapping genes conferring resistance to soybean cyst nematodes [SCN] and the development of varieties with these genes. We have mapped the specific locations on DNA where two major SCN resistance genes are located, and

through collaborations helped improve our understanding of how the major SCN resistance gene rhg1 works.

Results
This information has been used in the development of SCN resistant varieties by our program and by other breeders in the U.S. Twenty-four varieties were released by the program and are being marketed by a company or are being increased for sale. To conduct this breeding research, the program grows over 10,000 yield plots and 10,000 plant rows in the field annually.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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
216	Integrated Pest Management Systems

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Annual rotation of soybean with corn is a fundamental IPM tactic used to manage field crop insect pests - especially the western corn rootworm, a corn pest that adapted its behavior to the predictable annual alternation of host availability to circumvent management via crop rotation. Soybean fields are principal locations for the monitoring and 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] and brown marmorated stinkbugs, as well as specific soybean pests and beneficial insects, such as lady bird beetles that will be affected by foliar insecticide applications that are intended to target WCR, JB, or soybean insects. Movement patterns play important roles in determining the severity of WCR and JB pest impacts in crop fields.

What has been done
We have conducted annual soybean pest/insects in soybean field abundance monitoring since 1998. The 2017 WCR abundance per sweep in soybean [0.025 ± 0.003 WCR/sweep ± SEM] increased marginally over that of 2016 [0.016 ± 0.003 WCR/sweep ± SEM]. The local summertime population of WCR in soybean continues to rebound from extreme lows in 2015 following severe flooding. Though increasing, the 2017 population is still far below the recent [2014] peak collection rate of 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. Though numerically greater, the mean August collection rate [0.03 ± 0.005] was not significantly greater than that in July [0.021 ± 0.004]. A total of just 84 beetles were collected in a total of 3,400 sweeps. This pales in comparison to 2005-2006 collection rates in Champaign County [0.73 beetles per sweep] and the over 1.5 WCR per sweep in 2004; the current WCR abundance is increasing, but remain incredibly low compared to historical patterns. Extremely low WCR abundance in soybean fields makes it difficult to justify use of corn rootworm Bt hybrids in rotated corn - there are not economic populations present in soybean fields.

Local surveys of Bt corn hybrids planted in 22 rotated cornfields near the research site show a very high adoption [95 percent] of corn varieties expressing one or two Bt traits designed to prevent feeding by rootworm larvae. Use of these Bt hybrids is completely unjustified based on WCR abundance as measured in the landscape. The 2017 JB abundance [0.014 ± 0.003/sweep ± SEM; n=47 total beetles] was essentially unchanged from 2016 [0.013 ± 0.003 /sweep]. Bean leaf beetles [BLB] are another important potential pest; their 2017 abundance [0.051 ± 0.006 /sweep; n=173 beetles] declined from that in 2016 [0.091 ± 0.006 /sweep]. It has been many years since BLB experienced high abundance. Only 42 JB and 301 BLB were collected. One insect that has a great potential to justify soybean treatment with insecticide is the soybean aphid; soybean aphids were not observed in the field until a few individuals were detected in late September. 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. It is notable that brown marmorated stinkbugs are being detected at an increasing rate in the local area, yet they were not detected at the field location. These insects have the potential to complicate both soybean and corn pest management if they increase in abundance.

Results
WCR numbers are slowing increasing at our field location. We believe that high rates of Bt corn adoption in rotated cornfields play an important role in reducing the background abundance of WCR. A survey of local cornfields within 1.0-1.5 miles of the "Lost 40" study field located in

Urbana, Illinois found that 95% were planted with Bt hybrids expressing one or more toxins targeting corn rootworms. In spite of low populations of WCR since 2015, and evidence for local development of Bt resistance to hybrids expressing all of the available single Bt traits, 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 is present at much less than the economic threshold] since it selects for resistance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The evolution of weed biotypes and populations demonstrating resistance to herbicides continued to increase across many areas of Illinois during 2016. Currently in Illinois, biotypes of 12 weed

species have been confirmed resistant to one or more herbicide mechanisms of action. Resistance to herbicides that inhibit the ALS enzyme is the most common type of resistance in Illinois. Waterhemp has evolved resistance to more herbicide mechanisms of action than any other Illinois weed species, including resistance to inhibitors of acetolactate synthase [ALS], photosystem II [PSII], protoporphyrinogen oxidase [PPO], enolpyruvyl shikimate-3-phosphate synthase [EPSPS] and hydroxyphenyl pyruvate dioxygenase [HPPD], and synthetic auxins. Perhaps even more daunting is the occurrence of multiple herbicide resistances within individual plants and/or fields. Research conducted within this project has included both field and greenhouse components that have furthered our understanding of herbicide resistance in Illinois Amaranthus populations. Research was initiated in 2013 to characterize a waterhemp population from east-central Illinois that was not effectively controlled in the fields with foliar-applied herbicides from two different site-of-action categories. Seeds of the putative resistant population were collected and plants generated under greenhouse growing conditions. Uniformly-sized plants were treated with various doses of foliar-applied herbicides from six different site-of-action categories.

What has been done

Results of this experiment revealed that waterhemp mortality was very low and that the majority of treated plants survived four of the five herbicides evaluated. Survivorship was high and plant injury was low following application of herbicides from the following site-of-action categories: ALS, PPO, PSII, and HPPD. Plant mortality was high following application of glyphosate and intermediate mortality was observed following application of dicamba. Two other waterhemp populations from central Illinois were screened for resistance to HPPD-inhibiting herbicides. Greenhouse results demonstrated each population contained plants that survived following foliar applications of tembotrione, atrazine, or imazethapyr applied at rates twice the labeled application rate. However, the frequency and magnitude of resistance to the HPPD-inhibiting herbicide tembotrione were not as high as observed in a previously-characterized HPPD-resistant waterhemp population from McLean County. Additionally, one population of Palmer amaranth was collected in east-central Illinois and screened for resistance to herbicides from three site-of-action categories. Results indicate treated plants were sensitive to all herbicides.

Results

Additional research was conducted with a waterhemp biotype that was not effectively controlled with herbicides from five site-of-action families. Results from herbicide dose-response experiments conducted in the greenhouse indicated this biotype demonstrated 16-fold, 30-fold, and 253-fold resistance to HPPD inhibitors, synthetic auxins, and PSII inhibitors, respectively, compared with a sensitive control population. Molecular analysis of the genes coding the target site proteins for PPO and ALS inhibitors revealed mutations previously documented to confer resistance to herbicides from these site-of-action families. Further characterization of this waterhemp population began in 2016. Results suggested a differential response of the population to soil-applied S-metolachlor and acetochlor, two Group 15 herbicides. While it is widely accepted that acetochlor is, in general, more effective on waterhemp than S-metolachlor, results in 2016 indicated the level of control with S-metolachlor was less than expected, while the level of control with acetochlor was greater than expected. These field experiments will be supplemented with greenhouse experiments to determine if the observed differential response is related to edaphic or plant factors. A dose-response experiment conducted with dicamba resulted in approximately 30 percent of the plants surviving 560 g ae dicamba ha-1. Dicamba previously has been effective against this population, but control in 2016 was much less than expected. Seeds were collected from approximately 30 female waterhemp plants that survived dicamba, and greenhouse dose-response experiments are being planned for progeny generated from these female plants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
206	Basic Plant Biology
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #8

1. **Outcome Measures**

Development Of Alternative Soybean Disease Management Strategies

Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

Identification Of New Microbial Pathogens Of Plant Parasitic Nematodes Important In Illinois

Not Reporting on this Outcome Measure

Outcome #10

1. **Outcome Measures**

Number Of Individuals Increasing Knowledge Related To Detecting And Managing Invasive Pests and Plants

2. **Associated Institution Types**

- 1862 Extension

3a. **Outcome Type:**

Change in Knowledge Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	200

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 seven [7] 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 participant awareness of current and emerging invasive plants, pathogens, and 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 "Invasive Species and Human Health Risks", "Oak Diseases", "Forest Pests", and an "Overview of First Detectors - The Success of the Program, Roles, and How to Report". Extension specialists delivered course elements for pests that included identification, life cycle/biology, hosts, sampling, management, and regulation. Following the training, 200 of the 239 participants completed an evaluation. About 25% of respondents indicated that they attended a First Detector training previously. Respondents were asked to compare their degree of understanding of workshop topics before and after the training sessions using a 5-part scale [1 = "Very Little", 5 = "A Lot"].

Results
All [200] respondents reported an increase in knowledge within at least one topic area. Based on a comparison of mean scores between pre-program and post-program knowledge, the greatest knowledge gains were in the areas of how to report invasive species [90% increase from mean score pre-program = 2.42 to post-program = 4.58], managing human health risks associated with invasive species [85% increase from mean score pre-program = 2.33 to post-program = 4.32], and sampling procedures for Oak diseases [83% increase from mean score pre-program = 2.28 to post-program = 4.19]. All post-program mean ratings exceeded 4.00 on the 5 point scale.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants

Outcome #11

1. Outcome Measures

Number Of Individuals Implementing Practices Related To Lawn And Garden Plant Systems

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

Studying Complex Traits In Maize

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In addition to the economic importance of maize, the vast genetic resources make it an ideal system for studying complex traits. Surprisingly, maize has long been overlooked as a model for studying photosynthesis. While dicot species have been extensively studied, previous research has not focused on grasses that utilize C4 photosynthesis as the primary method of carbon fixation [which include many of the most productive crop species, including maize]. The goal of this project is to identify leaf traits, and the genes that control these traits, in maize and related grasses that alter photosynthesis and transpiration. These findings will be incorporated into elite germplasm and tested under agronomically relevant conditions. Both discovery and applied approaches will enable the development of maize that can better adapt to the changing global climate.

What has been done
Data from whole genome resequencing of the Lambert reduced leaf area mutants [rdla] identified several introgressed regions common in the two backcross lineages. Thus, five backcross generations were not sufficient to identify a single region. We have generated the BC6 lines, and will continue the backcross process, but are also exploring other routes to speed up mapping. Though time consuming, additional generations are being grown in the greenhouse, which enables us to grow three generations a year. The identification of the underlying gene will greatly enhance our ability to test the rdla mutation in additional backgrounds and understand its biological function.

Complementation tests between the Lambert rdla mutant and known leaf area mutants from the Maize Genetic Coop collection have thus far indicated that the Lambert rdla mutation is unique. We were also able to perform in depth characterization of the rdla mutant in field and growth chamber studies. Interestingly, the rdla phenotype is not present in juvenile leaves. We have made crosses with glossy15 mutants to investigate the relationship between the onset of rdla and

the juvenile to adult transition. The timing of the rdla phenotype has agronomic implications related to canopy light interception and row cover. Gas exchange physiology was used to determine that in an inbred background the rdla mutation does not affect net photosynthesis or transpiration on a per area basis. However, leaf images have shown that there is a cell size difference between rdla mutants and wild-type. This cell size difference will be quantified and replicated in an additional generation.

Results
The characterization of the rdla mutation in an inbred background has thus laid the foundation for exploring its effects in a hybrid. Previous reports indicate that the rdla increases yields in a hybrid background under three different planting densities compared to wild-type hybrids. Our results indicate that this may be due to an optimization of plant architecture and/or harvest index. We will generate hybrid seed to repeat these experiments using an expanded set of planting densities, and also using different row spacing. We will also begin introgressing the rdla mutation into ExPVP germplasm to make agronomic comparisons more relevant to current commercial germplasm. The rdla mutation may represent a single gene that effects key traits related to high planting density and row spacing tolerance which will be important for future agricultural systems.

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

Outcome #13

1. Outcome Measures

Developing A More Economical Source Of Natural Colorants

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increasing consumer demand for natural ingredients in foods and beverages has necessitated a

more economical source of natural colorants.

What has been done
In this study, 398 genetically diverse pigmented accessions of maize were analyzed using HPLC to characterize the diversity of anthocyanin composition in maize germplasm. These accessions were then categorized based on the abundance of pigments in the aleurone or pericarp layers and on compositional variations. Aleurone categories were divided on whether the kernels appeared blue or pink, a trait determined chemically by the abundance of either cyanidin or pelargonidin anthocyanins and genetically by the purple aleurone1 [Pr1] gene. Pericarp categories were divided based on the presence or absence of flavanol-anthocyanin condensed forms.

Results
The major finding was that the highest performing category in terms of total anthocyanin content was pericarp-pigmentation with condensed forms. Breeders should focus on adapting Andean maíz morado landraces to the Midwest to create purple corn hybrids. This study represents the most comprehensive screening of pigmented maize lines to date. Information from this study will provide information to plant breeders looking to develop anthocyanin-rich purple corn hybrids as an economic source of natural colorants for food and beverages.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology

Outcome #14

1. Outcome Measures

Identifying Important Genes And Proteins That Confer Safener-Induced Tolerance In Grain Sorghum

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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]. Our project aims to shed new light on important genes and proteins that confer safener-induced tolerance in grain sorghum using a diverse array of methods that are described below.

What has been done
Several 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. 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 conducted during the Summers of 2015 and 2016 to evaluate the effectiveness of pyroxasulfone for weed control under field conditions as well as determine its effect on stand count and final grain yield, with or without fluxofenim seed treatment.

Results indicated that pyroxasulfone enhanced grass and dicot weed control [relative to S-metolachlor, 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. In general, however, significant effects on final grain yield were not detected. This finding indicates that grain sorghum plants may be able to compensate for early season injury and stand count reductions by increasing the numbers of tillers per plant and/or grain test weight.

Results
Using a genome-wide association study [GWAS], 800 diverse sorghum lines were evaluated for phenotypic differences in herbicide tolerance, and the expressions of two candidate SbGST genes identified via GWAS were investigated further via gene-specific RT-pPCR. Greenhouse studies were conducted with preemergence pyroxasulfone and S-metolachlor, plus or minus the safener fluxofenim applied as a seed treatment or soil drench, 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 these SbGSTs in three sorghum genotypes at 4, 8, or 12 HAT [normalized to three stably expressed reference genes] indicated that expression of each SbGST gene increased within the twelve hour period following safener treatment. However, expression levels and kinetics of induction by safener 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 genes and/or other genes encoding metabolic detoxification enzymes that may also play a role in safener-regulated herbicide tolerance in grain sorghum. Identifying effective herbicide x safener combinations is an ongoing challenge that limits grain sorghum production in the U.S., but understanding the biochemical and molecular basis of safener-induced detoxification responses via this research will facilitate the discovery of new crop protection

chemicals for enhancing herbicide tolerance in cereal crops, as well as assist in developing marker-based screening assays to identify sorghum lines with an increased safener response or abiotic stress tolerance.

4. Associated Knowledge Areas

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

Outcome #15

1. Outcome Measures

Improving Domesticated Asian Rice With Genes From Its Wild Relatives O. Longistaminata And O. Rufipogon

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Rice is critically important for the food security of humanity. This collaborative study between the University of Illinois, the Yunnan Academy of Agricultural Sciences [YAAS], and the International Rice Research Institute [IRRI] will improve domesticated Asian rice [O. sativa] with genes from its wild relatives, O. longistaminata and O. rufipogon. In particular, we will: [1] Conduct high-density genotyping on an already established O. sativa x O. longistaminata recombinant inbred line population that has been found to be segregating for leafroller resistance, thereby facilitating marker assisted selection for this important trait; [2] Determine genetic diversity and population structure for a collection of more than 200 accessions of O. longistaminata; [3] Quantify genotypic variation within O. sativa and O. longistaminata for interspecific crossability and develop new interspecific hybrids; and [4] Conduct studies to improve cold hardiness in rice.

What has been done

A visiting scholar from YAAS will be trained at the University of Illinois to conduct the genotyping and map genes associated with traits of interest such as leafroller resistance. The genotyped recombinant inbred line population and new interspecific hybrids will also be a valuable genetic resource for future work to introgress genes for many different and desirable traits from O. longistaminata into O. sativa. Additionally, populations will be evaluated for cold tolerance during seedling stage and at flowering. Crosses will be made between a high-ratooning but non-cold-hardy selection from this population [PR23] and donors of cold tolerance, thereby linking work at the University of Illinois with work at IRRI and YAAS.

Results

A high-density genetic map was developed for a population of more than 300 RILs from a cross between O. sativa and O. longistaminata. Phenotyping for leafroller resistance was initiated. Additionally, a germplasm panel of approximately 200 accessions of O. longistaminata was genotyped via RAD-Seq to obtain thousands of SNP markers. The panel was also screened for tolerance to low temperature and tolerance to high salinity; the data indicate that this species has individuals with exceptional tolerance to both abiotic stresses, which will be valuable for improving cultivated rice. Cultivars of rice were also screened for seedling stage cold tolerance. An analysis of population structure was conducted for O. longistaminata and distinct genetic groups were identified. The relationships between O. longistaminata and the two domesticated rice species, O. sativa and O. glaberrima, were also clarified.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #16

1. Outcome Measures

Assessing The Effects Of Crop Rotation And Tillage On Soil Properties And Crop Yields

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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 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
Three studies were undertaken:

To determine the relative yield of all crops in wheat-corn-soy, wheat-soy-corn, corn-soy, continuous-corn, and continuous soybean rotations at three locations in Illinois. Objective One: Crop yields in five sequences [continuous corn, continuous soybean, corn-soybean, corn-soybean-wheat, and corn-wheat-soybean] were measured at two Illinois sites from 1998 through 2017. At a third location, all sequences except continuous soybean were included, all under no-till, from 2002 through 2016. This database is of great value as producers search for information needed to decide what sequence will better provide a stable return in income. A current impact comes from using these findings to predict the effect of growing soybean following soybean, which some producers are doing as soybean gains area in the U.S.

To assess the effect of tillage [tilled and no-till] on yields and timing of operations in these rotations. Objective Two: This objective was incorporated into the rotation experiment described under Objective One at the two locations where continuous soybean was included. These data have been accumulated and analyzed and have been made available to producers and professionals to help make the complex decision about whether or not to adopt no-till methods of production.

To maintain trials at six Illinois sites to compare corn-corn-soybean with continuous corn and with the corn-soybean rotation. Objective Three: This objective was fully met; data on each phase of continuous corn, corn-soybean, and corn-corn-soybean were collected over a period of more than ten years at each of six sites. Three of the sites were closed as research centers, with the last year of data collection in 2015; the other three sites were intact through 2017. While corn following corn is not as common in recent years as acreage of soybean has increased at the expense of corn acres in Illinois, the data we produced comparing yields of these three sequences have proven valuable for those deciding how to allocate farmland to different crop sequences. This study filled a gap in knowledge about how each crop in the corn-corn-soybean sequence responds in comparison to the corn-soybean and continuous corn sequences.

Results
Rigorous assessment of the effects of crop rotation and tillage on soil properties and crop yields

has rarely been done, leaving a void in the information needed to help move producers to more profitable and sustainable crop production sequences and practices. The studies completed under this project have provided the information needed to fill this gap in knowledge. In addition, one experiment conducted under this project attracted funding under the NIFA Sustainable Corn CAP and provided the venue for conducting soil quality and greenhouse gas emission measurements.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
206	Basic Plant Biology

Outcome #17

1. Outcome Measures

Updating Information On The Effect Of Inputs On Crop Yields To Improve Producer Decision Making

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Achieving and maintaining high crop yields is at the heart of competitiveness of Illinois agriculture in the nation and the world. With outstanding soil and human resources, Illinois is well-positioned to maintain its preeminence among crop-producing states. But in order to accomplish this, management practices must constantly be adjusted to reflect changes in cultivars, markets, and available technology. One practice that has gained widespread acceptance in recent years is the use of foliar fungicides on corn [and to a lesser extent on soybean], not only to manage developing fungal diseases, but also to maintain "plant health" [a euphemism for physiological effects] and thereby increase yield, particularly when the crop is under stress. Our preliminary work on this has produced mixed results, with no consistent increase in yield when disease pressure is low or absent. We simply must have better answers to guide the use of a costly practice that counters the IPM approach to management. This project will help provide solid answers to real questions that farmers continue to face as they adjust to new demands and opportunities in grain crop production. New options must be evaluated, and optimum practices

determined in order to prevent deterioration in the state's competitive advantage in grain crop production efficiency. Public welfare is directly increased when farmers, informed about technological options, can make decisions that increase efficiency, stabilize production, and lower food costs. This project will produce information needed to bring this about. At the same time farmers receive this information, publication in scientific journals will assure that this knowledge is available to the scientific community.

What has been done
Four studies were undertaken as part of this project:

To determine the effects of planting date and plant population on yield of recent corn hybrids, with the view toward formulating new planting and replanting guidelines. Objective One: We have conducted a long series of plant density trials using different corn hybrids, with more studies possible and greater data quality resulting from the use of precision plot planters over the past six years. We have accumulated density response data over some thirty site-years over the past six years involving some thirty different corn hybrids. The value of these data consist of both the response to density over a wide range of soil and weather conditions and to the overall response, which we use to predict optimal densities for producers. We have also made use of these data to simulate the value of site-specific density in planting by utilizing responses from different trials as responses within a single field. This allows the estimation of using a single density within a field compared to varying density by zone.

To assess foliar fungicide effects on corn planted at different times. Objective Two: We have completed more than ten corn fungicide trials over the past five years, with different products and with different application times as allowed by product labels. Data have been analyzed, assembled, and presented to audiences who are faced with the decision of whether or not to invest in fungicide application for corn. The response to fungicide is rather unpredictable, and so larger numbers of trials are needed to derive estimated return to fungicide application as the price of corn grain changes.

To assess the effects of plant damage on corn yield. Objective Three: The goal of assessing the effects of plant damage on corn grain yield was fully met by establishing complex trials annually over the past decade. Many of these trials are in conjunction with the crop hail industry, and include collaboration with scientists in other states. These trials are designed to assess damage effects in order to make predictions about yield loss before the crop is harvested. The resulting assembly of new data helps us to understand environmental responses of the crop to damage such as leaf and stand loss, and is used as a basis for assessing hail damage, thereby improving the performance and pricing of insurance against such damage.

To determine the effect of hybrid, N rate, and plant density on yields of corn. Objective Four: This goal was fully met by the completion of a two-year study conducted at three sites, with each trial comprising a combination of four hybrids, four nitrogen rates, and three plant densities. Data from the six sites divided neatly into three low-stress sites and three higher-stress sites, with very different responses between the two groups. These data were analyzed and assembled into an MS thesis by a graduate student and have been presented a number of times to professional audiences and crop producers. They helped to dispel the widespread idea that high corn plant densities require more nitrogen, thereby improving economic and environmental outcomes for corn production.

Results

The effects of inputs and input rates on crop yields need to be updated as crop cultivars and production techniques change over time. This project has fulfilled this need, and has provided a sound foundation on which producers can make decisions regarding inputs. As an example, many seed suppliers and others promoted the idea that corn plant density needs to be raised, with densities in excess of 100,000 plants per hectare being promoted in some cases. Our recent findings are that densities in the range of 75,000 to 80,000 are almost always adequate for high yields, with little return to raising these higher.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

An end of program evaluation form was completed by 200 of the 239 participants across seven **First Detector** programs delivered throughout the state. About 25% of respondents reported having attended a First Detector training in a prior year and were therefore returning learners. Respondents were asked to compare their degree of understanding related to topics addressed in the one-day workshop. Self-reported knowledge associated with each topic before and after the program was rated using a 1 to 5 scale [1 = "Very Little", 5 = "A Lot"]. Topics included "Invasive Species and Human Health Risks", "Oak Diseases", "Forest Pests", and an "Overview of First Detectors - The Success of the Program, Roles, and How to Report". All 200 respondents reported a higher knowledge rating [in at least one topical area] in their post-program rating, compared with their pre-program rating. On average, respondents rated their knowledge of all topics very high at the end of the training, with an group knowledge mean score of 4.00 or more in every topic area.

In the area of Invasive Species and Human Health Risks, there was an 85% change in knowledge of "Managing Health Risks" based a group mean knowledge score of 2.33 pre-program and 4.32 post-program. Within the area of Oak Diseases, there was an 83% increase in mean knowledge rating for "Sampling" from pre-program [2.28] to post-program [4.19]. Every knowledge mean score associated with topics in the area of Forest Pests increased by 70% or more from pre-program to post-program. Finally, the greatest increase in knowledge overall was in the topic of "How to Report" with an 90% increase in mean knowledge score from pre-program [2.42] to post-program [4.58].

Key Items of Evaluation

All 200 **First Detector** training respondents reported an increase in knowledge related to invasive plant and tree pests. Given their role in helping other people address tree and plant care issues, they collectively forecasted the potential to reach an additional 35,000 individuals.

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	10%		15%	
136	Conservation of Biological Diversity	10%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		15%	
206	Basic Plant Biology	30%		15%	
402	Engineering Systems and Equipment	30%		15%	
601	Economics of Agricultural Production and Farm Management	10%		10%	
606	International Trade and Development Economics	0%		10%	
610	Domestic Policy Analysis	0%		10%	
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: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.0	0.0
Actual Paid	0.8	0.0	13.4	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
27702	0	277771	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
27702	0	277771	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
208375	0	2180069	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities included an effort to apply systems thinking to combine deconstruction, hydrolysis, and microbiology to develop an efficient, cost-effective system for converting biomass into biofuels, 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, an effort to covert biowaste into biocrude oil via hydrothermal liquefaction, a study to improve our understanding of increased fouling in maize processes [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], and research consisting of three related projects focusing on the economic aspects of biofuel production [investigating the technical and economic potential for sugarcane ethanol production in Brazil and its land use implications, examining optimal policy in cellulosic biofuel production and the effectiveness of alternative policies in promoting cost-reducing innovations, and examining the effects of riskiness of energy crops compared to conventional crops and its implications for crop, contract, and location choices for refineries].

Research activities also included several studies to examine the incentives of farmers to adopt perennial energy crops and to determine the amount of land they would be willing to allocate to these crops [perennial energy crops are a promising source of bioenergy whose 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], a project that seeks to acquire information about genes and their expression for traits important to both economic and environmental sustainability in crop systems, research with the overall goal of assessing the potential of telomere manipulation in plant improvement with regard to adaptation to global climate change and increasing yield of both food and fuel endpoints, the development of a genetic modification system for the solvent producing clostridia to produce renewable chemicals [the use of mycotoxin contaminated corn for non-food fermentation based applications has been verified for the production of value-added chemicals], and research that represents one of the first field experiments to explicitly evaluate how biofuel crops affect animal movement and landscape connectivity.

Conference presentations included the American Society of Agronomy, Illinois Nutrient Loss Reduction Strategic Meeting, American Society of Agricultural and Biological Engineers, American Society of Chemistry, American Society of Chemical Engineers, American Association of Cereal Chemistry, International Heat Exchanger Fouling and Cleaning XII, 3rd iSEE Congress, Energy 2030: Paths to a Sustainable Future, 8th Biennial Forestry and Agriculture Greenhouse Gas Modeling Forum, Yangling International Agri-Science Forum, Green Business Forum for Asia and the Pacific: Investing in a Sustainable Future, Biobased Industry Center Workshop, Workshop on Corporate Social Responsibility in

India: Incentives and Effectiveness, Agricultural and Applied Economics Association Workshop, 23rd Annual Conference of the European Association of Environmental and Resource Economists, and the Maize Genetics Conference.

An exciting development in 2017 for this planned program was news that a new grant was awarded to Extension from the Illinois Science and Energy Innovation Foundation based on a proposal prepared and submitted by the Energy and Stewardship Team of Extension educators. The **Smart Grid/Smart Meter** grant will support creating a basic outreach module centered on consumer energy use and smart meter technology to be used in Illinois. The **Illinois Energy Education Council** staff will work with Extension educators to develop content and materials for the new program. The **Illinois Energy Education Council** is a cooperative effort of University of Illinois Extension and investor-owned electric utilities, rural electric cooperatives, and municipal power suppliers. Other outreach activities for the **Illinois Energy Education Council** included regular updates to their website as a source of information to increase energy efficiency through presentations, videos, games, and links.

An Extension educator contributed again this year to the **Northern Illinois Renewable Energy Summit and Expo**. The display featured a comparison of rural energy efficiency and urban energy efficiency opportunities. A need for information addressing this topic was expressed by the event coordinator. Sustainable alternative energy sources remained a priority for 119 youth enrolled in a **4-H Wind Energy** project.

2. Brief description of the target audience

Members of the target audience included dry grind ethanol producers and cellulosic ethanol producers, agricultural crop and plant scientists, agricultural crop production professionals and producers, policy makers and governments, those with interests in the biorefinery industry and in developing the bioeconomy [including fuel ethanol production facilities as well as researchers working on improving efficiency of fuel ethanol production], industry analysts, congressional staff, farmers, academics, students, scientists engaged in studies of the structure and function of genomes for C4 grasses used for bioenergy production, scientists conducting research about plant responses to environmental stress, wildlife ecologists, agronomists, land managers, and members of the general public interested in biofuels.

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

3. How was eXtension used?

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

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1426	1329	706	0

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

Patent Applications Submitted

Year:	2017
Actual:	2

Patents listed

[2016-233-01] Improved Dry Grind Corn Process For Bioethanol Production; [2016-237-01] Methods And Compositions For Ethanol Production

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	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
2017	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Understanding The Causes Of Evaporator Fouling In Maize And Ethanol Production Systems

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Economic Analysis Of The Implications Of Cellulosic Biofuel Production

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The proposed research will consist of three related projects that extend ongoing research in this area. First, we will investigate the technical and economic potential for sugarcane ethanol production in Brazil and its land use implications. Second, we will examine optimal biofuel policy in the presence of learning by doing 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 will examine the effects of riskiness of energy crops compared to conventional crops and its implications for crop, contract, and location choices for refineries.

What has been done
We published Volume II of the Handbook of Bioenergy Economics and Policy. This book demonstrates that two biofuel sectors - corn ethanol in the U.S. and sugarcane ethanol in Brazil - have emerged and achieved maturity. Political economic motivations led to the establishment of these industries and they reflect different weights given to energy security, reduction of GHG emissions, food security, and biodiversity. The analyses also suggest that there is significant potential to increase the production of biofuels both in the form of sugarcane in Brazil as well as through the introduction of cellulosic biofuels. However, the evolution of the industry and its future depends heavily on government policy choices.

Selection of policy instruments depends also on regulatory procedures and measurement criteria. While political economic considerations have and will continue to weigh heavily on policy choices, the analysis in this book suggests that some policies have resulted in significant inefficiencies. Policies that augment market processes and reflect societal values on measurable outcomes, for example a carbon tax, tend to result in more efficient outcomes. It also seems that there is societal gain from investment in research to improve the production and processing of biofuels. However, the political economy implications may not be desirable. Nevertheless, the various chapters of the book were able to identify policy designs that allow for the improvement over current policies both of economic welfare as well as of other societal objectives. Nevertheless, there remains a large space for future research that informs policy choices as new information is discovered.

Results

The book also suggests that one of the main constraints for the development of the biofuel sector is the debate about indirect land use change. The bulk of the analysis suggests that the early estimates of ILUC were overestimated and that the lion's share of the greenhouse gas emission impact of biofuels is captured by its direct effects. Thus, it is likely that sugarcane ethanol and some forms of cellulosic ethanol [especially as their processing becomes more efficient] will make a significant contribution to reduce GHG emissions, while corn ethanol will continue to make a modest contribution to reduce GHG emissions compared to the fossil fuels it replaces. Thus, GHG emission considerations should not serve as barriers to further utilization of biofuel technologies but should rather be incorporated in policy design so that biofuel feedstocks can be rewarded based on their relative merit.

While the analysis suggests that the magnitude of ILUC is rather modest, other rebound effects through fuel markets are quite significant. Since climate change is a global issue, local policies that aim to address climate change may be less impactful. This prompts the need to develop a coordinated framework in order to achieve the common goal of reducing GHG emissions globally.

One of the important features of biofuels is that their production requires a sequence of processes that are carried out by several industries. Therefore, unlike more traditional analyses of environmental and resource issues, the analysis here emphasizes supply chain-related aspects. In particular, an understanding of the economic considerations of alternative designs of a supply chain is important for the adoption and evolution of different forms of biofuels as well as design of policies to induce and regulate the biofuel sector. Understanding supply chains also serves to develop a more comprehensive and effective life cycle analysis of the various impacts of biofuels. The emphasis on supply chains and interconnectedness between different segments of the biofuel sector can provide insights and lessons for analysis of other sectors of the economy.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
601	Economics of Agricultural Production and Farm Management
606	International Trade and Development Economics
610	Domestic Policy Analysis
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #3

1. **Outcome Measures**

Toward An Improved Understanding Of How Biofuel Crops Will Impact Habitat Connectivity

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Breeding Miscanthus Cultivars With High Yield Potential In The Midwest

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

Increased Knowledge Of Biomass Energy Production And Use

2. **Associated Institution Types**

- 1862 Research

3a. **Outcome Type:**

Change in Knowledge Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	0

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

Issue (Who cares and Why)
Perennial energy crops are a promising source of bioenergy whose 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 several studies to examine the incentives of farmers to adopt these crops and to determine the amount of land they would be willing to allocate to these crops.

What has been done
We find 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 are less robust across specifications. The effect of conventional crop insurance on the energy crop adoption decision differs across types of insurance. In particular, farmers with revenue insurance are statistically significantly less likely to adopt an energy crop.

Results

Our results have implications for the design of effective contracts and policy incentives to induce the production of energy crops. We also examined the design of policies to encourage adoption that minimize the total [public and private] costs and land requirements of providing biomass for meeting a one-billion-gallon biofuel mandate by using miscanthus as feedstock. We find that a high degree of risk aversion, high discount rate, credit constraint, and availability of crop insurance for conventional crops can increase the cost of producing enough biomass for a one-billion-gallon biofuel mandate by up to 43% and increase the land required by 16% as compared to otherwise. Removal of subsidized crop insurance and credit constraints could lower these costs by 50%. We found that in most cases the cost-effective energy crop insurance subsidy rate is 0% while the cost-effective establishment cost subsidy rate is 100%. Relative to the case with no policy intervention for energy crops, energy crop insurance can reduce the total costs [net of government expenditures] of meeting the 1 billion gallon mandate by 1.3% whereas an establishment cost subsidy can reduce these costs by 34%.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
601	Economics of Agricultural Production and Farm Management
610	Domestic Policy Analysis
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #6

1. Outcome Measures

Acquiring Information About Genes And Their Expression For Traits Important To Economic And Environmental Sustainability

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Genetic improvements offer significant potential to improve the economic and environmental sustainability of agricultural systems. These genetic improvements may be directed at increasing harvestable energy, reducing production inputs, enhancing tolerance to abiotic or biotic stress factors, or adding value to products or processing streams. Many of our important crop species have been subjected to intensive genetic improvement programs, whereas other plants species possess desirable attributes whose biological basis is currently poorly understood. Furthermore, knowledge of the genetic control of valuable traits in one plant species may be transferrable to other crops through molecular breeding or synthetic biology methods.

Recent advances in methods for low-cost and high-throughput DNA sequencing now enable rapid acquisition of information about genetic diversity and variation in gene function for essentially any plant species and trait of interest. Deep sequencing technologies have been developed that can explore a number of different levels of genome organization and regulatory control, and thus are now becoming the preferred method to discover genes and characterize their function. The data from such studies is also directly applicable to genetic improvement programs. This project aims to acquire information about genes and their expression for traits important to both economic and environmental sustainability in crop systems.

What has been done

Tissue samples were collected from maize plants that were grown with different levels of soil nitrogen supply in nitrogen-responsive field plots. Two RNASeq experiments were conducted. The first experiment profiled nitrogen-responsive gene expression in leaves and developing ear tissues from the W22 inbred line, which is the genetic background for the two leading community resources for transposon-induced mutations in maize. This dataset serves as an important baseline from which to then assess how mutations in specific genes influence growth and physiological responses to soil nitrogen. The dataset also permits detailed comparisons to a similar dataset generated previously for the maize inbred line B73 to investigate genetic variation in nitrogen-responsive gene expression.

The second RNASeq experiment profiled gene expression changes in both leaf and ear tissues conditioned by a Mutator transposon-induced mutation in the maize ortholog of the APETALA1 gene [zap1-mum1]. This mutant line was selected for analysis because the ZAP1 gene, which encodes a MADS-box transcription factor, was identified in previous experiments as a regulatory gene whose expression profile throughout plant development was highly correlated with metabolic genes showing strong nitrogen-responsive gene expression.

Results

Analysis of the RNASeq data revealed three interesting findings. First, although the ZAP1 gene is expressed in both leaf and ear tissues, the mutant allele only reduced ZAP1 expression in leaf tissues, and this was associated with a delay in leaf senescence for mutant plants grown in the field. Secondly, relatively few genes were confidently identified as being N-responsive in either the W22 control or zap1-mum1 mutant. However, these genes were highly-enriched in NIN-like proteins known to mediate responses to nitrate in Arabidopsis, as well as genes that function in carbon and nitrogen metabolism. Finally, AP2/EREBP and WRKY transcription factors were found to be highly enriched among genes that showed differential expression between W22 control and the zap1-mum1 mutant, suggesting a regulatory network that may modulate leaf senescence in

response to nitrogen.

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

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 were conducted under this planned program in 2017.

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: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	0.0
Actual Paid	62.4	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**
2171783	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2171783	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
16336101	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

4-H Club enrollment in Illinois totaled 24,708 in 2017. Slightly more than 156,000 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, continued to focus efforts to create 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. Modest gains have been made to engage minority youth, and specifically youth of Hispanic ethnicity. Over the past five years, 4-H minority club membership is up 34% and 4-H Hispanic club membership is up 147%.

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 focusing on 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 [275] 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. For many teens, it was their first time on the University of Illinois campus and their first time to consider potential college majors and future careers. A new program, **Juntos**, was piloted with 58 participants throughout Illinois this year. This six session program is aimed at helping families of middle and high school students gain the skills and knowledge needed to be successful through high school, college, and in their chosen career.

Welcome to the Real World, a multi-disciplinary curriculum and simulation that allows youth ages twelve through eighteen to explore careers and money management [balancing income and expenses] in adult life, was delivered to 2,929 youth in 2017 [this activity is further 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 2017, over 1,700 youth and adult volunteers provided responses directed toward solutions including community gardens, meals for food pantry patrons, a weekend backpack program, canned food drives, meal packaging events, and creating mobile pantries. Through individual and collective efforts of the **Illinois 4-H Feeding & Growing Our Communities** outreach program, more than 100 food pantries in Illinois received meals in 2017 from the 4-H Feeding and Growing packaging events.

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 984 in 2017 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] team in supporting teens who taught the grant-funded **Junior Chef** program and the **Health Jam** program, reaching over 4,100 youth in 2017. 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. Across Illinois, 4-H participants enrolled in over 180,000 STEM-related projects and over 5,195 youth participated in one or more robotics focused programs. A pilot project in 2017 blended goals for STEM and environmental stewardship. The **Healthy Soils C.S.I.** [**Carbon Soil Investigation**] **Challenge** was piloted with 55 trained teen facilitators, who led 1,589 youth through 25 different Healthy Soils C.S.I. Challenge events in suburban and downstate locations. In Part One, teams of youth conducted prescribed soil analysis [visual,

slake, and chemical] to assess soil quality. In Part Two, the **C.S.I. Soil Sleuth** teams designed, built, and tested a 1:64 scale no-till planter. Feedback from teen facilitators and participants has been very positive. A final program of note, **4-H Incubation and Embryology**, was implemented by Extension educators who trained teachers to apply STEM in the classroom. In 2017, 13,029 youth were reported by teachers to have participated in either the Kindergarten-2nd grade or 3rd-5th grade level of the curriculum.

Building youth leadership skills is both a national and Illinois area of focus.The annual **Teen Leadership Conference** drew 59 high school teens and the **Jr. Leadership Conference** was attended by 96 middle school youth. Youth participants in **Speaking for Illinois 4-H** also demonstrated their skills in articulating the impact of the 4-H program to legislators. **Youth Science Ambassadors** [22 in 2017] were involved in leading and facilitating events like the annual **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 over 12,000 adult volunteers gave their time and talents to the 4-H Youth Development program in Illinois with approximately 4,244 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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	128544	0	290395	661449

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- No State-Defined Outputs Reported For 4-H Youth Development

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Youth Will Demonstrate Leadership Efficacy [Citizenship Common Measure Indicator]
2	Cumulative Effect Of 4-H Participation Through The Development Of Skills And Competencies In Making Choices, Forming Connections, Effectively Communicating, And Applying Content Results In Citizens Who Contribute To Their Community And To The World [Universal Common Measure Indicator]
3	Youth Will Demonstrate The Ability To Communicate Through Multiple Methods And Media [Universal Common Measure Indicator]
4	Youth Will Express Interest And Be Engaged In Science Related Activities [Science Common Measure Indicator]
5	Youth Participate In Community Service And Volunteer [Civic Engagement Common Measure Indicator]
6	Number Of 4-H Youth Applying Leadership Skills

Outcome #1

1. **Outcome Measures**

Youth Will Demonstrate Leadership Efficacy [Citizenship Common Measure Indicator]

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Cumulative Effect Of 4-H Participation Through The Development Of Skills And Competencies In Making Choices, Forming Connections, Effectively Communicating, And Applying Content Results In Citizens Who Contribute To Their Community And To The World [Universal Common Measure Indicator]

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Youth Will Demonstrate The Ability To Communicate Through Multiple Methods And Media [Universal Common Measure Indicator]

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Youth Will Express Interest And Be Engaged In Science Related Activities [Science Common Measure Indicator]

2. **Associated Institution Types**

- 1862 Extension

3a. **Outcome Type:**

Change in Knowledge Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the Department of Labor's Bureau of Labor Statistics, STEM fields have the greatest potential for job growth in the 21st century. Engaging youth early in scientific discovery is important for skills and interest to grow over time.

What has been done
The 4-H Incubation and Embryology project has been implemented 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. Curriculum development and training was provided to teachers by the Extension poultry faculty member and local educators. Evaluations were collected from 170 teachers who implemented the program in 2017. Collectively, respondents reported reaching a student population of over 13,029 students with the program. About 75% of teachers reported teaching Kindergarten - 2nd grade and 25% reported teaching 3rd - 12th grade. The goal of the evaluation was to use teacher observations to detect student changes in science abilities and life skills as a result of participating in the program.

Results
Using a 4-part scale [1 = "Not at All", 2 = "Sometimes", 3 = "Usually", and 4 = "Always"], teachers were asked to rate their students [as a group] with respect to science abilities and life skills before and after the program. Teacher ratings of students' pre-program science competencies were compared with ratings of students' post-program competencies. For every science skill rated, a higher proportion of teachers reported that their students "Usually" or "Always" demonstrated the skill after the program than prior to the program.

Using the same 4-part scale [1 = "Not at All", 2 = "Sometimes", 3 = "Usually", and 4 = "Always"], teachers were asked to rate their students [as a group] with respect to demonstration of specific life skills before and after the program. Teacher ratings of students' pre-program life skills were compared with ratings of students' post-program competencies for each life skill. For every life skill rated, a higher proportion of teachers reported that their students "Usually" or "Always" demonstrated the skill after the program than prior to the program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #5

1. Outcome Measures

Youth Participate In Community Service And Volunteer [Civic Engagement Common Measure Indicator]

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number Of 4-H Youth Applying Leadership Skills

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	89

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research shows that youth who engage in their communities become adults who are actively engaged. It is important to provide opportunities to enable youth to affect and influence others through their actions and ideas.

What has been done
The Illinois State 4-H Youth Leadership Team plans and leads the annual Illinois Junior Leadership Conference for 7th and 8th grade 4-H members. All activities and workshops are developed by the 4-H Youth Leadership Team teens in partnership with adult volunteers. This overnight conference offers a chance to explore new 4-H project areas, learn activities and games they can take home to their 4-H clubs, and learn and practice new leadership skills and interact with other 4-H members from around the state. Participants should leave with a better understanding of the opportunities available in the Illinois 4-H program and learn how to make a difference in their own communities. In 2017, 96 youth attended from 37 counties. Participants were asked to complete an end-of-conference evaluation to determine what they learned and what they will do as a result of new knowledge and skills.

Results
Nearly all [95 out of 96] of the conference participants completed the end-of-conference survey. The majority of respondents were in eighth grade [63%] and participated in the conference during one or more prior years [80%]. Using the a 4-part scale [1 = "Strongly Agree", 2 = "Agree", 3 = "Disagree", and 4 = "Strongly Disagree"], youth were asked to respond to a series of statements about self-efficacy to demonstrated leadership skills, what they learned during the conference, and to what extent they plan to translate that knowledge into action. Nearly all respondents [89 out of 95] agreed that "I feel more comfortable taking on leadership responsibilities" and 90% of youth agreed that "I plan to teach others what I learned". A significant majority [81%] indicated an intention to become a member of the Illinois State 4-H Youth Leadership Team when they are

eligible.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities
- Competing Programmatic Challenges
- 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 a University of Illinois poultry specialist in conjunction with state and local 4-H staff, 170 teachers responded to a survey asking them to share their perceptions of the impact of the multi-week **4-H Incubation and Embryology Program**. A reported 8,480 students in their Kindergarten-2nd grade classrooms and 4,549 students in their 3rd-5th grade classrooms participated in the program. Two surveys were tailored around grade level science skills learning standards for the two grade level groupings [5 science skills for K-2nd and 10 for Grades 3rd-5th].

Student science skills rated by K-2nd grade teachers included the ability to observe, predict, organize/order/classify, hypothesize, and compare/contrast. The largest gains noted by teachers in their K-2nd grade students were in ability to observe [49% increase from pre- to post-program], ability to predict [48% increase pre- to post-program], and ability to organize/order/classify [48% increase from pre- to post-program].

Student science skills rated by 3rd-12th grade teachers included the ability to collect data, evaluate, problem solve, summarize, interpret/analyze/reason, communicate/demonstrate, hypothesize, question, observe, and predict. The largest gains were in the ability to collect data [55% increase from pre- to post-program] and the ability to evaluate [55% increase from pre- to post-program].

For every science skill rated, teachers in both grade groupings [K-2nd and 3rd-5th] were more likely to report that their students "Usually" or "Always" demonstrated the science skill after the program compared with before the program.

Using the same 4-part scale [1 = "Not at All", 2 = "Sometimes", 3 = "Usually", and 4 = "Always"], teachers were asked to rate their students [as a group] with respect to demonstration of specific life skills before and after the program. For every life skill rated, a higher proportion of teachers reported that their students "Usually" or "Always" demonstrate the skill after the program than prior to the program.

Student life skills rated by K-2nd grade teachers included keeping records, planning/organizing, self-responsibility, learning to learn, teamwork, empathy, concern for others, and cooperation. The largest change in demonstration of life skills was associated with keeping records [52% increase from pre- to post-program]. Student life skills rated by 3rd-12th grade teachers included demonstration of critical thinking, keeping records, self-responsibility, decision-making, concern for others, cooperation, teamwork, sharing, personal safety, and making healthy lifestyle choices. The largest gains in demonstration of life skills were associated with critical thinking [49% increase from pre- to post-program], and keeping records [49% increase from pre- to post-program].

Teachers were also asked to query their students, through a show of hands, to gauge how their students felt about the program, about science and about their interest in a future job related to science. All teachers reported that the majority of students raised their hands when asked if they would like to do more activities like this in the future and over 60% of teachers reported that the majority of students raised their hands when asked if they would like to have a job related to science.

Teacher ratings of student life skills and science competencies suggest that the program was successful in supporting enhancement of science skills that are crucial building blocks for STEM-related careers. Students responded positively to the program and to interest in science-related careers.

Key Items of Evaluation

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, 170 teachers 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 8,480 students in their Kindergarten-2nd grade classrooms and 4,549 students in their 3rd-5th grade classrooms participated in the program. Two surveys were tailored around grade level science skills learning standards for the two grade level groupings [5 science skills for K-2nd and 10 for Grades 3rd-5th].

Teachers in both grade groupings [K-2nd and 3rd-5th] were more likely to report that their students "Usually" or "Always" demonstrated every science skill after the program than before the program. The largest gains in student science skills, observed by K-2nd grade teachers, were in the ability to observe, ability to predict, and ability to organize/order/classify. The largest gains in student science skills, observed by 3rd-5th grade teachers, were in the ability to collect data and the ability to evaluate.

Teacher ratings of student life skills and science competencies suggest that the program was successful in supporting enhancement of science skills that are crucial building blocks for STEM-related careers.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
4	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)	
32	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
3	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.