

2015 University of Illinois Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

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

The College of ACES is finding solutions to the world's most critical challenges in order to ensure abundant food and energy, a healthy environment, and successful families and communities. Through exceptional teaching, research, and outreach, ACES provides the public greater access to higher education with a focus on agricultural, consumer, and environmental sciences. ACES is recognized for excellent scholarship and program quality. Illinois is the largest food and agricultural economy in the region and the University of Illinois has some of the premier faculty and programs in the nation [even though state support for comparable programs is significantly lower in Illinois than in other Midwestern peer institutions]. External funding remains strong, in terms of grants and contracts, local support, development activity, and scholarship awards. Student placement and other parameters reflect strong program quality, and student enrollment has increased. So far, the college has kept its quality at a competitive level while losing faculty and staff capacity. Meanwhile, food, agriculture, natural resources, and related sciences have been recognized by our peers as fertile ground for additional faculty investment and expanded enrollment.

For several consecutive years, ACES has exercised fiscal discipline, increased student enrollment, and managed contraction of its human capacity and statewide organizational structure. However, the State of Illinois failed to enact a budget for FY 2016, which began on July 1, 2015, creating substantial uncertainty with respect to recurring state support for the University of Illinois. While many other state programs were funded by specific legislative and court actions, higher education has not been appropriated any state funds for FY 2016. Neither has the state acted on a budget for FY 2017. The university has taken certain austerity measures to contain costs, pending resolution of the state budget situation. No salary program was announced for FY 2016, nor was funding allocated to address compression, market, equity, and retention issues. Scenarios for cash rescissions and additional permanent reductions in state funding are being formulated. Although a late budget resolution could occur for FY 2016, the University of Illinois and the College of ACES covered current costs from cash reserves and other sources of revenue for a finite period. During FY 2015, aggregate expenditures by the college increased by 2.3% [+\$3,780,223] over the previous year, reflecting further rebuilding of the statewide Extension organization and sustained growth in research activity last year. Growth in expenditures will be constrained in the current and subsequent years due to rapidly declining state support and cyclical economic conditions affecting industry support and commodity sales.

The Illinois Agricultural Experiment Station [IAES]

The Office of Research aligns the research mission of ACES with the Illinois Agricultural Experiment Station [IAES], which operates as a statutory state-federal partnership, strategically promoting investment in research that is balanced between discovery and application, and between long-term and short-term outcomes, to increase fundamental knowledge and ensure relevance to the state's food, agricultural, environmental, and human interests. This encompasses research projects in ACES and in other academic units, including the Colleges of Veterinary Medicine, Engineering, LAS, and Law, as well as the Prairie

Research Institute. The IAES also supports research with partners in other institutions and cooperates with the USDA's Agricultural Research Service [ARS], which has permanently assigned a number of scientists to the Urbana campus.

The IAES administers federal formula funding provided to Illinois through the USDA National Institute of Food and Agriculture [NIFA]. Prorated allocations of Hatch Act formula funding are invested centrally by the college or allocated to academic departments. The Office of Research also oversees the research programs funded from grant, contract, donor, and university sources. The IAES coordinates with other state agricultural experiment stations across the country and with USDA/NIFA to effectively utilize federal capacity to undertake research and education related to food, agriculture, communities, and the environment. The Consolidated Appropriations Act of 2016 gave USDA the authority to maintain funding for formula and competitive research programs. From all sources, the combined research activities of IAES/ACES accounted for \$62,944,470 [36%] of the FY 2015 expenditures in the college. External funding has shifted in recent years from reliance on state and traditional USDA support toward industry gifts and grants, a broader array of federal granting agencies, and involvement in multi-disciplinary centers and initiatives. The mission of the IAES includes research to support stakeholders in Illinois, in partnership with USDA and industry entities in the state.

The research infrastructure maintained by the IAES and the College of ACES includes field research and education centers. These centers, operated on the main campus south farms and in several other locations in the state, provide capacity for field-scale research that takes advantage of various environmental conditions represented in Illinois. Operational management of the field research and education centers is generally delegated to the respective academic departments where the programs reside. The Office of Research participates as necessary in the effective operation and maintenance of these critical field-scale laboratories. Due to financial constraints and strategic directions, the college and the Department of Crop Sciences took the decision this year to cease crops research operations at four of the field research and education centers and consolidate those activities at the remaining facilities. Also, as development occurs on the south campus, related to expansion of the U of I Research Park and to accommodate the needs of the Division of Intercollegiate Athletics, the college cooperates to both facilitate development and maintain excellent south farm research facilities. The Office of Research also manages central research support units on campus, such as the plant care facility.

University of Illinois Extension

University of Illinois Extension [Extension] has been able to maintain a professional field-based presence of approximately 150 Extension educators that includes 17 grant-funded positions and 27 county directors this past year. Twelve Extension State 4-H academic professionals supported county 4-H youth program delivery this past year. The number of department faculty FTEs supported by Extension Smith-Lever funds remained the same.

Unfilled field staff vacancies began to accumulate late in FY 2015 and salary increases were not awarded due to funding uncertainties. Extension has been able to identify grants and offer several new programs developed by teams of Extension educators as indicated in this report. In addition, the delivery of interdisciplinary programming needed to address the issues reflected in this annual report has continued.

Use of synchronous and asynchronous distance delivery continued to increase in FY 2015. Extension websites generated 187,843 average daily page views as compared to 176,341 daily page views in FY 2014. Direct teaching contacts for FY 2015 decreased and numbered 1,574,330 as compared to 1,640,278 in FY 2014. Few peer-reviewed publications were produced by field staff members who are supported in doing so, but who are not a part of the university tenure system. Instead, field staff have seized and continued to expand other scholarship-related opportunities in educational delivery via websites, webinars, online modules, YouTube videos, and social media. Measuring program impact

[knowledge, practices, and condition changes] and gathering this information from the distance delivery participants both remain challenging.

Although Illinois is the most populous state in the North Central Region, Illinois' Extension faculty capacity is less than that of many of our peer land-grant universities in the region - 11.4 FTE state Extension specialists [tenure-system faculty with departmental appointments] and another 2.75 FTE academic professionals with Extension appointments located in campus departments. Research translation and program delivery by campus-based specialists remains important. Maintaining a critical mass of campus-based specialists to provide the educational content for programs continues to be a concern. The effort to build relevant Extension programs that explore new areas of outreach education with faculty from non-traditional units continued for a second year as planned. This cross-campus University of Illinois Extension and Outreach Initiative was designed to: [1] Raise the visibility and relevance of outreach across university units and among stakeholders in the state with the purpose of developing stronger and more meaningful connection with stakeholders; [2] Create a model for working across campus units to support and expand the university's land-grant mission of outreach; [3] Develop collaborative, change-oriented projects that respond to or address a need evident or identified at the community level; and [4] Foster or develop outreach from interdisciplinary work. These projects have involved collaborations with the College of Business, Graduate School of Library and Information Science, Illinois Sustainable Technology Center, School of Art and Design, Spurlock Museum, Department of Computer Science, College of Education, and the Department of Recreation, Sport and Tourism along with multiple community entities. Extension has continued to provide funding for the eight Cross Campus Initiatives projects, splitting the overall funding support with the Office of the Provost.

With respect to Extension funding, local funding for University of Illinois Extension decreased by 6% in FY 2015. State general revenue funds remained level, but have not been appropriated for FY 2016 due to an impasse in the passage of a state budget for FY 2016 and agreement on how best to address the state deficit. Dedicated appropriations through the Illinois Department of Agriculture were reduced by over \$1.5 million in FY 2015, and are unfunded thus far in FY 2016. Although reserve funds have been available to operate Extension at all levels for this past year and beyond, the number of unfilled Extension staff positions has continued to increase since future state fiscal support remains uncertain. The state fiscal deficit continues to be a very serious concern. Extension engaged University staff from the campus Institute for Government and Public Affairs to conduct webinars for county elected and appointed officials, community leaders, and Extension staff to provide information regarding Illinois' fiscal crisis. In addition the Director of Extension has been active in monitoring the fiscal crisis, working with University administrators, and communicating with staff and stakeholders regarding the value of Extension's educational outreach and impact.

Changes In The College of ACES

In late 2015 it was announced that Dr. Robert Hauser would be retiring as Dean of the College of ACES in 2016. Prior to serving as dean, Dr. Hauser was a professor and later department head in the Department of Agricultural and Consumer Economics. A search is currently underway, and Dr. Hauser will continue to serve as dean until August of 2016. It was also announced in early 2016 that Dr. Laurie Kramer would be leaving the University of Illinois for Northeastern University in Boston. Prior to serving as Associate Dean for Academic Affairs, Dr. Kramer was a professor in the Department of Human Development and Family Studies and was the founding director of the University of Illinois Family Resiliency Center. Dr. Kramer has served as associate dean since 2007. Resignations and retirements of individuals who provided leadership for University of Illinois Extension necessitated successful searches to fill the Associate Director, Field Operations position, the Assistant Dean and Agriculture and Natural Resources Program Leader position, and the Assistant Dean and Director 4-H Youth Development position.

FTE Calculations

Per guidelines spelled out in the August 13, 2015 NIFA AREERA State Plan of Work Newsletter, NIFA is requesting that individual planned programs include only formula-funded FTE's while the executive summary include all FTE's regardless of funding. Extension has been collecting, via an online reporting site, the number of hours coded against priority program areas and program content codes and using those to identify hours of effort devoted to the various planned programs in this report. That process still serves as the method to report total FTE's in the executive summary. However, since Smith-Lever funds are allocated as program support dollars to departments and Extension units, Smith-Lever funds are not actually used to support salaries.

The Planned Programs

Agricultural and Biological Engineering - Activities in 2015 included work to automate the process of phenotyping corn ears, a study with the goal of optimizing the design of vegetative filter strips [VFS], the conducting of both laboratory and field experiments using a real-time droplet size monitoring system for an unmanned aerial vehicle [UAV] sprayer, experiments on the use of water-cooled perches for laying hens kept in heat stress conditions, a study aimed at developing a paired bioreactor system for evaluating the effects of a bioreactor heating system, and a project focusing on quantifying the changes in watershed hydrology [water quantity and quality] under changing climate and land use conditions and how they impact ecosystem services. Extension activities in 2015 continued to focus on manure management, training on pesticide applicator equipment use, the use of unmanned aerial vehicles [drones], and a new Extension workshop that addressed livestock mortality composting through combined classroom and on-site training for livestock facility operators.

Agricultural and Consumer Economics - Extension activities in 2015 included agricultural economics programs focused on profitability outlook and management challenges. Specialists prepared resources, conducted 14 seminars, and trained field staff who conducted additional local seminars on the Farm Bill to provide information to help farmers and landowners with payment yield and base acre reallocation decisions. A major revision of **All My Money**, a train-the-trainer curriculum for working with limited resources audiences, was completed this past year and piloted at a detention center and a new program was developed and delivered in 2nd-5th grade classrooms. Research activities included a tick-by-tick and quote-by-quote examination of commodity markets to develop metrics on liquidity and transformation of information, an assessment of the impact of Dodd-Frank on agricultural producers, a study to analyze local, state, federal, and selected international laws that constitute the legal environment for agriculture, ongoing work on the **Varietal Information Program for Soybeans** [VIPS] database, a project studying 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, and the development of data related to the impact of crop insurance on the financial capacity of agricultural borrowers.

Animal Health and Production - Activities in 2015 included the formulation of diets that meet the requirements of cows but avoid over-consumption of energy to improve outcomes of the transition period and lead to improved fertility, the development of research findings that could help the dairy goat industry genetically improve the health of goats and increase milk production, an examination of individual dietary macronutrients and other components known to affect microbial-derived fermentative metabolites and/or barrier function in growing pigs, a study with the goal of developing a modified live vaccine that will elicit a protective immune response against strangles that is free of the significant safety risks associated with the currently-marketed Pinnacle IN product, a study that seeks to determine the pharmacokinetics of transmucosal meloxicam via both oral and rectal routes in piglets in hopes of identifying this route as an efficacious, efficient, and minimally stressful way of providing pain management during castration, and the use of microbiomic analysis to evaluate the intestinal microbial population of the newborn calf. Extension programming continues to focus on manure management, training on pesticide applicator equipment use, use of unmanned aerial vehicles [drones], and a new Extension workshop that addressed livestock

mortality composting through combined classroom and on-site training for livestock facility operators. Extension annual statewide programs addressed animal production and health for swine, beef, dairy, sheep, goats, poultry, and horses for owners, producers, and 4-H youth.

Community Resource Planning and Development - Extension activities in 2015 included data gathering and process management assistance to municipalities, counties, and regions engaging residents in decision-making and planning successful expansion of "buying local" campaigns. Curriculum development related to fostering youth creativity and entrepreneurship progressed and was piloted with additional age groups. The University of Illinois Extension **Local Government Information and Education Network [LGIEN]** series was expanded and addressed topics via webinars related to Illinois' fiscal situation and eGovernment opportunities. Activities also included a research study that will contribute to existing empirical knowledge by explicating the role of different types of violence in different patterns of judicial involvement among divorcing mothers with and without a history of violence, a research project that examined the role of racial socialization practices in African American families and also examined the role of nonstandard work in early child development, and research to identify chronic stressors in the lives of low-income, African-American families living in inner-city neighborhoods and the coping strategies used to address these stressors.

Food Safety and Food Security - Activities in 2015 included research on food insecurity that examined one of the consequences of food insecurity [sleep problems] and how it can be addressed through policy interventions and how SNAP could be used to reduce these consequences, the development of a laboratory scale method to produce and model Hispanic-style fresh cheeses, an evaluation of the effect of ultrasound treatment at low acoustic power density [APD] on antioxidant capacity and overall quality of Romaine lettuce, a study with the long-term goal of providing an effective labeling system for consumers who have health concerns related to sodium and fat to aid in making healthy food choices, a study on the efficacy of two leafy produce washing methods [the traditional cutting-before-washing process and a new washing-before cutting method] in reducing *Escherichia coli* O157:H7 inoculated on Iceberg lettuce, and work to provide growers and buyers with up-to-date information to allow them to more efficiently meet market demands associated with organic production, food safety regulations, **Farm to School**, and extended seasons for production and marketing. Extension activities continued to focus on food safety for volunteers that prepare or serve food to the public and training for producers and employees of those producers regarding safe food production and handling to prevent food contamination. New online and supplemental programs entitled **Yes, You Can - Preserve Food Safely** were conducted during the summer. Food security programming encompassed field crop and fresh produce management and production and hunger mediation for limited resource families. Compared to the previous year, 4-H youth and volunteers doubled the number [128,856] of meals of soy-fortified rice distributed to families in need. Impact evaluations were collected from participants in fruit and vegetable schools and trainings, food safety programs, and programming for small farms exploring local foods production.

Human Health and Human Development - Activities in 2015 included a study that seeks to better understand the protective factors that maintain relationship quality during the transitions to marriage and parenthood, the development of 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, ongoing work under the **Child Development Laboratory Research Database Project**, work to identify the frequency of high-risk alleles on genes related to the early onset obesity phenotype using data from two ongoing research cohorts [STRONG-KIDS and UP-AMIGOS], an investigation into the roles that dietary soy flour and purified isoflavones may play in treating breast cancer, the identification of genetic factors influencing the accumulation of individual glucosinolates in broccoli florets to gain further insight into the regulation of glucosinolates in Brassica vegetables, research that will contribute to our understanding of social-emotional development among young children from rural and suburban communities, and work to identify methods for the fortification of staples in low-income countries. Extension activities included web-based parenting education resources, workshops and resources

addressing food choices and management of chronic diseases, expansion of childcare provider training on nutrition for children of military families, and outreach to youth focused on tobacco, alcohol and drug use prevention, and bullying prevention. New programs encompassed additional strategies and techniques for building a better memory, defining and identifying the benefits of "mindfulness meditation", and a series addressing preparing for retirement. 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. Impact studies encompassed the chronic disease programs, programs on building a better memory and brain health, retirement planning, bullying prevention, and youth's knowledge of the dangers of drug abuse.

Natural Resources and the Environment - Extension activities in 2015 encompassed soil and water management, forestry, environmental stewardship, and climate change addressed through workshops, conferences, expansion of Master Naturalist training, youth conservation days, two new YouTube videos on weather and a new pond management website. Impact evaluations for the youth **I Think Green** curriculum documented knowledge and practice change with respect to protecting the environment. Research activities also included ongoing measurement of atmospheric deposition conducted under the **National Atmospheric Deposition Program**, a project that demonstrated links between sub-lethal physiological metrics across a gradient of habitat qualities, a study on habitat use by migrating birds, an assessment of active carbon pool levels within soil landscapes, ongoing data collection with the ultimate goal of quantifying the costs and benefits of different urban agricultural systems, research with the goal of developing statistical models that can better predict restoration outcomes at a site given its landscape context and management, and a project to evaluate the effectiveness of a network framework for evaluating the capacity of environmental governance structures to accommodate multiple ecosystem services and the extent to which decentralized environmental governance networks are able to incorporate justice concerns into planning processes and outcomes.

Plant Health, Systems and Production - Activities in 2015 included work to determine the role of small RNA, sigma factors, and protein lysine acetylation in regulating virulence factors in *E. amylovora*, the testing of over 1,300 individual waterhemp plants from over 330 fields for specific herbicide resistance traits, research to improve our understanding of the biology of *X. cucurbitae* and determine the etiology and epidemiology of bacterial spot for developing effective strategies for management of the disease, ongoing work under the **Illinois Long Term Selection Experiment [ILTSE]** for grain protein and oil concentration, research through the **University of Illinois Soybean Breeding Program** that developed several new experimental lines and tested these lines for yield, agronomic traits, and disease and pest resistance, work to implement genomic selection into Illinois breeding programs, research to evaluate different cover crop rotations, green manures, and tillage practices for their potential to develop weed suppressive soil legacies, and an effort to develop a rapid approach to discovering new viruses in plant parasitic nematodes. Extension activities encompassed a significant number of website and webinars addressing horticulture topics, with new programs and two new online modules that focused on invasive species with impact evaluations indicating participants' knowledge and practice changes regarding invasive species. Impact evaluations also included interviews with Master Gardener Hotline/Help Desk callers.

Sustainable Energy - Activities in 2015 included an analysis of the role of biofuel policies in Brazil on incentives to produce sugarcane ethanol, an examination of the design of long term contracts for inducing the production of perennial energy crops as a feedstock for the emerging cellulosic biofuel industry, work to improve our understanding of the fundamental causes of increased fouling in maize processes, the evaluation of twenty-one perennial woody species for their potential as short rotation bioenergy feedstocks, the development of a pilot plant to convert biowaste into biocrude oil via hydrothermal liquefaction, and the quantification of substantial genotypic variation for winter-hardiness, flowering time, autumn dormancy, and yield in *Miscanthus* germplasm panels and F1 mapping populations. Extension activities included presentations, demonstrations, tours, displays, and field days focused on biomass [both

feedstocks and woody], use of solar power and wind energy, and residential energy efficiencies. Presentations, demonstrations, and displays at two events [Southern Illinois Sustainable Living Expo and the Farm Progress Show] provided opportunities to reach over 1,500 people. Presentations were also made at two Renewable Energy Conferences held in Illinois.

4-H Youth Development - Activities in 2015 focused on and successfully expanded youth involvement that included an intentional outreach to urban and Hispanic youth, expanded opportunities to engage teens, and volunteer training to ensure positive youth development experiences. Delivery systems and educational curricula were enhanced and expanded to increase the number of youth involved in educational priorities focused on: [1] College and career readiness; [2] Food access; [3] Environmental stewardship; [4] Leadership; and [5] Health. Expansion of teen leadership roles included the following opportunities: [1] Teens as advocates for change; [2] Teens planning activities; [3] Teens promoting 4-H impact; [4] Teens advising partnering councils; [5] Teens mentoring peers; or [6] Teens as teachers of others.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	100.0	0.0	180.0	0.0
Actual	203.5	0.0	182.5	0.0

II. Merit Review Process

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

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

2. Brief Explanation

In the Department of Animal Sciences all Hatch proposals are reviewed and evaluated by a standing research committee. The committee members are asked to review the proposals and submit questions and comments. The PI makes any necessary revisions and the committee then renders a final decision. In the Department of Crop Sciences and in the Department of Food Science and Human Nutrition proposals are reviewed by two faculty members in addition to the department head. In the Department of Human Development and Family Studies Hatch proposals are typically reviewed by the department head. Under select circumstances [such as for a specialized field of study] the department head would request input from another full professor in the department. The review ensures that the proposed research addresses an issue of scientific and societal significance, uses appropriate research methods, includes some focus on rural populations, and would have applied or practical implications. The review also confirms that the scientist submitting the proposal is capable of conducting the proposed project and that the timeline is feasible.

In the Department of Agricultural and Biological Engineering effort is made to insure that every proposal is reviewed by two external peers with knowledge in the subject area. The reviewers are provided with specific instructions regarding their purpose of enhancing the proposal as opposed to seeking the recommendation to accept or reject. The reviewers' comments are used to help improve the proposal and researchers take the reviewers' comments into consideration in revising their proposal to prepare a final version for submission. In the Department of Natural Resources and Environmental Sciences, faculty members submitting Hatch proposals are asked to provide the names of two or three individuals to conduct a peer review. While the majority of the reviewers are within the department, other colleagues may serve as reviewers. Reviewers are asked to comment on the following six areas with recommendations and suggestions 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 they have knowledge? If so, is the duplication warranted? [6] Are the users of the results identified? In all cases, Hatch proposals are submitted to NIFA via the Research, Education and Extension Project Online Reporting Tool [REEport] for review and must be approved by NIFA prior to being eligible for Hatch support.

State Extension program leaders in family and consumer science, agricultural and natural resources, community and economic development, and 4-H youth development gave leadership in describing and leading discussions with county directors, Extension educators, and support staff on the importance of research-based programming, inventorying and prioritizing what programming should be continued or discontinued, encouraging use of technology, and employing other innovative ways to carry out Extension education. These discussions resulted in the identification of the need to update and create several new programs and Extension educational resources [such as websites and online modules]. Extension campus faculty [11.4 FTEs] and professional staff [2.75 FTEs] delivered face-to-face traditional statewide programs that encompassed the latest research, and in limited instances, engaged with individuals and teams of Extension educators to carry out applied research. However, teams of Extension educators have been the primary developers of new programs guided by program leaders and that require program content review by their peers. State program leaders play an important role in communicating with and connecting campus and field staff with respect to educational needs and program development.

Through the annual performance appraisal system, multi-county Extension educators self-assessed their performance and provided stories about their successes in programming including its impact. County directors reviewed and provided a merit assessment of the Extension educators they supervised as did the appropriate state program leader. The county directors also completed a performance self-assessment and their regional director provided a merit review assessment of the county directors they supervised. In addition, a section of the monthly statewide staff reporting system provided an opportunity to document program impact and was accessible to staff supervisors and administrators. Evaluation surveys distributed and collected allowed participants to provide feedback on program quality. Program reviews conducted in one-third of the multi-county staffing units each year focused on reviewing and improving outreach to minority and underserved audiences. Extension recognizes the need to explore additional program review processes that more formally involve external source input for future merit review of program content and delivery.

III. Stakeholder Input

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

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of the general public
- Other (Department Advisory Committees)

Brief explanation.

The college office of News and Public Affairs [NPA] plays a crucial role in informing stakeholders about activities in the college. NPA maintains an e-mail list of over 1,000 media outlets to which it selectively distributes approximately 400 news releases each year with over 2,000 placements in publications such as Men's Health, Reader's Digest, Shape, Parents, Prairie Farmer, Corn and Soybean Digest, Community Concierge, Farmweek, AgriNews, and Farm Journal. NPA stories also appear regularly in the Chicago Tribune, New York Times, USA Today, Huffington Post, St. Louis Post Dispatch, Boston Globe, the BBC, and the Globe and Mail. These placements are also due to memberships in subscription services with EurekaAlert [a distribution service with AAAS] and AlphaGalileo [a British news distribution service].

NPA also assists ACES Communications and Marketing by writing stories for the college magazine. ACES@Illinois is a 36-page magazine that is delivered in print or electronically twice each year to ACES alumni, donors, potential students, and others who are interested in the college. A pdf of the most recent issue is available at https://aces.illinois.edu/sites/aces.illinois.edu/files/Fall-Issue_2015_web.pdf.

In 2015, NPA also produced a 60-page full-color publication entitled AdvanCES in Research to share 35 research projects and findings with the public and invite feedback. The publication was distributed at Agronomy Day on the University of Illinois South Farms and at the 2015 Farm Progress Show in Decatur. A pdf is available at <http://research.aces.illinois.edu/reports>.

Another vital contribution from NPA is connecting ACES researchers with media. Reporters contact NPA writers to help them set up an interview with an ACES faculty member in response to a press release on their research. NPA staff are also contacted daily by media when they seek an expert to comment on a current issue in the news.

In the Department of Agricultural and Biological Engineering, research is funded to a significant extent by industry, and so a substantial effort is made to engage with these stakeholders. International stakeholders are also sought out for input as a good number of research projects in ABE involve institutions in other countries. The Department of Food Science and Human Nutrition undergoes an external review of programs once every seven years. Annually, the department asks the external advisory committee to provide formal feedback on departmental activities. In the Department of Natural Resources and Environmental Sciences, researchers continue to work with state and federal environmental agencies to discuss research areas and learn of needs within these organizations.

County directors were expected to seek input from Extension multi-county unit councils regarding identifying priority issues for educational programming. Ten of the twenty-seven county directors formally reported seeking input from their multi-county council members regarding prioritizing issues to be addressed and reviewing data and conducting discussions regarding underserved audiences. This input was used to update local Plans of Work.

In addition to council discussions, other formal methods were identified and used to gather data regarding program offerings. Five of the 27 multi-county units gathered input on interests in horticulture, agricultural, and natural resources, 4-H training needs, and 4-H future programming. Surveys were the tool of choice for gathering data and for identifying customer satisfaction regarding Extension programs in four units. All Extension educators continued to enhance efforts to seek feedback on additional educational needs and feedback on the quality of the current programs through end-of-program evaluations collected from program participants.

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. In one unit an advisory group of 30 individuals interested in agriculture was formed to develop, expand, and coordinate formal agricultural education for credit through the local community college and informal agricultural educational outreach offered by Extension. Of note, a comprehensive needs assessment of a diverse array of issues was distributed widely in one unit and garnered over 700 responses from both Extension participants and non-participants.

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

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Surveys
- Other (Visits/requests to community collaborators and key leaders)

Brief explanation.

The Dean of the College of ACES [Dr. Robert Hauser] and the Associate Deans for Research [Dr. Neal Merchen] and Extension [Dr. George Czapar] interact frequently with a number of stakeholders 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, and other individuals and organizations within the University of Illinois. The dean and associate dean provide reports to the College of ACES external advisory committee; this diverse group includes participants from the agricultural production community, natural resources management groups, human sciences, and agribusiness. This group meets annually and creates an excellent opportunity for presentation and review of the activities of the AES to an external audience with a broad cross-section of interests. Also at the college level, the development, corporate relations, and public engagement offices serve an important role in engaging with stakeholders.

In the Division of Nutritional Sciences, the portfolio of research and outreach activities is presented to the external advisory committee for comment, allowing external stakeholders to provide input. 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, outreach, and detaching programs. Faculty members regularly participate as liaisons 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 with them 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 provide feedback on Animal Sciences programs. Stakeholders are also invited to speak to classes and to serve on graduate research committees and on faculty search committees. Leadership in the Department of Agricultural and Biological Engineering seeks out input from faculty members who are in frequent contact with stakeholders. An established external advisory committee is also important to ABE in identifying stakeholders. Attendance at regional, national, and international conferences also provides a valuable forum for identifying stakeholders and the issues that are high priorities to them. In NRES, faculty in human dimensions conduct meetings with community partners as well as with the City of Chicago Public School system. Networks from the National Great Rivers Research and Education Center, Illinois-Indiana Sea Grant, and the Illinois Water Resource Research Center have also been utilized. Faculty also participate in national and statewide events and committees throughout the year as well as working with local organizations.

Extension Advisory Council members and local Extension volunteers remained as keys in providing advice on who should be targeted for an invitation to a specific program or a particular input opportunity. Multi-county staff meetings and Extension educator meetings with colleagues who had the same expertise responsibilities were also used to generate ideas and information on stakeholders they should contact. Extension staff members also relied on their involvement in meeting with community collaborators and key leaders who were targets for input and helped to identify other representative stakeholders to contact regarding 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
- Survey of the general public

Brief explanation.

Specific interactions of the associate dean for research/director of the AES with stakeholders in 2015 included: [1] Participation in the June meeting of the Illinois Agricultural Legislative Roundtable sponsored by the Illinois Farm Bureau; [2] Meetings with the Board of the Illinois Soybean Association; [3] Discussions with Illinois Soybean Association staff concerning future programming at the National Soybean Research Laboratory; [4] Meeting with the advisory committee of the Dixon Springs Agricultural Center [the largest off-campus research and education center in the College of ACES]; [5] Meeting with the advisory committee of the Dudley Smith Research Program [an endowed research program in sustainable agricultural production]; [6] Collaboration with the Illinois Corn Growers Association and the Illinois Council on Best Management Practices and preparation of a grant proposal to the NRCS Regional Conservation Partnership Program [this project was selected for funding and represents a large collaborative effort involving approximately thirty partners]; [7] A visit to the Illinois Department of Agriculture and meeting with the director; [8]

Meetings with leadership and staff of multiple commodity organizations and a state legislator at the Illinois State Fair; [9] The cultivation of corporate partnerships in 2015 [major contacts and significant discussions occurred with Dow AgroSciences, ADM, Monsanto, Kraft Foods, Pepsico, and Agrible]; [10] Participation in meetings with the north central region AES directors; [11] Serving on the steering committee of the ADM Institute for Prevention of Postharvest Loss and on the board of the North Central Regional Center for Rural Development; [12] Participating in the first ADM Institute International Congress on Prevention of Post-Harvest Loss in Rome; and [13] Meeting with the external advisory committees in the Departments of Food Science and Human Nutrition, Human Development and Family Studies, and Crop Sciences. Looking ahead to 2016 and beyond, the Illinois AES will continue to work with commodity organizations and producers in the state of Illinois [for example, input is currently being sought on the significant changes in programming that will be made at our off-campus research and education centers].

At the department level, in ABE stakeholder input is collected through direct interactions between faculty members and stakeholders as well as through publication of department newsletters, attendance at professional, technical, and social events hosted by ABE, and through an established external advisory committee. Leadership in the Department of Crop Sciences meets annually with their state advisory committee. This committee then submits a report with suggestions as to the direction and future of the department. In FSHN input is collected through in-person meetings with external stakeholders. Feedback is also sought from industry via one-on-one meetings with the department head and industry representatives. Graduates of the program are asked for input on research and emerging key issues. Input is collected from stakeholders in the Department of Natural Resources and Environmental Sciences through an external advisory committee comprised of four representatives from environmental agencies including state government, consulting and conservation.

As mentioned in Section III, the process most often used by Extension to collect input involved informal conversations proactively initiated through professional staff contact with current funders, key community leaders, Extension Council members, and Extension volunteers and customer satisfaction and program content surveys. In some instances Community and Economic Development Extension Educators assisted with survey distribution and analysis that yielded information about needs that Extension could use in developing educational responses. In addition, the majority of Extension programs included end-of-program evaluations and surveys that sought suggestions for additional topics for future programs.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

Brief explanation.

As in previous years, the College of ACES strives to incorporate stakeholder input and evaluation into decision making at all levels. Areas include the allocation of resources, the development of Extension programs, the determination of areas of focus for college publications and other outreach materials, identification of opportunities to improve communication with stakeholders [or to identify

stakeholders who were previously underrepresented], and the identification of new faculty hires who will address currently-unmet needs identified by stakeholders. Through their funding decisions grant awarding agencies play a very significant role in guiding research activities [and indirectly in promotion and tenure decisions for faculty].

Extension staff members were once again encouraged to involve Extension Council in reviewing, and if warranted, revising the 3-5 priorities to be reflected in a FY15 multi-county plan of work. At one Unit Extension Council meeting, members were charged to discuss meeting the needs of underserved audiences and identified single parent families and discussed the challenges they encounter. In another Extension unit the county director led the council members through a mind map activity where issues, solutions, programing partners, and resources were all identified. Input through 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 and to determine how to more effectively market programing and use various methods of technology. Input through these evaluations has also been used to develop new programs that are reflected in annual plans of work. Data was also used to identifying staffing needs when vacancies arose.

In NRES, input was used to reallocate resources and modify research questions to better address scientific and stakeholder needs. The input received from NRES stakeholders allows the department to evaluate current programs within teaching, research and Extension. As an added benefit, stakeholder input provides a guideline for trends that impact course content for our undergraduate and graduate students. In the Department of Animal Sciences, the external advisory committee meets annually with an agenda of items to act on and formulates recommendations. In ABE, decisions regarding research activities are often shaped by stakeholders through input collected and discussed at regular department meetings, faculty/staff meetings, administrative committee meetings, faculty advisory committee meetings, and at external advisory committee meetings. In FSHN, external advisory committee input, graduate survey data, informal stakeholder feedback, and external program reviewer's comments are incorporated into discussions during department faculty meetings and in advisory committee meetings. The strategic planning committee also uses stakeholder input to make decisions on strategic directions. In the Department of Crop Sciences recommendations from stakeholders are considered in faculty meetings and in department advisory committee meetings.

Brief Explanation of what you learned from your Stakeholders

The Director of the Illinois AES spent considerable time with an array of agricultural leaders, agribusiness associations, and colleagues from other Midwestern land-grant institutions to gain a better understanding of land-grant mission research needs. There continues to be strong support and interest in work conducted in applied agricultural sciences at our field research stations, particularly in studies on agronomic factors and in some areas of applied food animal science [primarily beef cattle production]. Stakeholders continue to derive great value in management and economic information provided by the farmdoc program [<http://www.farmdoc.illinois.edu/>].

Since 2012, the AES and College of ACES have been engaged in a visioning and strategizing exercise with Illinois agricultural leaders. Beginning in the Fall of 2014, this process of futuring Illinois agriculture has further evolved into a statewide strategic planning exercise that incorporates the Chicago Community Trust and several other longstanding and emerging partners in charting future scenarios for the development of the Illinois food and agriculture sectors. This process has involved extensive input gathering and has resulted in a report and visioning document entitled FARM Illinois [Food and Agriculture RoadMap for Illinois]. A copy of this report can be found at: http://farmillinois.org/wp-content/uploads/2015/06/FARM-IL-Report-2015_FULL_vF3.pdf.

Overall, more than 170 stakeholders from all sectors of the agriculture, food, and business communities came together "to develop a comprehensive strategic plan to enable Illinois and the Chicago region to become the leading global hub for food and agriculture system innovation and ensure their leadership in sustainably meeting the 21st century challenge of global and local food security".

FARM Illinois articulates recommendations for action in six categories: [1] Leadership for innovation; [2] Business development and entrepreneurship; [3] Workforce and education; [4] Resource management; [5] Infrastructure; and [6] Branding and market development. As we move ahead, it is anticipated that the direction of the Illinois AES will be coordinated with the implementation of the FARM Illinois plan.

In ABE it was learned that the current and emerging issues emphasized by stakeholders were: [1] Agricultural and Biological Systems and Technology - Precision and information agriculture, plant and animal production, sustainable agricultural intensification, big data, informatics and analytics, and health and safety; [2] Food and Bioproducts - Processes and products as well as security and safety; [3] Energy - Renewable energy and energy efficiency; [4] Water - Land and water resources and water quality and use; [5] Environment - Air, soil, and water quality and built environment; and [6] Biological Engineering - Biotechnology and biosensors. In the Department of Animal Sciences key recommendations from stakeholders came 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 to society as a whole. Key research findings commented on by stakeholders included beef cattle efficiency in response to various feedstuffs, genomic testing of cattle and dogs for recessive traits, immunological responses to stress in animals and humans, utilization of corn co-products by swine and poultry, and growth enhancers as it affects meat quality in swine. In FSHN it was learned from stakeholders that: [1] Sustainability across the food system is critical; food science and human nutrition should play a larger role in these efforts; [2] Cross-training in food science and human nutrition is needed to solve the grand challenges facing the food system; and [3] Nutrition and cancer and food microbiology are strengths of the department. Emerging areas identified included integration of food and nutrition for gut microbiome and health and consumer behaviors around food choices and health outcomes.

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

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

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
9764396	0	6897603	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	4847499	0	8045000	0
Actual Matching	4847499	0	8045000	0
Actual All Other	42685123	0	39688986	0
Total Actual Expended	52380121	0	55778986	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	4847499	0	3734020	0

V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Agricultural And Biological Engineering
2	Agricultural And Consumer Economics
3	Animal Health And Production
4	Community Resource Planning And Development
5	Food Safety And Food Security
6	Human Health And Human Development
7	Natural Resources And The Environment
8	Plant Health, Systems And Production
9	Sustainable Energy
10	4-H Youth Development

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%		10%	
133	Pollution Prevention and Mitigation	25%		10%	
141	Air Resource Protection and Management	10%		10%	
315	Animal Welfare/Well-Being and Protection	0%		10%	
401	Structures, Facilities, and General Purpose Farm Supplies	5%		10%	
402	Engineering Systems and Equipment	15%		15%	
403	Waste Disposal, Recycling, and Reuse	10%		10%	
404	Instrumentation and Control Systems	15%		15%	
405	Drainage and Irrigation Systems and Facilities	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.0	0.0
Actual Paid	0.0	0.0	4.8	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
9696	0	351519	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
9696	0	351519	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
85372	0	1624929	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included work to automate the process of phenotyping corn ears, an assessment of the silver nanoparticle toxicity to denitrifying bacteria in soils, a project focused on developing a framework and methodology for collecting information and evaluating field-based supply chain logistics to implement global engineering solutions concerning agricultural machinery, a study aimed at developing a paired bioreactor system for evaluating the effects of a bioreactor heating system, the development of a new technology to rapidly assess the impact of perturbations due to nanoparticles on complex microbial ecosystems [such as those found in anaerobic waste processing], work to develop, evaluate, and modify models for predicting best management practices performance and water quality at the laboratory, field, and watershed scales, and a project focusing on quantifying the changes in watershed hydrology [water quantity and quality] under changing climate and land use and how they impact ecosystem services in terms of sediment delivery and aquatic biodiversity [understanding the fundamental mechanisms that drive significant changes in hydrologic functions is crucial to developing sound management and conservation strategies for sustainable agro-ecosystem services].

Activities also included a study with the goal of optimizing the design of vegetative filter strips [VFS] to prevent the transport of infective microbial pathogens to receiving waters while maintaining an effective removal of nutrients and pesticides [reducing or eliminating contaminants at the source and before entering streams and rivers will prevent the transmission of these contaminants in irrigation and livestock watering by downstream users], the development of a living laboratory that provides "plug and play" capabilities for studying the advances of agricultural production components and technological components, the conducting of both laboratory and field experiments using a real-time droplet size monitoring system for an unmanned aerial vehicle [UAV] sprayer, research showing that hydrothermal liquefaction [HTL] treatment of livestock manure can simultaneously produce an energy-dense bio-oil and effectively destruct a range of bio-active compounds in manure including various antibiotics and estrogenic compounds, experiments on the use of water-cooled perches for laying hens kept in heat stress conditions, a research project designed to evaluate a new drift reduction adjuvant specifically for aerial applications, and a project with the goal of improving our understanding of the impacts of environmental management on poultry.

Conference presentations included the South African Sugar Research Institute, Institute of Biological Engineering, Gordon Research Conference, American Society of Agricultural and Biological Engineers, Water Environment Federation, Algae Biomass Organization, and the National Agricultural Aviation Association.

Extension activities related to this planned program are interdisciplinary in nature and relate to other

planned programs featured in this report [Sustainable Energy, Natural Resources and the Environment, Animal Health & Production]. Much effort was devoted to education focused on livestock manure management through 10 statewide **Certified Livestock Manager Training** workshops that covered not only the basics of nutrient management but also new technologies, research, and trends. The training and completion of an online five-part quiz series also meets state livestock waste management training requirements for producers. Livestock producers with 300 or more animal units must be recertified through training and/or exam passage every three years.

With limited Extension specialist FTE's, Extension has chosen to expand outreach through websites. The **Manure Central** website experienced more than 160,000 page views this past year and consists of several sections that include: [1] **Certified Livestock Management Training** materials and the **Illinois Manure Management Plan** designed to help livestock producers develop manure management plans to more efficiently and safely use manure as a fertilizer. The website allows users to customize the plan to meet a given producer's needs and facilitates any required annual updates. Other sections of the website include: [2] **Manure Share**, an exchange program that brings gardeners and landscapers searching for organic materials for use in composting or field applications in contact with livestock owners with excess manure; [3] **Small Farms Manure Management**, a website for individuals with less than 300 animal units; [4] **EZregs** for users who have established accounts to store their questions and Extension responses related to identifying environmental regulations that pertain to specific agricultural and horticultural operations and practices in Illinois; and [5] **Compost Central** which features resources for composting livestock manure, food scraps, and yard waste. In addition, training was provided for custom manure haulers in Illinois and certification and testing was provided on a voluntary basis.

Extension educators and campus staff collaborated with the Department of Agricultural Engineering, the Illinois Environmental Protection Agency, and the Illinois Pork Producers Association to conduct a **Livestock Mortality Composting Workshop** that combined classroom and on-site training for the 68 participants. Eight of the attendees took advantage of the presence of an on-site Spanish translator. Presentations were made by a Michigan State professor/Extension specialist, an Illinois State retired professor, and a University of Illinois Extension retired specialist.

With respect to education regarding equipment, **Operation S.A.F.E.** fly-ins were conducted in Illinois and several other states by an Extension pesticide safety education staff member to ensure aerial applications of fungicides to corn are accurately applied and encompassed information related to spraying equipment.

A commercial agriculture Extension educator continued to conduct research and educational outreach regarding unmanned aerial vehicles [drones] and their potential use in crop scouting and management. Twelve presentations were delivered to a wide variety of audiences. He also served on the Campus Drone Committee. Extension faculty and staff with agricultural engineering expertise have also provided leadership in programming that addresses sustainable energy [see Sustainable Energy planned program]. In addition, there were 39,000 page views of the **Agriculture Safety and Health** website. Extension field staff also presented information on electronic technology [such as GIS and Autosteer] adoption by agriculture at a youth technology day.

2. Brief description of the target audience

Members of the target audience included farmers, members of the scientific community involved in greenhouse engineering, undergraduate, graduate, and professional students interested in the areas of nanotechnology, environmental engineering, and biotechnology, scientists, policy makers, watershed managers, landowners, agricultural engineers, researchers in the livestock industry, animal scientists, livestock producers, the agricultural equipment industry, chemical companies, poultry producers, professional pesticide applicators, growers, pesticide registrants, pesticide and adjuvant retailers, crop consultants, and individuals, companies, and governmental agencies involved with the livestock, biofuels,

and wastewater treatment industries.

Extension target audiences included crop producers, certified crop advisers, livestock producers, custom manure haulers, pesticide applicators, gardeners, landscapers, and youth.

3. How was eXtension used?

eXtension was not used in this program.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	679	14812	3747	0

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

Patent Applications Submitted

Year: 2015
 Actual: 1

Patents listed

Patent Application TF13083-01: Method And Process For Nematode Egg Extraction, Quantification, And Characterization.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	31	31

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2015	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Maximizing Efficiency And Minimizing Drift For Agricultural Aerial Applications
2	Improving Emission Control Technologies For Livestock Buildings
3	Implementation Of Global Engineering Solutions Using Agricultural Machinery
4	Development And Use Of A Manure Management Plan
5	Development Of A Paired Bioreactor System To Study The Effects Of A Bioreactor Heating System
6	Reducing The Risks Associated With Bioactive Compounds In Wastewaters

Outcome #1

1. Outcome Measures

Maximizing Efficiency And Minimizing Drift For Agricultural Aerial Applications

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The primary objective of this project is to evaluate nozzle performance, both selection and usage, and with the inclusion of spray adjuvants. The goal will be to create recommendations for various application scenarios common to agriculture in Illinois, both aerial and ground, that maximize efficacy while minimizing drift.

What has been done

The following individual projects are planned to meet this objective: [1] Evaluation of various adjuvants for efficacy and drift control for low volume aerial applications of fungicides on corn. Adjuvants to be tested include deposition aids, surfactants, crop oils, and others; [2] An investigation of how various pesticides and adjuvants impact the spray droplet size and pattern uniformity for aerial applications. Pesticides will primarily be foliar fungicides commonly applied to corn in Illinois. Adjuvants to be tested include deposition aids, surfactants, crop oils, and others; [3] A study to determine how swath width, application height, and weather factors impact the uniformity of low volume aerial applications on corn. The spray patterns will be measured using a monofilament line strung through a corn field at ear height; [4] Measuring the differences in efficacy and drift reduction of various nozzle types used in aerial application; [5] Comparing the efficacy of a low volume aerial application and a high volume ground application; [6] Determining the impact the use of automatic spray rate controllers has on spray droplet spectrum and application uniformity. Popular nozzle types and sizes will be examined at pressures throughout their pressure range to determine how the droplet size and pattern width changes as the pressure increases; and [7] Study to determine the impact various pesticides, deposition aids, and surfactants have on the spray droplet spectrum of popular ground application nozzles.

Results

A research project designed to evaluate a new drift reduction adjuvant specifically for aerial applications was conducted. Results are still being analyzed but it is clear the adjuvant does work to reduce drift. Additionally, the field project also compared straight stream nozzles and flat fan nozzles for drift mitigation and speeds in excess of 160 miles per hour. The results showed there was substantially less drift from the straight stream nozzle, which was surprising because the droplet size for the two nozzle types at that speed are almost identical.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems

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 Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Considerable research has gone into developing agricultural machines that can perform the necessary operations on farms in a timely and efficient manner. However, this development has taken place with relatively little consideration of the overall system in which the machine is expected to operate, especially in a global context. Sufficient understanding of the environment and constraints in which the machinery must operate in different countries leads to a more effective supply of appropriate equipment for farmers. The lack of consideration for the compatibility of the machine within the system and the agricultural environment leads to inefficiencies and additional costs that could have been avoided if there had been some systems analysis beforehand. A systems approach is an effective way to analyze the overall farming operation, accounting for tractor-implement matching, machinery work rates and productivity, and in-field environmental impacts such as soil compaction resulting from equipment selection and usage. The purpose of this project is to develop a framework and methodology for collecting information and evaluating field-based supply chain logistics with a global perspective in order to implement global engineering solutions concerning agricultural machinery. The supply chain logistics includes not only commodities with the agricultural industry but also other industries. Coupled with the technological aspects of agricultural machinery systems are the issues of environmental impact and energy usage. System characterization on a global scale will need to account for social, political, and cultural factors.

What has been done

During visits to Texas A&M University and to Italy, the PI was able to strengthen existing contacts and create new contacts with university institutions and with industry. A visit to Texas A&M University allowed the project PI to learn about efforts of professors and researchers there in the domain of global engineering. In September the PI attended the annual meeting of the Club of Bologna in Italy, the topic of which was "Farm Machinery to Feed the World". Presentations were made by a range of experts around the globe, addressing the topics of agricultural mechanization development and human growth, strategies for sustainable intensification of agricultural production, and extensive farming systems. These presentations, the content of which aligned closely with the goals of this research project, highlighted the urgency for increased food production and some pathways for achieving this increase.

Results

During this year the PI for this project was also the PI in preparing a research proposal which has been awarded by USAID and involves the creation of an appropriate scale mechanization innovation laboratory as a subaward under the Sustainable Intensification Innovation Laboratory based at Kansas State University. The funding amounts to \$4.7 million over four years and addresses SI in the four developing countries of Bangladesh, Cambodia, Ethiopia, and Burkina Faso. There are three U.S. institutions contributing with a total of 11 team members, including four from the University of Illinois. The project objectives and its scope are very much aligned with the focus of providing global engineering solutions for agricultural machinery systems. Developing such systems in developing countries is a complex process that includes a number of social and economic issues such as female empowerment and local manufacture of machinery. Logistics of field preparation, planting, harvesting, and on-farm processing are also of great importance. Surveys will be carried out to assess the status of mechanization in selected rural communities both at the beginning to establish a benchmark and near the end of the four year period to determine the impact of interventions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies

402 Engineering Systems and Equipment
404 Instrumentation and Control Systems

Outcome #4

1. Outcome Measures

Development And Use Of A Manure Management Plan

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	39

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

[1] 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; [2] Training continued to be offered to custom manure haulers in Illinois by providing certification and testing programs on a voluntary basis. Operators who haul and apply manure to cropland for hire are not regulated in Illinois. The training enabled custom haulers to better understand Illinois regulations and evolving best management practices for environmental protection; [3] In addition, annual training for the Certified Livestock Manager Training program was conducted at 10 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; and [4] Assistance was provided in developing curriculum on waste management for livestock and poultry operations to certify Technical Service Providers [TSPs] who act as consultants and who specialize in developing Comprehensive Nutrient Management Plans [CNMP] for producers that are actively using conservation practices and implementing the latest best management practices.

Results

[1] The Illinois Manure Management Planner website received 13,219 accesses, with 22 new accounts created and 17 plans updated and/or modified; [2] Twenty-three manure haulers, environmental managers, and their employees attended the Custom Applicator Training program. Collectively, their production units and clients represented over 500 million gallons of annual manure application. All 23 individuals completed and passed the Level 2 exam for custom applicator certification; and [3] Five hundred and three [503] individuals attended the Certified Livestock Manager Training programs. According to the survey data, 81% of attendees responded that they currently had manure management plans. Additionally, 46 people successfully completed an online version of the training program.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Development Of A Paired Bioreactor System To Study The Effects Of A Bioreactor Heating System

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

This study seeks to develop a paired bioreactor system for a study evaluating the effects of a bioreactor heating system. The treatment bioreactor was equipped with both solar powered underground electric heaters and a solar greenhouse in an attempt to raise internal temperature. The treatment and control bioreactors were compared based on temperature, nitrate, pH, and dissolved oxygen content.

What has been done

Temperature was analyzed for both submerged and unsubmerged portions of the bioreactors. The submerged section of the bioreactor had an average increase of 0.8 degrees C and the unsubmerged section had an average increase of 7.5 degrees C. The submerged temperature is of most interest because denitrification occurs in the submerged portion of the bioreactor. The submerged temperature increased longitudinally within the bioreactor as flow moved horizontally from inlet to outlet. Overall, there was an increase in temperature in the treatment bioreactor.

Results

The effect of bioreactor temperature on water quality was analyzed in this study. Nitrate data were inconclusive due to sampling errors resulting from nitrate stratification in the inlet structure. The pH levels in this investigation ranged from 6.5 - 7.0. The pH of the treatment bioreactor was statistically significantly lower than the pH of the control bioreactor, suggesting that an increase in bioreactor temperature lowers effluent pH. The dissolved oxygen content results confirmed that both the treatment and control bioreactors performed as expected. Dissolved oxygen content was statistically significantly lower in the treatment bioreactor compared to the control bioreactor, indicating more biological activity in the treatment bioreactor. The study proved it is possible to increase internal bioreactor temperature. This study did not determine an effect on nitrate reduction due to change in temperature in the paired system, however it is still hypothesized the increase in temperature will affect nitrate reduction. Future paired heated bioreactor research is needed to quantify the effect of temperature on nitrate reduction.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
404	Instrumentation and Control Systems
405	Drainage and Irrigation Systems and Facilities

Outcome #6

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
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There is a critical need to better understand the fate, transport and transformation of emerging contaminants in water purification processes and to develop novel processes that cost-effectively reduce the risks associated with bioactive compounds in wastewaters. This study will provide new knowledge on the effects of novel water treatment processes, which are expected to have certain advantages. In particular, we are focused on treatment systems using activated carbon adsorption, ion exchange, membrane bioreactors, algal treatment systems, hydrothermal liquefaction, and various hybrids of these components.

What has been done

Our research has shown that hydrothermal liquefaction [HTL] treatment of livestock manure can simultaneously produce an energy-dense bio-oil and effectively destruct a range of bio-active compounds in manure including various antibiotics and estrogenic compounds. These results showed that HTL reaction times of 60 minutes and/or reaction temperatures of 300 degrees C provided nearly complete removal of the measured contaminants to below detection limits. By simultaneously producing valuable bio-crude oil and destructing bio-active compounds in animal manure, this process can improve the economic return of livestock production and reduce negative environmental impacts.

Results

Our research also showed that HTL treatment of manure can produce some additional chemical compounds, not in the original manure, that have deleterious biological effects. Specifically, we showed that the aqueous organic mixture produced by HTL exhibited mammalian cell cytotoxicity with an LC-50 at a dilution of 7.5% and also showed inhibitory effects on anaerobic bacteria and algae. Subsequently, we showed that biological treatment with algal bioreactors can effectively capture/remove a variety of organic contaminants and reduced mammalian cytotoxicity by 30%. Integrating adsorbents into bioreactors treating HTL wastewaters can further improve bioreactor performance and reduced mammalian cytotoxicity by up to 90%. These biological post treatments of HTL wastewater were able to effectively remove target contaminants and produce additional biomass feedstocks for HTL or biogas, which improves both net energy production and wastewater treatment efficacy.

Finally, during this project a report was prepared for the Water Research Foundation on the removal of pesticides, endocrine disruptors, pharmaceuticals, and several other emerging organic contaminants using activated carbon filters. The report included a survey of activated carbon filter use, bench- and pilot-scale treatability studies, and development of predictive models for the removal of a broad range of trace organic compounds under a variety of activated carbon filter operating conditions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Commercial Pesticide Applicator Training

Using the results of a survey of practice changes that was mailed to a random sample of participants in the 2011-12 Commercial Pesticide Applicator training and in response to the question asking them how much they had improved implementing 12 practices as a result of the training, it may be assumed that of the 9,879 participants in this year's training, 6,490 [66%] improved calibration procedures [frequency, accuracy, and measurement], 5,315 [54%] improved equipment maintenance [inspecting, cleaning, and replacing worn nozzles], and 5,216 [53%] improved changing type, size, or materials of the nozzles used as a result of attending the training.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Agricultural And Consumer Economics

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management	0%		5%	
601	Economics of Agricultural Production and Farm Management	5%		10%	
602	Business Management, Finance, and Taxation	10%		10%	
603	Market Economics	0%		15%	
604	Marketing and Distribution Practices	5%		10%	
605	Natural Resource and Environmental Economics	0%		10%	
606	International Trade and Development	0%		10%	
607	Consumer Economics	40%		10%	
610	Domestic Policy Analysis	25%		10%	
801	Individual and Family Resource Management	15%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	5.0	0.0
Actual Paid	0.0	0.0	7.4	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
208442	0	657885	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
208442	0	657885	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
1835460	0	2764221	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included a tick-by-tick and quote-by-quote examination of commodity markets to develop metrics on liquidity and transformation of information, an assessment of the impact of Dodd-Frank on agricultural producers, a study to analyze local, state, federal, and selected international laws that constitute the legal environment for agriculture [evaluating their impact on agricultural production and agri-business and on the protection and conservation of the environment], the application of mathematical programming methods and computer simulation models to address operations management and policy analysis problems [economic analyses of biofuels and bioenergy both at the U.S. and global level, optimum land use management for conservation and environmental protection, and supply chain management are typical examples of such problems], the use of rigorous statistical analysis to understand constraints on adoption of agricultural technologies in Africa and other developing regions and the impact of technologies when they are adopted [in the context of this work examining and adapting measures of food security relating to dietary diversity and also examining various economic impacts of animal agriculture], research to address the challenges faced by households in saving for housing [by evaluating a housing provident fund in China which consisted of voluntary or mandatory savings accounts and eligibility for discounted mortgage loans], an examination of young adults' major financial decisions such as student loans and homeownership as well as basic financial management behaviors, a study of how payday loan restrictions have affected crime in neighborhoods where payday loans used to be prevalent, ongoing work on the **Varietal Information Program for Soybeans** [VIPS] database that provides important results on soybean varieties planted throughout the State of Illinois and how they delivered for yield [the VIPS tool also provided key information on weed, disease, and insect resistance as well as renewed focus on quality measurements such as protein and oil content and amino acid profiles], an investigation into communication technologies and information outlets [modes] used by communities to share information about soy protein applications in the developing world, a project studying 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 [the research will explore both the drivers and the consequences of these inefficiencies and the economic effects of public and private sector initiatives to resolve market failures as well as the decisions and investments of farmers themselves], an effort to provide greatly needed information on the causes, consequences, and likely future of farmland prices, and the development of data related to the impact of crop insurance on the financial capacity of agricultural borrowers.

Conference presentations included the NCCC-134 Annual Meeting on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, National Dairy Markets and Policy Extension Education Committee, XXVIII European Congress on Rural Law, Agricultural and Applied Economics Association, Consultative Group for International Agricultural Research, National Defense University, International Crops Research Institute for the Semi-Arid Tropics, Asian Consumer and Family Economics Association,

International Conference of the Association for Public Policy Analysis and Management, Annual Meeting of the Population Association of America, Association for Financial Counseling and Planning Education, Michigan Agricultural Credit Conference, USDA Outlook Forum, and the Crop Insurance and Farm Bill Summit.

Extension specialists conducted the annual **Illinois Tax Schools** held in 30 locations in the state and five regional **Illinois Farm Economics Summits** that addressed farm profitability outlook and management challenges from several perspectives [including the 2015 outlook for prices, farm income prospects, land rents and valuation, long-term credit cycles, nutrient management, and the outlook for conventional bio-fuels]. During the months of January and February of 2015, 14 **Farm Bill** seminars were conducted by Extension specialists and held throughout Illinois to provide information to help farmers and landowners with payment yield and base acre reallocation decisions [also discussed in the evaluation section of this planned program]. Projecting returns for 2015 corn, soybeans, and wheat was a topic addressed at the four regional **Crop Management Conferences**.

Extension educators with consumer economics as their area of expertise supported programs this past year that included the **Financial Wellness Peer Educator** program that involved 25 trained college student interns in providing financial education outreach by talking with over 2,600 college students. Additional outreach was conducted through social media, YouTube, an e-newsletter with over 2,500 subscribers, and a six-session webinar series entitled **Get Savvy: Grow Your Green Stuff**. A revised and updated version of **All My Money**, a train-the-trainer curriculum for working with limited resource audiences, was completed this past year and piloted at a detention center. Other outreach included the **Plan Well, Retire Well** blog and e-newsletters, **America Saves** activities that included a friendly competition between the three University of Illinois campuses, and a "Paint-the Pig" party with over 165 students who took time to set savings goals, discuss savings, and paint a piggy bank. The competition resulted in 698 University staff and students setting a savings goal and ended during national **Money Smart Week** during which consumer science Extension educators conducted 51 programs that offered financial information that reached nearly 1,000 individuals. **Money Mentors**, a volunteer program that matched mentors with 99 mentees who sought help with basic money management, was conducted in five counties this past year [also discussed in the indicator and evaluation sections of this planned program].

Financial literacy for youth involved staff and volunteers in over 20 counties who conducted and evaluated knowledge gained by participants in **Welcome to the Real World**, a simulation that gives students [age 12 through young adults] a taste of managing income and expenses and is in the process of being updated [also discussed in the evaluation section of this planned program]. **Money Madness**, a new program for youth from second through fifth grade, was delivered in afterschool as well as classroom settings by volunteers from partner organizations.

2. Brief description of the target audience

Members of the target audience included academics and industry professionals from across the U.S. and around the globe, farmers, landowners, policymakers, regulators, practicing lawyers and academic lawyers in the U.S. and abroad, government regulatory agencies, processors and retail distributors of agricultural products, private firms with agricultural interests, public and private utility companies, international and domestic scholars in economics, financial planning, psychology, law, and demographics, financial educators, students, financial planning practitioners, soybean growers, food manufacturers, livestock feed manufacturers, NGO and USAID staff, professional farm managers, financial managers in the agricultural investment community, agricultural lenders, academic economists, agricultural production students, farm credit system lenders, agricultural policy committees, federal reserve banks, and academic researchers with an interest in agricultural finance.

Extension targeted audiences this past year included crop and livestock producers, land owners, financial

advisers, tax consultants, youth, college students, senior citizens, and consumers and families facing financial challenges.

3. How was eXtension used?

Three Illinois individuals are members of the Financial Security for All Community of Practice.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	12854	15913	3403	0

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

Patent Applications Submitted

Year: 2015

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	28	28

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2015	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Page File Requests Made To Farmdoc
2	Number Of Web Hits On The Varietal Information Program For Soybeans Website
3	Identification Of Strategies For Increasing Producer Value
4	Numbers Of Individuals Improving Financial Capability And/Or Adapting Consumer Behavior Skills
5	Number Of Youth Increasing Knowledge Of The Cost Of Independent Living
6	The Impact Of Recent Commodity Market Developments On Market Efficiency
7	Investigating How Households React To Investment Incentives For Energy Efficiency Improvements
8	Exploring The Impact Of Government Policy Decisions On Household Finance And Home Purchase
9	An Investigation Into Communication Technologies Used To Share Information About Soy Protein Applications In The Developing World
10	Increased Knowledge And Skills In Managing Income And Expenses
11	Number Of Individuals Increasing Knowledge Related To Making Payment Yield And Base Acre Reallocation Decisions

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
2015	18800000

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 2015 well over 18 million page requests and over 2.8 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 but scarcely imagined just ten years ago. The new farmdoc daily site has an eye towards not only the technology people are increasingly using to access information but also the desired form of the information. Information needs to be easily accessible across a variety of platforms [desktops, laptops, and mobile devices] and in a condensed format that fits the needs of busy people with hectic schedules.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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

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

Identification Of Strategies For Increasing Producer Value

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Numbers Of Individuals Improving Financial Capability And/Or Adapting Consumer Behavior Skills

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Number Of Youth Increasing Knowledge Of The Cost Of Independent Living

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

The Impact Of Recent Commodity Market Developments On Market Efficiency

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Recent developments in commodity markets [such as financialization, increases in biofuel production, climate change, and rising demand for agricultural commodities] may have involved profound shifts in the way commodity markets operate. The previous literature has looked at how these changes have impacted market efficiency and efficacy in the traditional roles of risk mitigation, coordinating production, and coordinating consumption through time. However, how these changes affect commodity markets tick-by-tick and quote-by-quote has not yet been considered.

What has been done

Correlation between quote revisions in nearby and deferred contracts measure information-based activity, and correlations between revisions of the time lagged nearby and deferred maturity measure the speed at which information is transmitted among the different futures maturities. Information based trading results in near perfect correlation between revisions to bids and offers in nearby and deferred contracts. We find that within one second information has been fully transmitted from nearby to deferred contracts.

Results

Since global price discovery occurs on global futures exchanges for the major food commodities, a deep consideration of these changes on trading activity, patterns, and consequences is warranted. During the first reporting period, we have used high frequency data [time stamped to the second] in order to allow for faster price change adjustments taking place after significant technical developments in trading platforms in the second half of the 2000's, characterized by high speed trading.

Our work has resulted in a change in knowledge by providing insights into the speed at which information is transmitted from the nearby to the deferred contracts. We focused our attention on

the corn market because it has experienced some of the most pronounced changes in recent years. As noted above, results indicate that by one second, any information that arrived to the market had been fully transmitted across all contract maturities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
603	Market Economics
606	International Trade and Development
610	Domestic Policy Analysis

Outcome #7

1. Outcome Measures

Investigating How Households React To Investment Incentives For Energy Efficiency Improvements

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Since the mid-1800's there has been a rapid increase in the combustion of fossil fuels [coal, oil, and gas], which has produced over 80% of global anthropogenic greenhouse gas emissions. Climate change is an emerging global threat to public health, largely due to its effects on agricultural systems. A rise in temperature, more variable precipitation, and increases in extreme weather events will reduce productivity of U.S. crops and expose livestock to higher degrees of heat and biotic stressors. Governments around the world are instituting a myriad of policy tools designed to curb climate change. Residential energy efficiency improvements are potentially one of the most cost effective ways to reduce greenhouse gas emissions. Energy efficiency advocates maintain that there are significant investments to be made in the residential sector that would pay for themselves in a short period of time. Paradoxically, many of these seemingly valuable economic improvements are not being made in the absence of public policy. This project aims 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.

What has been done

This research 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 research effort will be divided into efforts exploring the rental market and single family, owner occupied homes.

[1] The Rental Market: There are two potential market failures in energy use stemming from the landlord-tenant relationship. If landlords pay for energy, tenants will consume more than they otherwise would because the marginal cost of energy use is zero. If tenants pay for energy, landlords may under-invest in efficiency. Tenants are often uninformed about or inattentive to energy costs when choosing a unit. As a result, landlords will under-invest in efficiency because they cannot capitalize on these investments in the form of higher rents.

[2] Single Family Homes: The SAVE Act [Sensible Accounting to Value Energy] has been introduced in the U.S. Senate, which would require federal mortgage agencies to include energy costs in the underwriting process. The hope is to improve the quality of mortgage underwriting by providing a more accurate picture of repayment risk and the expected costs of home ownership. By requiring lenders to consistently and accurately account for energy cost in appraisals, lawmakers hope to encourage investment in energy efficiency and demand for energy efficient homes. This study will speak directly to this policy debate by determining the extent to which energy costs are being taken into account in the housing market.

Results

For the rental market, a working paper has been released as part of the E2e working paper series, WP-021. It demonstrates that there is asymmetric information between landlords and tenants about energy costs. This market failure can result in overuse on the order of 2% of energy consumption. For single family homes, a draft of a paper has been written. In it we found that home buyers are informed about energy costs, and they are not myopic. This work was presented at the Heartland Workshop at the University of Illinois and will also be presented at the American Economic Association meetings in 2016 and at the EPIC research lunch at the University of Chicago in February.

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 #8

1. Outcome Measures

Exploring The Impact Of Government Policy Decisions On Household Finance And Home Purchase

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

During this reporting period, we made considerable progress in understanding the household finance decisions for both the Chinese and U.S. populations. The findings not only provided insight into the long-term financial security of households but also have important implications for designing effective financial education and financial intervention programs.

To address the challenges faced by households in saving for housing, we evaluated a housing provident fund in China which consisted of a voluntary or mandatory savings account and eligibility for discounted mortgage loans. Our findings suggest that mandatory savings accounts earmarked for housing complemented by discounted loan opportunities could incentivize saving for housing and resolve the wealth, income, and credit constraints on homeownership. The findings of this study suggest the importance of designing government housing and mortgage programs that incorporate behavioral economics theories. There have been increasing applications of behavioral economics theories in policy designs regarding saving for retirement and education. More applications along this line can be explored to promote homeownership. In another paper we examined the security investment decisions of Chinese households, and we found that Chinese households who had investment knowledge and a long-term financial plan were more likely to participate in the securities markets.

Our research on the U.S. population focuses on the younger demographic. Young adulthood sets the stage for financial security in later life; as such, this study provides insight for lifelong financial well-being. This research examines young adults' major financial decisions such as student loans and homeownership as well as basic financial management behaviors. We reviewed student loan decisions regarding human capital investment and intergenerational wealth transfer and its impact on college enrollment, career, and other personal life decisions. We examined both external and internal factors that affect homeownership for millennials. We found that mortgage accessibility is a key constraint to homeownership for millennials. High student loan debt among millennials impedes their transition from renters to homeowners. Family events such as marriage, divorce, and childbearing are very much related to home purchase. We have initiated a study that investigates the generational differences in the perceived value of a college education and the differences in funding sources for a college education.

We also examined how payday loan restrictions have affected crime in neighborhoods where payday loans used to be prevalent. The empirical evidence suggests that theft declined in Chicago as the state implemented the Illinois Payday Loan Reform Act that restricted the loan amount, fees, terms, and number of concurrent loans and stipulated other measures to prevent repeated borrowing. The findings suggest that the lending restrictions prevented financial damages that could motivate crimes in extreme cases.

Results

A better understanding of what leads to poor financial outcomes can suggest alternative interventions to promote financial well-being in the next generation. We have developed a line of work that studies personality and financial behaviors. In our initial work, we established the cross-sectional correlations between personality traits and financial behaviors. These correlations are robust to controlling for early life background and other demographic and socioeconomic factors. The findings suggest that personality traits are human capital factors that are independent of other background factors that contribute to a young adult's financial outcomes. We expanded our early work to incorporate a behavioral genetics approach to partition the genetic and environmental components in financial behaviors and personality traits respectively. We are now working on exploring how personality traits affect financial behaviors through a genetic pathway. Findings from this study will shed light on the mechanism of individual differences in financial behaviors. Based on the empirical results, we can inform stakeholders how to design effective behavioral and policy interventions that can be used to improve financial well-being.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

An Investigation Into Communication Technologies Used To Share Information About Soy Protein Applications In The Developing World

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The goal of this research is to share information on soybean research, production, processing, and utilization in a useful and cost effective manner to foster communication between the U.S. and developing world public institutions, organizations, and industry. This improved communication would enhance information access for food processors, feeding organizations, and the agriculture community about the activities, investments, and outcomes of grower-supported soy protein work for the developing world. This program includes three phases: Phase I - Investigate communication technologies and information outlets [modes] used by communities to share information about soy protein applications in the developing world; Phase II - Select appropriate modes and design applications to create a technologically-driven communications environment for key audiences; and Phase III - Include research and industry data using static and dynamic resources to broaden the use of U.S. soybeans and soy processing and utilization technologies.

What has been done

Work in the past year focused on Phase I objectives: Investigate communication technologies and information outlets [modes] used by communities to share information about soy protein applications in the developing world. Research into preliminary background data was gathered on market capacity for U.S. soy protein and oil products and information technologies in Haiti, Ethiopia, Malawi, and Mozambique. In summary, the slow penetration of dependable broadband technologies in all of these countries would translate into difficulties meeting expectations. The African countries reviewed wish to grow their own market for domestic soybean. At this juncture, Haiti does not appear to have the infrastructure to effectively use information technology in the realm of soybeans.

Results

Cell phone technologies and broadband access and domestic soybean production and market demand were researched for Haiti, Ethiopia, Malawi, and Mozambique. The summary by country follows:

Haiti: There are issues with the speed and sustainability of telecommunication technologies in Haiti. Digicel had 85% of the cell phone market, with banking services offered, but limited availability in rural areas where information about soy is most important. Overall phone internet use has low market penetration [21%]. It is very premature to expect target populations of farmers and processors to use their cell phones as a dependable information source for U.S. soybean processing and protein applications.

Ethiopia: Ethiopia has just 24% of its population using cell phones, and the company providing the technology has a monopoly on fixed, mobile, internet, and data communications. Ethiopia has one of the lowest internet penetration rates in Africa at 1.5%. The country has created several initiatives to expand internet access with limited success.

Malawi: Cell phone and internet access in Malawi is expensive and is very slow to be adopted. There is just 4% of the population with internet access.

Mozambique: Mozambique has a higher rate of cell phone and internet access than the other countries in Africa reviewed, with three cell phone providers. There is rapid growth in the mobile-cellular network with mobile-cellular coverage in the main cities. The penetration though is still low, with about 35 per 100 persons having cell phone access. This is much lower in the rural areas. As discussed below, due to limited cell phone coverage and internet access, we suggest moving in a different direction with respect to the utilization of soy in these countries.

Availability of U.S. Soybeans and Soy Products

Haiti: Soybean production is limited, with almost all oil dependent on imports. The Haiti government desires more Haiti-based processing of soybeans into animal feed and oil to increase the country's food and feed infrastructure.

Ethiopia: Ethiopia produces about 49,110 tons of soy per year, and there are initiatives to produce more soybeans and sunflowers to reduce dependence on imported soy. Ethiopia uses its soy for edible oil, meal, and soy milk.

Malawi: Growing soybeans in Malawi is growing with production increasing 55% between 2000 and 2010. Yet the farmers are not meeting the demand for oil with Malawi importing 67% of their oil. Government and non-governmental organizations are actively promoting the growing and use of soybeans in Malawi.

Mozambique: There was a large increase in soybean production in Mozambique between 2000 and 2010, with 44% more soybeans produced. This is still not sufficient to meet the country's demand for oil, and internal transport from soybean producing areas to where end users are located is poor. There is increased promotion and support for improving domestic soybean production and less emphasis on importing soybeans.

4. Associated Knowledge Areas

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

Outcome #10

1. Outcome Measures

Increased Knowledge And Skills In Managing Income And Expenses

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1636

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Many adults strive to improve their financial situation, but lack the information and motivation needed to practice healthy financial habits. In addition, older youth need knowledge and skills to assist them in selecting careers and in managing income and expenses in order to live as an independent adult.

What has been done

Money Mentors, a USDA/NIFA supported volunteer program that matches trained volunteers with mentees who seek help with basic money management, was expanded this year to additional locations. Since the program's inception in 2013, 82 volunteers have received 30 hours of initial training and 12 hours of annual continuing education. The Money Mentors have been paired with 99 mentees who sought help with basic money management. The mentees completed a survey indicating the degree to which they were following 15 financial practices as a tool to identify areas that might warrant their assistance. Interviews were also used to discuss the type of assistance to be sought and whether they should be directed to another entity. The length and frequency of the mentoring process was dependent on the needs of the mentee and ranged from meeting a few times to continuing to meet for over a year.

Extension field staff members annually 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 in a family budget such as housing, utilities, food, transportation, insurance, and child care. Youth then complete an evaluation following the simulation.

Results

During the first year the Money Mentors completed a survey at the end of their training to determine their confidence in their knowledge and ability to work with the mentors to address their needs. Twenty-nine [29] mentees have successfully completed their goals. Information provided by mentees and their mentors indicate significant changes in mentees financial behaviors. For example, changes in healthy financial behaviors included: [1] Making the hard decision not to take a cash advance loan when feeling pressured; [2] Using an employer-sponsored retirement plan to save for retirement; [3] Saving money for the first month of rent to get a home or apartment; and [4] Reducing expenses by returning rent-to-own furniture and avoiding high interest rates. Using the Independent Sector value of a volunteer hour, Mentor's volunteer time is valued at \$35,305.

This past year two focus groups were used to explore program improvement/needs of the mentors and another was conducted with a group of mentees. The recordings have not yet been transcribed. Extension educators are planning to continue to explore tools that will help determine the changes made and sustained in the mentees' financial practices.

At the end of the Welcome to the Real World simulation, evaluation forms were completed and collected from 2,114 youth participants located across Illinois. The evaluation was designed to identify increased knowledge of financial management. The evaluation asked students to evaluate five money management skills choosing between "learned how to do" or "already knew how to do". Of the 2,114 youth respondents, 1,607 [76%] indicated that they learned at least one of the five skills with the largest number reporting learning how to balance income and expenses. More information can be found in the evaluation section of this planned program.

4. Associated Knowledge Areas

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

Outcome #11

1. Outcome Measures

Number Of Individuals Increasing Knowledge Related To Making Payment Yield And Base Acre Reallocation Decisions

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	331

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The decisions farmers and landowners make regarding payment yield and base acre reallocation were two of the requirements of the 2015 Farm Bill. Farmers and landowners faced challenges in understanding the content of the Farm Bill and needed assistance in making these decisions.

What has been done

During the months of January and February of 2015, fourteen seminars were held throughout Illinois to provide information regarding the Farm Bill to help farmers and landowners with payment yield and base acre reallocation decisions by February 27 and other Farm Bill decisions by March 31. Following the conclusion of each meeting, participants were asked to complete an evaluation regarding the quality of the program, knowledge gained, and intention to use the information received. Three hundred thirty-one [331] participants completed the evaluation.

Results

The 331 individuals who participated in one of the fourteen University of Illinois Farm Bill seminars conducted across the state were asked to complete an evaluation at the end of the seminar. Using a seven-part scale with 1 = low and 7 = high, their group average rating was above a "6" with respect to the quality of the presentations and training [6.30] and quality of materials and information [6.18] provided. When asked to rate their knowledge about the Farm Bill before and after the program, the average group rating increased considerably from 2.77 to 5.33. Also of note, they intend to use the information received in making required decisions related to the 2015 Farm Bill as reflected in the average group score of 6.19. Given the opportunity to make comments, the majority who did so expressed their appreciation for the quality and value of these seminars.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
610	Domestic Policy Analysis

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

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 and collected from 2,114 of the youth participants located across Illinois. The evaluation was designed to identify increased knowledge of financial management. The evaluation asked students to evaluate five money management skills choosing between "learned how to do" or "already knew how to do". Of the 2,114 youth respondents, 1,607 [76%] indicated that they learned at least one of the five skills: [1] 1,275 [60%] reported learning how to balance income and expenses; [2] 1,171 [55%] learned how to open a savings account; [3] 1,031 [49%] learned how to balance a checkbook; [4] 1,007 [48.0%] gained skill in keeping track of savings; and [5] 498 [24%] learned how to write a check.

When students were asked to indicate their awareness or knowledge of three items related to a future career after, as compared to before, they participated in **Welcome to the Real World** by checking "not much", "a little", or "a lot", 1,080 [52%] of the 2,077 students who completed this set of questions indicated increasing their awareness or knowledge for at least one of the three items after participating in the program. Levels of students who indicated increases for a given item follow. The numbers do not include those whose ratings remained the same after as compared to before the program or those who failed to provide both a "before" and "after" rating: [1] 809 of 2,069 [39%] indicated increasing their awareness or knowledge of the relationship between education and money; [2] 794 of 2,066 [38%] of the students indicating increasing their awareness or knowledge of the relationship of a job and money; and [3] 504 of 2,063 [24%] of the students indicated increasing their awareness or knowledge of the importance of getting more education after high school.

Key Items of Evaluation

Simulations help youth recognize the challenges of independent living. There is a need to determine the scope of the use of curriculum materials in the schools where the simulation was conducted.

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

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.0	0.0
Actual Paid	0.0	0.0	10.5	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
19390	0	1453466	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
19390	0	1453466	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
170740	0	8846335	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included an investigation of potential chemokines that can be used to recruit osteo-progenitor cells to sites of bone repair, experiments addressing the hypothesis that bisphosphonate administration will delay cortical bone defect repair under conditions where osteo-progenitor migration is a requirement for repair, the formulation of diets that meet the requirements of cows but avoid over-consumption of energy to improve outcomes of the transition period and lead to improved fertility, the successful performance of ELISA and DLS screening on H1 subtype influenza viruses to evaluate binding of a panel of different anti-influenza virus antibodies and demonstrate excellent correlation between ELISA screening and the DLS assay to examine the affinity of these antibodies for different influenza viruses [importantly, DLS results were obtained in 30 minutes compared to a 24 hour ELISA], the development of research findings that could help the dairy goat industry genetically improve the health of goats and increase milk production, and a close examination of individual dietary macronutrients and other components known to affect microbial-derived fermentative metabolites and/or barrier function [such as prebiotics] in growing pigs.

Activities also included the development and application of advanced analytical approaches to identifying genes, transcripts, and pathways associated with health, performance, production, and behavior traits using information from next-generation genomic and transcriptomic technologies, work to elucidate molecular and cellular processes that regulate differentiation and growth of skeletal muscle [providing the basic knowledge necessary to increase the efficiency of lean meat production in meat-producing animals], the identification of the molecular sources of individual variation in response to the changing environment [providing a foundation for developing effective methods for the assessment of stress-related behaviors and the potential improvement of livestock through selection], a study with the goal of developing a modified live vaccine that will elicit a protective immune response against strangles that is free of the significant safety risks associated with the currently marketed Pinnacle IN product, the validation of a mouse model of renal ischemia/reperfusion [I/R] injury that represents an alternative to the unilateral ureter obstruction [UUO] model of renal failure, a study that seeks to determine the pharmacokinetics of transmucosal meloxicam via both oral and rectal routes in piglets in hopes of identifying this route as an efficacious, efficient, and minimally stressful way of providing pain management during castration, and work to better understand how early-life infection affects brain microglial cells, making them hypersensitive to subsequent stimuli.

Activities also included research to determine if Hif2a-mediated signaling is involved in the generation of critical maternal nutrients and metabolites in ovine endometrial stromal cells [a clear understanding of the mechanisms by which maternal nutrition and metabolites impact establishment of pregnancy may provide insights for improving the reproductive outcome of the ewe], the finding that the energy value of soybean

meal produced in the United States is greater than what has previously been concluded [this will increase the economic value of soybean meal from the United States], the use of microbiomic analysis to evaluate the intestinal microbial population of the newborn calf [our data has helped elucidate the main composition of the different microbial communities in the different intestinal segments], work to identify and quantify molecular, cellular, and organismal signals that regulate partitioning and efficient conversion of nutrients to milk, a study to determine if feeding an excess calorie high fat diet and the consequent development of obesity would lead to alterations in the morphology of the small intestine and distribution of enteroendocrine cells, a project with the goal of determining if whole blood from horses can have the number of white cells in it reduced by filtering after collection using special leukoreduction filters, and a study designed to serve as a "proof of concept" project to demonstrate the influence of management on the host-microbiome ecosystem and animal performance and to establish a unique and versatile model livestock system to help identify, study, and control the principal drivers of swine intestinal and respiratory microbiome configurations that are associated with health and production [the long term goal will be to apply a management-based approach to controlling the microbial ecosystem within a production unit, thereby reducing the use of antimicrobials].

Conference presentations included the 45th Central Region American Chemical Society, Veterinary Orthopaedic Society, American College of Veterinary Pathologists, American College of Wound Healing and Regeneration, Professional Dairy Producers of Wisconsin Transition Cow Conference, American Society of Animal Science, American Dairy Science Association, American Society of Nutrition, 4th Annual Genomics and Computational Biology Symposium, 80th Annual Meeting of the Society for American Archaeology, Advances in Canine and Feline Genomics and Inherited Disease, VII European Congress in Mammalogy, Chromosoma 2015, American Association of Veterinary Laboratory Diagnosticians, Illinois State Veterinary Medical Association, American Association of Veterinary Parasitologists, International Veterinary Emergency and Critical Care Symposium, American Angus Association, American International Charolais Association, National Program for Genetic Improvement of Feed Efficiency in Beef Cattle, Beef Improvement Federation, and the Conference of Research Workers in Animal Disease.

Two key programmatic thrusts characterize Extension livestock production education: [1] Increasing reproductive efficiency; and [2] Reducing livestock production input costs. Two Extension educators located in research stations provided leadership for a number of programs that focused on beef production. These included statewide **Beef Quality Assurance** certifications, **Sire Selection and Reproduction Management** seminars, the **Illinois Performance Tested Bull Sale and Illinois Beef Exposition**, the **Illinois Cattle Feeders** day, the **Illinois Forage Institute**, and the **Southern Illinois and Driftless Area Beef Conferences** [with the latter attended by participants from Illinois, Iowa, Minnesota and Wisconsin]. Other local and regional programs included pasture walks, research farm field days, and regional **Cow/Calf Seminars**. The University of Illinois College of Veterinary Medicine also offered the **Executive Pork Producers Program** which addressed essential skills for excellence in swine business management and the **Executive Veterinary Program in Swine Health Management** which covered the essential aspects of swine production medicine for veterinarians.

Five educational workshops for sheep and goat producers were offered and attended by nearly 100 producers in the southern and northern parts of the state. Three **Dairy Summit** meetings were held throughout the state for dairy producers and included presentations on feeding strategies for 2015, dairy related regulations updates, university research, and dairy focus team activities [additional information can be found in the evaluation section of this planned program on the sheep and goat workshop and the Dairy Summits].

Certified Livestock Manager Training Workshops targeted at manure management are examples of programs that were delivered by Extension staff to audiences at 10 locations in the state at campus and off-campus sites. This program is also discussed in the Agricultural and Biological Engineering planned program.

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**, the regional and state **Horse Bowl/Hippology**, and speech contests. The Extension faculty specialist in poultry taught teachers how to use the curriculum and incubators for the 4-H chick incubation and embryology project in 232 classrooms that included 12,290 youth during the 2014-15 school year [this is also discussed in the 4-H Youth Development planned program]. In addition, 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. Pet columns are provided on a variety of topics and species by the University of Illinois College of Veterinary Medicine. The Companion Animal Biology and Humane Education outreach program engages in strong relationships with local agencies such as the Companion Animal Research and Education Center.

2. Brief description of the target audience

Members of the target audience included poultry producers, veterinarians, the general public, veterinary and biomedical orthopaedic researchers, veterinary surgeons, beef and dairy farmers, nutritionists, students, national and international dairy goat farmers, scientists in academia, industry and government researching molecular mechanisms that influence performance, health, and behavior in food and biomedical animals, livestock producers, farmers, pork producers, nutritionists in feed companies, swine integrators, animal scientists working in the fields of nutrition, physiology, reproduction, and genetics, breed associations, beef cattle producers, pharmaceutical and animal nutrition companies, and scientists involved in investigating the development of effective vaccines against porcine reproductive and respiratory syndrome virus.

Extension targets livestock producers, custom manure haulers, 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

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2412	5783	11596	0

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

Patent Applications Submitted

Year: 2015
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	45	45

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2015	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	Enhancing The Efficiency Of Feed Utilization In Beef Production Systems
4	Treating Forages Prior To Feeding To Improve Feeding Value
5	Improved Understanding Of The Role Of Nutrition Before And After Calving On Endocrine Function And Fertility
6	Improving The Health Of Dairy Goats Through The Development Of New Genetic Resources
7	Identifying Genes, Transcripts, And Pathways Associated With Health In Livestock
8	Testing The Hypothesis That Postnatal Viral Infection And Subsequent Activation Of Brain Microglial Cells Disrupts Neurodevelopment Resulting In Reduced Resilience
9	Improving Control Methods Of Strangles Infection In Horses
10	Understanding The Link Between The Dry Period Dietary Energy Management And The Inflammatory Status Around Parturition
11	Understanding The Mechanisms Of Insulin Signalling In Adipose Tissue And Skeletal Muscle Of Dairy Cows As It Relates To Plane Of Dietary Energy
12	Decreasing Storage Injury From Blood Transfusions
13	Aspirations To Enhance Profitability Of Livestock Production And Management
14	Aspirations To Reduce Risks In Livestock Production

Outcome #1

1. Outcome Measures

Increased Knowledge Of Livestock Care And Management

Not Reporting on this Outcome Measure

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
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The goal of this project's contribution to Multistate Project NC-1180 "Control of Emerging and Re-Emerging Poultry Respiratory Diseases in the United States" is to collaborate on the development of a surface-enhanced Raman spectroscopy [SERS] based avian influenza virus diagnostic assay that will allow for rapid detection of avian influenza and allow for multiplexing for detection of multiple influenza virus hemagglutinin subtypes simultaneously. A diagnostic method for rapid, in the field subtyping of outbreaks of avian influenza virus in poultry is a critical area in need of development that would aid in rapid response and risk assessment of an avian influenza outbreak in poultry.

What has been done

We successfully performed ELISA and DLS screening on H1 subtype influenza viruses to evaluate binding of a panel of different anti-influenza virus antibodies and demonstrated excellent correlation between ELISA screening and the DLS assay to examine the affinity of these antibodies for different influenza viruses, supporting that DLS will be a robust platform. Importantly, DLS results were obtained in 30 minutes compared to a 24 hour ELISA. Some of the polyclonal antibodies tested demonstrated better intrasubtypic cross reactivity with weak reaction to the H3 influenza virus.

Results

These results demonstrated the high likelihood of obtaining optimal antibodies for use in the DLS and SERS platforms for AIV detection. In FY 2015, we built on these initial studies by screening antibodies against multiple subtypes of AIVs. We obtained and propagated stocks of eight different AIVs including H1, H3, and H9 subtypes. We identified a polyclonal anti-H3 antibody that demonstrated broad intrasubtypic cross reactivity as well as weak cross reactivity between different subtypes. Initial work was performed to explore DLS and SERS with this anti-H3 antibody. However, optimization for the immunolabeling step is still in progress. We also developed a lysis buffer and screened several anti-M1 antibodies against several influenza viruses, although we were unable to identify an anti-M1 antibody that demonstrated broad cross reactivity with the potential to serve as a universal detection for multiple AIV subtypes during FY 2015.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #3

1. Outcome Measures

Enhancing The Efficiency Of Feed Utilization In Beef Production Systems

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Treating Forages Prior To Feeding To Improve Feeding Value

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Improved Understanding Of The Role Of Nutrition Before And After Calving On Endocrine Function And Fertility

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A better understanding of the role of global nutrition of the cow's diet before and after calving on its endocrine function and fertility would increase postpartum reproductive performance in dairy cows. Reproductive failure is one of the major reasons that dairy cows are marketed for beef. This failure, accounting for 20-25% of animals culled, has a great economic impact on dairy farms and agriculture at large. The central thesis of the proposed research is that feeding a high-energy diet before calving to dairy cows will induce insulin resistance [IR], which in turn will predispose cows to other metabolic disorders [such as ketosis and fatty liver] and to reproductive failure [uterine pathologies and increased days to pregnancy]. Therefore, we hypothesize that decreasing the intensity of IR in dairy cows during the transition period by feeding the flavonoid Naringenin will reduce metabolic disorders, improve milk production, and improve reproductive performance.

What has been done

Nutritional strategies and feeding management during pre-calving and post-calving periods impact health, productivity, and fertility of high-producing dairy cows. Formulating diets to meet requirements of the cows but avoid over-consumption of energy may improve outcomes of the transition period and lead to improved fertility. Management to improve cow comfort and ensure good intake of the ration is pivotal for success. Impacts of the transition program should be evaluated in a holistic way that considers disease occurrence, productivity, and fertility. Additionally, BW and BCS at breeding tended to increase as the plane of nutrition was increased during either mid or late gestation.

Results

The plane of nutrition during mid or late gestation did not affect cyclicity, concentrations of blood hormone, or embryo quality. However, when cows were fed diverging planes of nutrition during late gestation in Experiment 1, cows fed 70% REQ and REQ tended to have a greater number of embryos recovered and embryos cleaved or degenerated when compared with cows that were fed 130% REQ. When cows were fed diverging planes of nutrition during mid-gestation in Experiment 2, cows fed 70% REQ and 130% REQ flushed a greater number of embryos when compared with cows fed 100% REQ. Feeding diverging planes of nutrition in either mid or late gestation did not impact the number of embryos that were frozen.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #6

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The goat is a species of growing importance to U.S. agriculture. According to the National Agricultural Statistics Service, the number of goats raised in the U.S. is now close to three million. Although some genetic resources have been developed for goats, the species has not been as intensively studied as other agricultural species. Our preliminary data has found that some goat ERVs are insertionally polymorphic, and thus could be used as genetic markers, while the relatively lower degree of genetic marker development in the goat suggests that retrotype markers would add to our knowledge of a livestock species of growing importance to U.S. agriculture.

What has been done

Whole blood samples were obtained from forty domestic goats [*Capra hircus*] including Nubian, LaMancha, and cross breeds. Twenty-two samples came from goats with low somatic cell counts [SCC < 200]; the additional samples were from goats with high somatic cell counts [SCC > 200]. DNA was isolated from the samples using the Qiagen DNeasy Blood and Tissue Kit.

Results

Previously published TLR2 primers successfully produced an amplicon of expected size. Three single nucleotide polymorphisms [SNPs] were identified in the sequence of TLR2 in the goats, of which two were synonymous. The nonsynonymous mutation resulted in a Valine [Val] to

Isoleucine [Ile] amino acid substitution. Goats heterozygous for the nonsynonymous mutation had significantly [p<0.02] lower SCCs than the homozygous goats. The findings of this study could potentially help the dairy goat industry genetically improve the health of goats and increase milk production and are being readied for publication.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #7

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
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

This project is focused on the development and application of advanced analytical approaches to identify genes, transcripts, and pathways associated with health, performance, production, and behavior traits using information from next-generation genomic and transcriptomic technologies.

What has been done

Levels of myostatin expression and physical activity have both been associated with transcriptome dysregulation and skeletal muscle hypertrophy. The transcriptome of triceps brachii muscles from male C57/BL6 mice corresponding to two genotypes [wild-type and myostatin-reduced] under two conditions [high and low physical activity] was characterized using RNA-Seq. Synergistic and antagonistic interaction and ortholog modes of action of myostatin genotype and activity level on genes and gene pathways in this skeletal muscle were uncovered. 1,836, 238, and 399 genes exhibited significant [FDR-adjusted p < 0.005] activity-by-genotype interaction,

genotype, and activity effects, respectively. The most common differentially expressed profiles were: [1] Inactive myostatin-reduced relative to active and inactive wild-type; [2] Inactive myostatin-reduced and active wild-type; and [3] Inactive myostatin-reduced and inactive wildtype.

Results

Several remarkable genes and gene pathways were identified. The expression profile of nascent polypeptide-associated complex alpha subunit [Naca] supports a synergistic interaction between activity level and myostatin genotype, while Gremlin 2 [Grem2] displayed an antagonistic interaction. Comparison between activity levels revealed expression changes in genes encoding for structural proteins important for muscle function [including troponin, tropomyosin, and myoglobin] and for fatty acid metabolism [some linked to diabetes and obesity, DNA-repair, stem cell renewal, and various forms of cancer]. Conversely, comparisons between genotype groups revealed changes in genes associated with G1-to-S-phase transition of the cell cycle of myoblasts and the expression of Grem2 proteins that modulate the cleavage of the myostatin propeptide. A number of myostatin-feedback regulated gene products that are primarily regulatory were uncovered, including microRNA impacting central functions and Piezo proteins that make cationic current-controlling mechanosensitive ion channels. These important findings extend hypotheses of myostatin and physical activity master regulation of genes and gene pathways, impacting medical practices and therapies associated with muscle atrophy in humans and companion animal species and genome-enabled selection practices applied to food-production animal species.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
315	Animal Welfare/Well-Being and Protection

Outcome #8

1. Outcome Measures

Testing The Hypothesis That Postnatal Viral Infection And Subsequent Activation Of Brain Microglial Cells Disrupts Neurodevelopment Resulting In Reduced Resilience

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The substantial increase in total brain volume in piglets the first few months after birth suggests that this is a period when disruption of neurodevelopment by environmental insults may affect brain structure and function, changing the trajectory for normal behavioral development. One hypothesis suggests that the postnatal period is a sensitive time during which exposure to environmental insults programs biological systems in a manner that persists and accentuates vulnerability to stress later in life.

This hypothesis is predicated on environmental insults influencing structural and functional plasticity of the brain and subsequent resilience. A loss of resilience is important to pig production because an exaggerated stress response negatively impacts animal well-being, reduces production efficiency, and leads to pre- and post-slaughter losses. This project will test the hypothesis that postnatal viral infection and subsequent activation of brain microglial cells disrupts neurodevelopment resulting in reduced resilience.

What has been done

Although poorly understood, early-life infection is predicted to affect brain microglial cells, making them hypersensitive to subsequent stimuli. To investigate this further, we assessed gene expression patterns in hippocampal tissue obtained from a previously published study reporting increased microglial cell activity and reduced hippocampal-dependent learning in neonatal piglets infected with porcine reproductive and respiratory syndrome virus [PRRSV], a virus that induces interstitial pneumonia. Infection altered expression of 455 genes, of which 334 were up-regulated and 121 were down-regulated. Functional annotation revealed that immune function genes were enriched among the up-regulated differentially expressed genes [DEGs], whereas calcium binding, cytoskeleton organization, and synaptic vesicle genes were enriched among the down-regulated DEGs. Twenty-five genes that are part of the microglia sensory apparatus [such as the sensome] were upregulated [IL1R1, TLR2, and TLR4], whereas 15 genes associated with the synaptosome and post-synaptic receptors [NPTX2, GABRA2, and SLC5A7] were down-regulated. As the sensome may foretell microglia reactivity, we next inoculated piglets with sterile culture medium or PRRSV at PD 7 and assessed hippocampal microglia morphology and when signs of acute infection were waning.

Results

Consistent with amplification of the sensome, microglia isolated from PRRSV piglets demonstrated enhanced responsiveness to chemoattractants, showed increased phagocytic activity, and secreted more TNF alpha in response to lipopolysaccharide and Poly I:C. Immunohistochemical staining indicated PRRSV infection affected microglia soma length and length-to-width ratio. Furthermore, bipolar rod-like microglia not evident in hippocampus of control piglets were present in infected piglets. Collectively, this study suggests early-life infection alters the microglia sensome as well as microglial cell morphology and function. The results highlight a new potential role for the microglial sensome in the response to peripheral infection. Said changes may result in animals that are less resilient to stress.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals

305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #9

1. Outcome Measures

Improving Control Methods Of Strangles Infection In Horses

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Strangles is a highly contagious *Streptococcus equi* ssp. *equi* [*Strep. equi*] infection that continues to plague the horse industry worldwide. The upper respiratory tract infection causes swelling of lymph nodes that can lead to airway obstruction and sometimes death of the horse. Control in the U.S. has been primarily by vaccination with Pinnacle IN, a modified live intranasal vaccine that was developed in the 1980's using chemical mutagenesis to create an attenuated strain. While an effective immunogen, the Pinnacle vaccine will, in as many as 25% of weanlings vaccinated, revert to virulence and cause clinical disease. Furthermore, there are no means to serologically differentiate between infection with the wild type strain or the vaccine strain in clinically ill horses and genetic sequence analysis of the *Strep. equi* isolate must be performed to identify the strain recovered. This could have a huge impact as horses infected with the wild type pathogenic *Strep. equi* are quarantined while horses with adverse vaccine reactions are not restricted.

What has been done

Work has focused on creating a safer vaccine with larger deletions of the virulence regulatory genes to assure that reversion to virulence is not possible. Preliminary trials show the new vaccine to be safe and not cause clinical disease. This being accomplished, we are now concerned with the efficacy or ability of the new vaccine candidates to result in protective immunity. A preliminary trial has shown some promise, and the intent of this project is to examine the sera from the experimental and Pinnacle IN vaccinated and challenged weanlings to identify immunoreactive surface antigens. These antigens will then be purified to develop an ELISA to

serologically identify wild type versus vaccine antibody titers. These reagents would also be useful for differentiating strangles versus vaccine titers.

Results

The monoclonal antibodies have been validated for the detection of Streptococcus equi subsp. equi antigens and have been tested for competitive ELISAs to determine titers of vaccinated horses and/or strangles infected horses. Vaccinated horses demonstrated on average 10-fold increases in titer specific to M-protein while clinically ill horses exhibited increased titers in excess of 100-fold. Strep. zoo.- like protein titers were on average 2-fold lower than M-protein titers in the competitive ELISA. A standard operating procedure is being developed to utilize these reagents for diagnostic purposes at the University of Illinois Veterinary Diagnostic Laboratory and testing will be offered for use by veterinarians throughout the United States.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #10

1. Outcome Measures

Understanding The Link Between The Dry Period Dietary Energy Management And The Inflammatory Status Around Parturition

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The prepartal dietary energy level is tightly correlated with the degree of tissue mobilization that the animal experiences around parturition [giving birth]. To better understand the link between dry period dietary energy management and the inflammatory status around parturition, 12 multiparous Holstein cows were fed for the entire dry period either a high-wheat straw/lower-energy diet to supply at least 100% of the calculated net energy for lactation [NEL] [control, CON]

or a higher energy diet to supply >140% of NEL [overfed, OVE].

What has been done

Blood was sampled throughout the transition period for biomarker analyses. Liver tissue samples were taken on days -14, 7, 14, and 30 relative to parturition for triacylglycerol [TAG] composition and gene expression analysis. Fifty genes involved in inflammation, endoplasmic reticulum [ER], oxidative stress, and cell cycle and growth were evaluated. Although blood biomarkers did not reveal signs of a greater inflammatory status compared with OVE, CON cows had a greater activation of the intrahepatic unfolded protein response prepartum. However, postpartum mRNA profiling indicated that the OVE group experienced a mild but sustained level of ER stress along with higher oxidative stress and impairment of antioxidant mechanisms. After parturition, inflammation-related genes were upregulated in OVE cows compared with CON. However, CON cows experienced a gradual increase in expression of key inflammatory transcription regulators up to 30 days postpartum which agreed with the lower plasma albumin and cholesterol, suggesting an inflammatory state.

Results

Data underscored that ER stress is not necessarily linked with inflammation during the peripartal period. Gene expression data also suggest that prepartum overnutrition could have negative effects on normal cell cycle activity. Overall, allowing cows to overconsume energy prepartum increased the hepatic pro-inflammatory response prepartum and up to the point of parturition. Subsequently, cows fed the lower-energy diet experienced a gradual increase in the inflammatory response. The lack of differences between groups in voluntary feed intake and lactation capacity suggests that nutritional management prepartum triggers different mechanisms that affect ER and oxidative stress along with inflammation. Although no clinical disorders were detected, these alterations expose animals to the development of immunometabolic disorders.

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
315	Animal Welfare/Well-Being and Protection

Outcome #11

1. Outcome Measures

Understanding The Mechanisms Of Insulin Signalling In Adipose Tissue And Skeletal Muscle Of Dairy Cows As It Relates To Plane Of Dietary Energy

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The mechanisms of insulin signalling in adipose tissue and skeletal muscle of dairy cows as it relates to plane of dietary energy are still not well understood. The effects of dietary energy level and 2,4-thiazolidinedione [TZD] injection on feed intake, body fatness, blood biomarkers and TZD concentrations, genes related to insulin sensitivity in adipose tissue [AT] and skeletal muscle, and peroxisome proliferator-activated receptor gamma [PPARG] protein in subcutaneous AT [SAT] were evaluated in Holstein cows.

What has been done

Fourteen nonpregnant nonlactating cows were fed a control low-energy [CON, 1.30 Mcal/kg] 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] and half of the cows continued on CON for six weeks. All cows received an intravenous injection of TZD starting two weeks after initiation of dietary treatments and for an additional two weeks, which served as the washout period. Cows fed OVE had greater energy intake and body mass than CON, and TZD had no effect during the administration period.

Results

The OVE cows had greater TZD clearance rate than CON cows. The lower concentration of nonesterified fatty acids [NEFA] and greater concentration of insulin in blood of OVE cows before TZD injection indicated positive energy balance and higher insulin sensitivity. Administration of TZD increased blood concentrations of glucose, insulin, and beta-hydroxybutyrate [BHBA] at two to four weeks after diet initiation, while the concentration of NEFA and adiponectin [ADIPOQ] remained unchanged during TZD. The TZD upregulated the mRNA expression of PPARG and its targets FASN and SREBF1 in SAT, but also SUMO1 and UBC9 which encode sumoylation proteins known to down-regulate PPARG expression and curtail adipogenesis. Therefore, a post-translational response to control PPARG gene expression in SAT could be a counteregulatory mechanism to restrain adipogenesis. The OVE cows had greater expression of the insulin sensitivity-related genes IRS1, SLC2A4, INSR, SCD, INSIG1, DGAT2, and ADIPOQ in SAT. In skeletal muscle, where PPARG and its targets orchestrate carbohydrate metabolism and fatty acid oxidation, the OVE cows had greater glyceroneogenesis [higher mRNA expression of PC and PCK1], whereas CON cows had greater glucose transport [SLC2A4]. Administration of TZD increased triacylglycerol concentration and altered expression of carbohydrate- and fatty acid oxidation-related genes in skeletal muscle. Results indicate that overfeeding did not affect insulin sensitivity in nonpregnant, nonlactating dairy cows. The bovine PPARG receptor appears TZD-responsive, with its activation potentially leading to greater adipogenesis and lipogenesis in SAT,

while differentially regulating glucose homeostasis and fatty acid oxidation in skeletal muscle. Targeting PPAR γ via dietary nutraceuticals while avoiding excessive fat deposition might improve insulin sensitivity in dairy cows during times such as the peripartal period when the onset of lactation naturally decreases systemic insulin release and sensitivity in tissues such as AT.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
315	Animal Welfare/Well-Being and Protection

Outcome #12

1. Outcome Measures

Decreasing Storage Injury From Blood Transfusions

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Transfusion of blood and blood products can produce deleterious reactions. Leukoreduction [LR] of blood reduces transfusion reaction frequency in people and decreases storage injury over time. We hypothesized that LR of equine blood was possible and would decrease storage injury.

What has been done

Two anticoagulated units of whole blood, LR and non-leukoreduced [non-LR], were collected from 10 normal horses and stored at 4 degrees C for 35 days. Complete blood counts [CBCs] were performed at collection [pre-LR and LR; non-LR]. Blood gas, L-lactate, and potassium measurements were made at collection and once weekly for 35 days. CBC differences were evaluated using Kruskal Wallis. Linear regression and general linear model MANOVA were used to evaluate associations and changes over time; $p < 0.05$. LR decreased WBC and platelet count by 99.8% and 76.1%, respectively. pO_2 was significantly [$p < 0.001$] larger in LR blood compared to non-LR [except at collection] while pCO_2 was lower [$p < 0.001$]. pH decrease and L-lactate

increase over time were significantly larger [$p < 0.05$] in non-LR blood. pH decrease was significantly associated with pCO₂ increase [$p < 0.001$] but not L-lactate increase [$p = 0.152$]. Potassium accumulation was similar but slightly less in non-LR blood. Leukoreduction is possible and effective for equine whole blood. The large pO₂ in LR blood may predispose LR blood to oxidative injury.

Results

Previously undescribed to our knowledge, pH change was predominately influenced by pCO₂ and not L-lactate. While the linear K increase [LR and non-LR] was in the expected range, there is evidence for greater cold temperature Na-K-ATPase inhibition in LR blood. The concentrations of IL-6 and IL-8 were determined by enzyme linked immunosorbent assays [ELISA] and were found to accumulate over time in both LR and non-LR blood. The statistical analyses were conducted using paired T-test [$p < 0.05$], Kruskal-Wallis, and Minitab 17 [$p < 0.05$]. It was concluded that leukoreduction effectively reduces WBC and PC in equine whole blood but does not impact accumulation of either IL-6 or IL-8 during storage. Some horses did not mount a measurable IL-6 response over time during storage. Overall increases over storage time in both IL-6 and IL-8 confirm an increase in pro-inflammatory responses in stored equine blood over time. These data suggest that transfusion of older stored equine whole blood might play a role in induction of adverse reactions to blood transfusion.

4. Associated Knowledge Areas

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

Outcome #13

1. Outcome Measures

Aspirations To Enhance Profitability Of Livestock Production And Management

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	43

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Maintaining production and profitability of the livestock industry in Illinois is an issue addressed through a number of University of Illinois Extension programs. Priorities in dairy production focus on production management [addressing new issues involving health, feeding, reproduction, genetics, and management] that enhance producers profitability and provides quality meat and dairy products for consumption.

What has been done

A new Extension dairy specialist provided leadership for the annual series of Dairy Summits held in three locations in the state. Economic opportunities were the focus of the 2015 program content that included sessions addressing a feeding checklist, University of Illinois research, dairy survey results, a generation transfer producer panel, and updates on the Concentrated Animal Feedlot Operations [CAFO] regulation program and Margin Protection Program [MPP], a voluntary program which places an emphasis on protecting income over feed cost margins. At the conclusion of the program evaluations were distributed, collected from 68 participants, and summarized.

Results

When asked if their personal objectives for attending the Dairy Summit were met, 65 of the 68 attendees who answered this question indicated that their personal objectives were met. In addition, participants were asked to rate how much they learned in each of the topics they attended using a four part-scale with 1 = "not met", 2 = "a little bit", 3 = "quite a bit", and 4 = "a lot". Sessions that received an average response rating above a "3" included: [1] The panel that addressed generation transfer of dairy farms [3.34 average score]; [2] Dairy Margin Protection Program [3.11 average score]; [3] Results of the Illinois dairy farm visits/assessments by a team of individuals that included the new specialist [3.12]; and [4] A feeding checklist for 2015 [3.29].

Approximately two-thirds of the respondents [43 of 68] indicated that they planned to make a change/do something differently regarding what they learned during the Summit. Plans mentioned addressed improving management by monitoring data, feeding practices, breeding practices, drones and IR camera use, and following items on the feeding checklist. In addition, 17 participants indicated they would like to have their farm visited by the Dairy Focus Team in the future.

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
307	Animal Management Systems

Outcome #14

1. Outcome Measures

Aspirations To Reduce Risks In Livestock Production

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1731

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

A University of Illinois Extension beef specialist and a Missouri small ruminant state Extension specialist at Lincoln University conducted a workshop held in Jefferson City, Missouri for producers interested in or currently raising goats and sheep. The title and focus of the workshop "Managing Risk for Small Ruminants" was attended by 25 producers. At the end of the program, participants were asked to respond to questions designed to assist in improving future programs and determining changes in knowledge regarding topics that covered a variety of health risks during the program. Seventeen participants responded.

Training was provided to 4-H youth enrolled in livestock projects via an online module on ethical treatment of animals that also included an examination to certify that they have the required knowledge. In addition, face-to-face training is offered in some locations that combine ethics and actual livestock production basics. This past year all counties made completion of the training a requirement for those youth enrolled in dairy, swine, beef, horses, rabbits, sheep, goats, and dogs.

Results

At the end of the "Managing Risk for Small Ruminants" program producers were asked to indicate to what extent they thought they learned about five areas of knowledge using a 5-part scale with 1 = "not much", 3 = "a moderate amount", and 5 = "a great deal". Ten participants

responded. All areas of learning were rated a "4" or "5". The average scores for each follow: [1] Effects of parasites on head production [4.67 average score]; [2] Internal parasites [4.67 average score]; [3] Diagnostic methods [4.6 average score]; [4] Nutritional interaction [4.5 average score]; and [5] Dewormers [4.4 average score]. In addition, 15 participants indicated that the workshop met their expectations and all participants indicated that their knowledge of sheep/goat parasite management increased by attending the workshop. Additional information can be found in the evaluation section of this planned program.

With respect to the required livestock ethics training, online module training records indicate that 1,716 youth were successfully certified in 2014-15.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Dairy Summits

At the three **Dairy Summits** conducted in January of 2015 an evaluation was distributed and returned by 68 of the attendees.

How Much Did They Learn?

Participants were asked to rate how much they learned in each of the topics they attended using a four part-scale with 1 = "not met", 2 = "a little bit", 3 = "quite a bit", and 4 = "a lot". The results are listed from highest average score [3.34] to lowest [2.67]: [1] Generational Transfer of the Dairy Farm [3.34 average group score; 25 of 57 rated this "a lot"]; [2] Your Feeding Checklist for 2015 [3.29 average group score; 23 of 63 rated this

"a lot"); [3] Dairy Focus Team - How Does Your Farm Stack Up? [3.12 average group score; 17 of 60 rated this "a lot"]; [4] Dairy Margin Protection Program - Ready for 2015 [3.11 average group score; 19 of 63 rated this "a lot"]; [5] Your Dairy Check Off at Work [2.80 average group score; 11 of 61 rated this "a lot"]; [6] University of Illinois Research Roundup [2.79 average group score; 12 of 63 rated this "a lot"]; and [7] CAFO Regulations Update [2.72 average group score; 10 of 57 rated this "a lot"].

Were Their Objectives Met?

When asked if their personal objectives for attending the Dairy Summit were met using a five part scale from 1 = "not met" to 5 = "extremely met", sixty-five responded. Three-fourths [48] selected a "4" or "5" score and one-fourth [16] selected a "3" [satisfactorily met] score. Only one selected a score of "2" and none indicated that their personal objectives had not been met.

What Do Those That Were Visited By The Dairy Focus Team Plan To Do Differently?

When asked "After a visit to your farm and today's presentation of the Dairy Focus Team topic, do you plan to do anything differently?", 47 provided an answer. Out of 47, 15 indicated that their farm was not visited. Of the remainder, five [5] did not plan to do anything differently, 14 checked "yes" and 13 checked "maybe" they planned to do something differently. However, when asked to describe their plans, only 10 of the 27 did so. Those ten individuals identified improving management by monitoring data [3], feeding practices [starch digestibility, feeding calves more], breeding practices [for heifers, fresh cow protocols, improve reproduction], and following items from the feeding checklist topical session. In response to an additional question, seventeen [17] individuals indicated they would like to have their farm visited by the Dairy Focus Team in the future.

Do Other Respondents Plan To Try Other Topic Techniques?

Of the 32 who responded to this question, 29 checked "yes" and 12 of those described what they planned to try. The techniques most often mentioned were related to feeding [feed management, closer attention to feed analysis, watch pounds of milk solids/day, and learn more about shredage, different ways to process corn silage, and feed methionine to reduce EED]. In addition, three individuals mentioned breeding [get more cows bred before 120 days, A1 early breeding, breeding research]. Two mentioned generational transfer of dairy farm and two mentioned management [cost evaluation, data-driven management].

Managing Risk For Small Ruminants

An evaluation was distributed to participants in the multi-state workshop **Managing Risk for Small Ruminants** [goats and sheep]. In response to a question seeking to determine if the content of the workshop met the participants' expectations, 15 checked "yes" and one checked "somewhat". All participants also indicated that their knowledge of sheep/goat parasite management increased by attending the workshop. Following the workshop the evaluation asked the participant to rate their knowledge of eight topical presentations.

Using a five-part scale anchored with 1 = "poor" and 5 = "excellent", participants were asked to indicate their self-perceived level of knowledge both before and after the workshop. The percentage of those who indicated increasing their knowledge of the eight topics after as compared to before scores follows: [1] Do's and Don'ts of a Low-Input

Operation - 14 of 15 [93%] increased their knowledge; [2] Toxicities: Differences for Goats and Sheep - 14 of 15 [93%] increased their knowledge; [3] Animal Disease Traceability USDA - 14 of 15 [93%] increased their knowledge; [4] Safe Farm-Safe Animals [biosecurity on your farm] - 14 of 15 [93%] increased their knowledge; [4] Parasite Management: 5-Point Check, FAMACHA, BCS - 11 of 13 [85%] increased their knowledge; [5] When to Call the Vet Q&A - 11 of 13 [73%] increased their knowledge; [7] Disaster Preparedness for Producers - 6 of 14 [43%] increased their knowledge; and [8] Raising Market-Worthy Animals Without Breaking the Bank - 5 of 15 [33%] increased their knowledge.

An additional question asked participants to indicate to what extent they thought they learned about five areas of knowledge using a 5-part scale with 1 = "not much", 3 = "moderate amount", and 5 = "a great deal". Ten participants responded. All areas of learning were rated a "4" or "5": [1] Effects of parasites on head production - 4.67 average score; [2] Internal parasites - 4.67 average score; [3] Diagnostic methods - 4.6 average score; [4] Nutritional interaction - 4.5 average score; and [5] Dewormers - 4.4 average score. When asked if participants intended to try any of the techniques discussed, 15 checked "yes".

Key Items of Evaluation

Dairy Summits

All 65 of the **Dairy Summit** participants who answered the question indicated that their knowledge increased "quite a bit" or "a lot" with respect to at least one topic. The greatest amount of knowledge was gained with respect to learning about the generational transfer of a dairy farm, feeding dairy cattle, the dairy focus team farm visits, and the Margin Protection Program [MPP], a voluntary program which places an emphasis on protecting income over feed cost margins. Nearly two-thirds of the program evaluation respondents planned to address improving management by monitoring data, feeding practices, breeding practices, or following items on the feeding checklist.

Managing Risk For Small Ruminants

All 17 participants in the **Managing Risk for Small Ruminants** who completed the evaluation indicated that their knowledge increased with respect to five areas of sheep and goat production risks as indicated by an average score of 4.4 or above. The greatest amount of knowledge was gained with respect to learning about internal parasites, the effects of parasites on head production, and diagnostic methods. All those who completed the evaluation planned to try the techniques discussed.

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
602	Business Management, Finance, and Taxation	15%		0%	
608	Community Resource Planning and Development	35%		35%	
802	Human Development and Family Well-Being	0%		25%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	10%		10%	
805	Community Institutions, Health, and Social Services	20%		20%	
806	Youth Development	20%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.0	0.0
Actual Paid	0.0	0.0	0.3	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
533225	0	112379	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
533225	0	112379	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
4695363	0	151765	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included a study that will contribute to existing empirical knowledge by explicating the role of different types of violence in different patterns of judicial involvement among a sample of 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], a research project that: [1] Examined the role of racial socialization practices in African-American families; [2] Completed a study on residential and school mobility; and [3] Examined the role of nonstandard work in early child development [path analysis was used to determine the direct and indirect effects of nonstandard work conditions on early child development], and research to identify chronic stressors in the lives of low-income, African-American families living in inner-city neighborhoods and the coping strategies used to address these stressors [this research is a response to theoretical discussions that argue that the compositional, social, institutional, and normative elements of impoverished inner-city communities undermine family organization and functioning].

Conference presentations included the Eastern Sociological Association, American Sociological Association, National Conference on Family Relations, Carl R. Woese Institute for Genomic Biology, and the International Congress of Qualitative Inquiry.

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

Community planning education in 2015 included continued work with communities in developing, implementing, and updating 17 action plans by providing assistance with surveys, focus groups, interviews, public meetings, goal formation, and implementation monitoring that successfully involved a diverse group of participants and stakeholders. These assistance processes were used to explore and address municipal, county, and regional issues and projects related to managing disasters, park development, transportation, community revitalization, housing, and economic development. In addition, several communities received University of Illinois student assistance with projects through the **Community Matters** program, a partnership between University of Illinois Extension, the University of Illinois Department of Urban and Regional Planning, and the University of Illinois College of Business [who provided student consulting teams]. The **USDA Stronger Economies Together [SET]** multi-year program focused on developing a high-quality regional economic development plan, has completed a vision statement, established communities of interest, and generated a list of opportunities and strategies to support a stronger, more sustainable regional economy.

Community and economic development Extension educators provided programs related to economic

development. The **On the Front Line for Customer Service** curriculum was used to educate employees of businesses, agencies, and government entities [as well as students] on customer service skills and best practices. **Age Matters**, a four module program addressing generational values and historical information, was focused on building participant's skills in working with consumers, employees, and volunteers. **Social Media for Businesses**, an online program for small business owners and managers who want to learn about and practice with tools to expand markets and monitor consumer activity, was also delivered to onsite audiences. Staff members also helped individuals plan for starting or sustaining small businesses. **Buy Local: A Sustainable Communities Initiative** was delivered via presentations to groups that included elected officials, planning commission members, business owners, community leaders, and residents. A shopping simulation created by an Extension educator to demonstrate the value of buying local was modified to use in high schools engaged in job shadowing programs.

Building Entrepreneurial Communities continued to be a focus associated with economic development and workforce preparation. Educators [both those with 4-H responsibilities and those with community development responsibilities] were active in workforce preparation for youth through high school career days, job shadowing, and week-long camps focused on entrepreneurship and starting small businesses. Partnering with schools, Extension staff members conducted simulated job interview experiences and taught workplace soft skills. The **iDREAM-iCREATE** curriculum, focused on fostering youth creativity and entrepreneurship, continued to be piloted in school settings. Extension and health department staff in a group of counties began working on creating a series of workforce development classes.

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

2. Brief description of the target audience

Members of the target audience included mothers who co-parent after separation, including those who do and do not experience intimate partner violence, family court judges, family law attorneys, parent educators, health care providers, researchers and graduate students from the fields of human development, sociology, and education, graduate students studying biology, psychology, and sociology, scholars and researchers from diverse disciplines including education, ethnic studies, family studies, social work, sociology, and urban planning, community-based programs and organizations that focus on enhancing family life, promoting positive child-youth development, and building strong communities, local families, and policy makers focusing on education, family strengthening, and community building.

Extension programming targeted local elected and appointed officials, current and emerging community leaders, current or potential business owners/managers, bankers, entrepreneurs, economic development organizations, community organization leaders, government agency representatives, teachers and their students, and youth and residents of targeted communities.

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 Extension Disaster Education.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	37970	24135	35556	0

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

Patent Applications Submitted

Year: 2015

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	5	5

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2015	1

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/Adjusted By Communities Through Resident Engagement
3	Percentage Of Community Plans/Goals Implemented
4	Number And Value of Volunteer Hours Invested In Community-Related Projects
5	Number Of Community/Organization Programs/Activities Initiated
6	Number Of Jobs Created By New Businesses
7	Identification Of The Stressors In The Lives Of Low-Income African-American Families
8	Taking Action To Increase Buying In Local Communities [# Of Communities]

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
2015	172

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
805	Community Institutions, Health, and Social Services

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	6

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 with responsibilities in community and economic development used a variety of processes to assist community leaders and residents in developing, implementing, and/or updating 18 action plans using a variety of processes to guide the future of their municipality, county, or region.

Results

Educational assistance was provided to eight municipalities that included the following actions: [1] Providing data regarding enterprise zones; [2] Conducting a strengths/weakness/opportunities planning session; [3] Assisting with business surveys in three municipalities and with household surveys in two additional ones; and [4] Initiating preliminary planning for two municipalities. Extension's Community Matters program involved the University of Illinois Department of Urban and Regional Planning faculty and students seeking to complete a capstone project and gain experience in supporting community planning processes. Their projects addressed the formation of a Historic Preservation District and a Sustainable Community project. Extension assistance was also provided for residents to complete action plans regarding municipal parks and recreation projects.

With respect to the six county-wide planning processes, Extension helped develop a county-wide strategic planning exercise in three counties. Collaborating with partners in another county, an Extension staff member worked with a village president to involve residents in assessing strengths and opportunities for economic development, setting goals, and developing three committees to carry out the goals. Extension educators also worked with community members in developing surveys and conducting interviews. An assessment of a county's hazard mitigation plan goals indicated that the goals were being implemented. A planning process for establishing a Community Organization's Active In Disasters [COAD] group was piloted in another county.

Four regional planning processes included two focused on regional transportation planning [both in the East Central region of Illinois]. The third and fourth regional planning processes are associated with the USDA Rural Development Stronger Economies Together [SET] program which is focused on developing a regional economic development plan to build on unique assets and regional strengths. The SET Phase IV planning process encompassing eleven counties in Southeastern Illinois completed a second year. Another region in Southern Illinois applied

[successfully] for funding to begin Phase V of the process. Illinois has also been successful in receiving funding to support another SET site that encompasses three contiguous counties located in North Central Illinois. A third SET Phase V site encompasses a multi-state region that includes one Illinois County adjacent to Missouri and Iowa.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
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

Outcome #3

1. Outcome Measures

Percentage Of Community Plans/Goals Implemented

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number And Value of Volunteer Hours Invested In Community-Related Projects

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	9360

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
805	Community Institutions, Health, and Social Services
806	Youth Development

Outcome #5

1. Outcome Measures

Number Of Community/Organization Programs/Activities Initiated

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	11

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
805	Community Institutions, Health, and Social Services
806	Youth Development

Outcome #6

1. Outcome Measures

Number Of Jobs Created By New Businesses

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Identification Of The Stressors In The Lives Of Low-Income African-American Families

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The goal of this research is to identify chronic stressors in the lives of low-income, African-American families living in inner-city neighborhoods and the coping strategies used to address these stressors. This research is a response to theoretical discussions that argue that the compositional, social, institutional, and normative elements of impoverished inner-city communities undermine family organization and functioning. According to theorists, families are unable to develop stable domestic routines or properly socialize their children in environments with large numbers of disadvantaged neighbors, few social or institutional supports, and ghetto-oriented value systems. In contrast, our research seeks to better understand how families raising children overcame the adversity of living in low-resource, high-risk neighborhoods. This research is informed by a family resilience framework. This approach focuses on family strengths, how families marshal resources to promote stability in the face of adversity, and the ecological context of coping.

What has been done

During the past year, qualitative interview data on resilient parenting practices to support school readiness were collected and analyzed for publication. Low-income children living in

impoverished neighborhoods are cited as being "at-risk" for poor educational outcomes. However, focusing on a high-quality preschool in an impoverished neighborhood and supportive parenting practices, we found in-home learning strategies that low-income, African-American mothers used to enhance children's literacy development. A major strategy was the use of extended kin. Grandmothers, aunts, resident/non-resident fathers, and adult and child siblings were engaged in child literacy activities. Families collectively supported children's reading, writing, and oral language development using multiple resources [books, games, and puzzles].

During the course of the project, we identified family practices that promoted the safety and well-being of adult and child family members in high-risk, low-resource neighborhoods. Through strong ties with extended kin, families were able to garner social, financial, affective, and childcare support despite limited neighborhood resources. The research also identified the best resources that were available in impoverished neighborhoods, such as neighborhood garden organizations, that provided social support to families and also served to stabilize challenged neighborhoods.

Results

The research identified resilient adult practices that promoted positive child development in a number of areas, including child health and nutrition and child physical activities. In response to the poor quality of the neighborhood food environment, families used restrictive food management strategies to limit unhealthy eating while employing promotional strategies to encourage healthy eating. In response to physical activity obstacles in the neighborhood built environment, families devised ways to promote child physical activity including chaperonage and collective supervision in outdoor spaces.

More generally, the research findings document patterns that families developed while living in resource-poor, high-risk neighborhoods. Families utilized strategies that insulate its members from the more negative aspects of neighborhood life [crime and food deserts]. In tandem with buffering strategies, families also utilized promotional strategies that allow them to seek out the positive, albeit limited, resources that do exist in low-income neighborhoods.

4. Associated Knowledge Areas

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

Outcome #8

1. Outcome Measures

Taking Action To Increase Buying In Local Communities [# Of Communities]

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Revenue is declining in many rural communities and is affected by many factors related to overall state and national challenges [as well as to local challenges to sustain economies such as the loss of businesses which in turn affects unemployment rates and out-population migration]. A Retail MarketPlace Profile Study of the sixteen-county Southern Illinois region was conducted in the fall of 2012 using data obtained from ESRI Business Analyst to compare consumer spending and business revenues. The analysis revealed a \$272 million net leakage for Southern Illinois in contrast to retail surpluses in states bordering Illinois.

What has been done

University of Illinois Extension's Buy Local:Sustainable Communities initiative helps elected officials, community leaders, and residents understand the importance of buying local to the sustainability of their local economies. Program participants recognize how buying patterns affect their household, their community, their county, and their state. In an effort to assist local residents, community leaders, and elected officials in understanding the importance of buying local, a University of Illinois Extension community and economic development educator made 13 presentations to various groups that included chambers of commerce, community clubs [such as Rotary and Kiwanis], community and regional development and planning committees, and a school board. Other educational efforts included conducting simulated shopping experiences, promoting the Illinois Department of Agriculture's Buy Illinois Challenge at the Sustainable Living Expo, and presenting information at the Midwest Community Development Institute. An additional Extension staff member took part in a Buy Local community meeting in Western Illinois.

Results

Inspired by Extension's Buy Local: Sustainable Communities initiative two members of a women in business association have continued to carry out their Keep It In The County - Think, Shop, and Buy Locally Fir\$t campaign and to share information regarding the importance of buying local. Ten local chambers of commerce joined together and created the Shop Southern Illinois campaign during the 2014-15 holiday season and launched a website that includes the Top 10 Reasons to Buy Locally [developed by the Extension staff member] and a pledge form and prizes for residents who agreed to buy locally. A city clerk in another location purchased gift cards from local businesses for the city workers and individuals who helped with a holiday parade and is using quotes from Extension articles and presentations in the newsletters that accompany monthly utility bills sent to residents of the community.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

No formal outcome evaluations were created or collected this past year.

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
111	Conservation and Efficient Use of Water	0%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		10%	
205	Plant Management Systems	15%		0%	
501	New and Improved Food Processing Technologies	0%		10%	
502	New and Improved Food Products	0%		15%	
503	Quality Maintenance in Storing and Marketing Food Products	0%		5%	
504	Home and Commercial Food Service	15%		0%	
603	Market Economics	0%		5%	
701	Nutrient Composition of Food	5%		5%	
702	Requirements and Function of Nutrients and Other Food Components	0%		5%	
703	Nutrition Education and Behavior	10%		10%	
704	Nutrition and Hunger in the Population	15%		10%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	15%		10%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	15%		10%	
806	Youth Development	10%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.0	0.0

Actual Paid	0.0	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
717429	0	684088	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
717429	0	684088	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
6317398	0	2173878	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included research on food insecurity that examined one of the consequences of food insecurity [sleep problems] and how it can be addressed through policy interventions and how SNAP can be used to reduce these consequences, the finding that pig producers can feed pelleted diets to improve growth performance without negatively affecting commercial bacon slicing yields, and the development of a laboratory scale method to produce and model Hispanic-style fresh cheese [a laboratory-scale method that would enable the production of a Hispanic-style cheese in a biosafety cabinet is critical for the safe evaluation of potential antimicrobials].

Activities also included an evaluation of the effect of ultrasound treatment at low acoustic power density [APD] on antioxidant capacity and overall quality of Romaine lettuce, a study with the long-term goal of providing an effective labeling system for consumers who have health concerns related to sodium and fat to aid in making healthy food choices, the comparison of two leafy produce wash methods, the traditional cutting-before-washing process and a new washing-before cutting method, on reduction of *Escherichia coli* O157:H7 inoculated on Iceberg lettuce, research designed to benefit food producers trying to incorporate protein into extruded or puffed snack foods at high levels [models generated will help food producers predict the changes a similar food will undergo when increasing the amount of protein or changing the type of protein, resulting in a snack with the right characteristics to make it more acceptable to consumers], a study that evaluated the bioactive compounds in five apple cultivars [including four scab resistant cultivars Gold Rush, Pixie Crunch, Crimson Crisp, Wine Crisp, and a non-scab resistant cultivar Golden Delicious], the determination that grated horseradish roots are a rich source of antioxidants, the identification of associations between major traits and genes and/or quantitative trait loci [QTLs] for fruit quality traits [such as fruit acidity] as well as anthocyanin synthesis genes and self-incompatibility genes in apples, work to provide growers and buyers with up-to-date information to allow them to more efficiently meet market demands associated with organic production, food safety regulations, **Farm to School**, and extended seasons for production and marketing, the conducting of image analysis of thousands of micrographs collected using micro CT scanning to understand the distribution of oil in fried foods and changes in the food microstructure, and the use of improved equipment to better determine both the physical parameters for detection and the algorithmic characterization of results to provide a better and more intuitive picture of material defects in food packaging.

Conference presentations included the 68th American Meat Science Association Reciprocal Meat Conference, American Society of Animal Science Midwest Section Meeting, Institute of Food Technologists, Illinois Specialty Crops, Agritourism, and Organic Conference, International Rice Research Institute, and InterPore.

Extension's Food Safety Training for employees of establishments, foodbank managers, and volunteers that prepare or serve food to the public was delivered primarily through the following programs: [1] The 8-hour **Food Handlers** course was conducted to meet the three year certification requirements for food service sanitation managers; [2] **Serve it Safely** is the title of a food class offered to volunteers who serve food for fundraisers, community organizations, and family events. In addition, a website provided information on the Illinois Cottage Food Operation Law regarding low-risk foods that can be prepared in the private home and sold at Illinois Farmers Markets; [3] New online and supplemental programs entitled **Yes, You Can - Preserve Food Safely** were conducted during the summer; and [4] The **Supplemental Nutrition Assistance Program-Education** [SNAP-Ed] curriculum for both youth and adults included an emphasis on proper hand-washing and cleanliness habits when preparing food.

Programs addressing **Good Agriculture Practices [GAPs]** continued to be offered online and face-to-face to ensure that fresh produce is free from contamination by microorganisms that cause foodborne illnesses.

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. **Corn and Soybean Classics** [six regional-based meetings] featured eight faculty presentations on the latest research concerning crop production, pest management, drainage systems, economics, nutrient management, drift reduction technologies, and yearly weather conditions and outlook. Attendance totaled 780 producers and agricultural consultants. The multi-state **AGMasters Conference**, a two-day multidisciplinary program, was attended by 170 individuals who participated in one general session and 12 specialized sessions. **Regional Crop Management Conferences** were held in four locations in 2015 and attended by 374 registrants who were primarily certified crop advisers. Extension of research to the public also included the **Varietal Information Program for Soybeans**, a website and publication that provided information on yield, protein and oil, and disease and pest susceptibility. Annual research farm field days were held on campus and at other University farms located throughout Illinois to showcase the results of research plots to producers.

The Bulletin is an online series of posts [52 this past year] primarily posted throughout the crop-growing season [early April to mid-August] and additional times in the off-season to announce programs and current pest management information provided by entomologists, agronomists, and plant pathologists. The majority of the 3,522 plant samples diagnosed by the **University of Illinois Plant Clinic** in 2015 were agronomic field crops and field crop soil samples. Approximately 150 involved fruit and vegetable crops. Pesticide safety education was conducted using presentations at numerous locations that resulted in 9,879 commercial pesticide applicator certifications and 3,265 private pesticide applicator certifications.

Total attendance at statewide Extension conferences related to produce production was approximately 300 and included several multi-state conferences: [1] The **Southern and Southwestern Tree Fruit Schools**; [2] The **Stateline Fruit & Vegetable Conference**; and [3] The **Southern Illinois Commercial Vegetable School**. Additional Illinois state or regional conferences focused specifically on growing horseradish, small fruit, and strawberries. Extension also provided leadership for the **Specialty, Agritourism and Organic Conference** and distributed 19 issues of **Fruit and Vegetable News** approximately bi-weekly. Aspiring farmers, new growers, and agriculture teachers participated in the third annual **Preparing a New Generation of Illinois Fruit and Vegetable Farmers**, a year-long program which features classroom, hands-on, and in-field instruction.

This year Extension staff again collected weekly fruit and vegetable prices from 12 farmers markets and posted them on a website created and shared by University of Kentucky Extension staff to help farmers [especially new farmers] decide how they might price their products. For a third year Extension educators with assigned responsibility for small farms and local foods education offered **Putting Small Acres to Work**, a one-day program that addressed a variety of topics including local food production that were offered to help people who have a few acres learn ways that they can put them to use. One hundred fifty-two individuals [152] attended one of the four programs [also discussed in the evaluation section of this planned program]. In addition, a series of 11 weekly one-hour webinars directed at small farm owners or operators was offered in the winter of 2015 to 502 Illinois residents and 163 residents of 42 other states and Canada who participated in one or more sessions. Several interdisciplinary efforts among Extension educators with responsibility for local foods, horticulture, foods and nutrition, community economic development, and/or 4-H development were targeted at supporting community gardens that raised produce to feed the hungry through the **Illinois 4-H Feeding & Growing Our Communities** initiative.

Extension activities that addressed hunger within Illinois were delivered by **Expanded Food and Nutrition Education Program** [EFNEP] staff and **Supplemental Nutrition Assistance Program Education** [SNAP-Ed] staff members who conduct hands-on activities with children and their parents with limited incomes. These activities include using food stamps, meal planning, wise shopping, and use of food pantries. The **SNAP-Ed** and **EFNEP** staff used the **CATCH** and **SPARK** curricula to educate elementary and preschool students in after-school and summer programs about healthy snacks, good nutrition, and the importance of physical activity. **OrganWise Guys** materials were also used by **SNAP-Ed** staff in elementary school classrooms. The curricula used to teach adults included **Eating Smart Being Active** and **Loving Your Family Feeding Your Future** that emphasized feeding your family on a budget and preparing meals safely. Some 600,000 direct teaching contacts were made through the **SNAP-Ed** program and nearly 9,500 teaching contacts were made through **EFNEP** this past year.

2. Brief description of the target audience

Members of the target audience included 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, the dairy industry, academic, industry, and government food professionals, graduate and undergraduate students, food industry professionals who work to reduce sodium in their products and are interested in learning how labels impact consumer perception, U.S. food producers, processors, ingredient manufacturers, and flavor companies, food industry professionals who work with extruded snack and cereal products, the horseradish and fresh cut industries in Illinois and beyond, the culinary and herb industries, apple, peach, and pear growers, the tree fruit nursery industry in the U.S. and internationally, scientists, postdocs, horticulturists, producers, supply chain personnel, and farmers' market managers.

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

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	144772	209998	84583	0

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

Patent Applications Submitted

Year: 2015

Actual: 3

Patents listed

Patent Application TF13169-PRO: Scanning Transmission Thermal Wave Tomography Detection Of Lamina Defects. Patent Application TF13169-PRO2: Scanning Transmission Thermal Wave Tomography Detection Of Lamina Defects. Patent Application TF14120-01: Inclusion Complexes And Methods Of Making The Same.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	27	27

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2015	4

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 Fresh Produce Donated For Consumption By Vulnerable Populations
3	Practices Adopted That Prevent Foodborne Illness Contamination During The Production And Distribution Of Fresh Produce
4	Number Of Food Preparers Reporting Using Proper Time And Temperature Controls
5	Number Of Food Preparers Reporting Taking Steps To Reduce Cross-Contamination
6	Knowledge Gained Through Improving The Availability Of Fresh Fruits And Vegetables To Low-Income Americans
7	Development Of Fortification Technologies For Developing Countries
8	Enhancement Of Microbial Safety In Fresh Produce
9	Number Of Growers, Producers, And Employees Completing GAPS, GMPs, HACCP, Food Safety Certification, And Onfarm BMP Programs To Increase Food Ssafety
10	Development Of Effective Methods For The Investigation Of Potent Odorants In Foods
11	Determining Commercial Slicing Yields Of Bellies From Immunologically Castrated Pigs Relative To Slicing Yields Of Other Sex Classes
12	Incorporating Protein Into Extruded Or Puffed Snack Foods
13	Attracting Customers To The Farm By Identifying Rootstocks That Will Reduce Tree Height Without Compromising Fruit Quality
14	Increased Knowledge Of Proper Processing Of Food Served At Home And Served/Sold To The Public To Prevent Food-Borne Illnesses
15	Increased Knowledge Of Fresh Fruit And Vegetable Production Practices
16	Increased Knowledge of Small Farm Production Options

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 Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	159

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, annually held two-day Crop Management Conferences were conducted in four locations in Illinois. Specific topics in these 2015 settings varied slightly with most addressing managing nutrients, managing insects, scouting for diseases, and selecting herbicides to minimize resistance development. Of particular interest was the topic on drones [UAV-unmanned aerial vehicles]. The 374 participants were primarily employed in agri-business [84%] as certified crop advisers [67%] and crop producers [42%] and advised, farmed, or managed slightly more than 2.35 million acres [with an average of 21,220 acres each]. At the end of each conference participants were asked to complete an evaluation. One hundred fifty-nine [44%] did so.

Results

Nearly all [96%] of the 159 Crop Management Conference evaluation respondents reported that attending the conference increased their knowledge of new crop management techniques and 80% planned on implementing something that they learned at the conference during the 2015 growing season. Of those respondents that shared their implementation plans, 28% plan to increase their vigilance to forestall the development of herbicide resistant weeds through tank mixes, 22% plan to try cover crops, 21% plan to change their sudden death syndrome management plan, 11% plan to change their soybean cyst nematode management, and 11% plan to try to use the "Useful 2 Useable" climate tools.

As a result of their 2014 Crop Management Conference attendance, 75 of the people that attended the 2015 conference reported implementing one or more of the following practices: [1] 38% began scouting for Palmer pigweed; [2] 37% changed their nutrient management in some

manner; [3] 24% took action to reduce off-target herbicide application; and [4] 24% adjusted their rootworm management plan.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Number Of Pounds Of Fresh Produce 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
2015	4913

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 2015, 1,525 youth and adult volunteers provided 9,141 hours of service directed toward solutions to the problem. Through their individual and collective efforts in the Illinois 4-H Feeding & Growing Our Communities outreach program, 1,734 families and 2,125 individuals were impacted by their efforts. Hunger responses included community gardens, meals for food

pantry patrons, weekend backpack programs, can food drives, and meal packaging events.

Results

With continued funding from Evelyn Brandt Thomas 4-H clubs and community groups responded to the call by raising and donating 4,913 pounds of fresh produce with an economic value of \$7,200 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 helped to provide 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. Involvement of 4-H community garden members in inner city Peoria inspired residents assigned community service hours to serve their community by assisting with the gardens on days when 4-H members could not be present.

Continuing the partnership with Illini Fighting Hunger 4-H members packaged 128,856 soy-rice casserole meals that were distributed through food pantries in their community. Previous success by 4-H clubs with hunger awareness and meal packaging events resulted in \$16,085 being donated by local organizations supporting their efforts in 2015. 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
111	Conservation and Efficient Use of Water
701	Nutrient Composition of Food
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #3

1. Outcome Measures

Practices Adopted That Prevent Foodborne Illness Contamination During The Production And Distribution Of Fresh Produce

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number Of Food Preparers Reporting Using Proper Time And Temperature Controls

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Periodic outbreaks of foodborne illnesses have generated public concern about the safety of the food they consume and have serious health consequences for those who eat contaminated foods and economic consequences for individuals who serve fresh or prepared food.

What has been done

The University of Illinois Extension Serve It Safely program was designed for volunteer groups that sell food to the public, often as a fundraising effort. In March of 2015, 13 volunteers received information on proper planning for food events, preparing, transporting, storing, and serving food, sanitation practices, and handling leftovers. In order to determine the impact of the program, participants were sent a follow-up evaluation to complete three months after the program ended.

Results

Ten of thirteen [77%] who returned the Serve It Safely evaluation adopted one or more practices to safely serve food at events. Seven [54%] of the thirteen now use a thermometer to check temperatures of foods, and seven now wash their hands for at least 20 seconds using soap and warm water [25%]. For four other practices, one or more individuals adopted the following: [1] Now label items clearly when storing prepared food [6]; [2] Now use a separate handwashing sink [3]; [3] Now make their own sanitizing solution [2]; and [4] One now prepares all foods on-site.

Three-fourths of the participants indicated feeling more confident in preparing foods to serve to the public and 11 of 13 reported being more aware of basic food safety principles which when followed can help reduce the risk of food borne illness.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Knowledge Gained Through Improving The Availability Of Fresh Fruits And Vegetables To Low-Income Americans

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Development Of Fortification Technologies For Developing Countries

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Enhancement Of Microbial Safety In Fresh Produce

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Consumer demand for fresh food has stimulated the production of fresh produce and made it one of the fastest growing market sectors in the United States. Unfortunately, the increase in production and consumption has also been accompanied by a simultaneous increase in the reported number of foodborne disease outbreaks. Between 1996 and 2005, leafy green consumption increased 9% and leafy green associated outbreaks increased 38.6%. Foodborne illness outbreaks erode consumer confidence in the safety of fresh produce and have adverse economic, social, and health consequences. Currently, commercial operations rely on a wash treatment with antimicrobials as the only step to reduce microbial populations on fresh produce. However, an industrial-scale operation that uses chlorinated water containing 50-200 mg/L free chlorine can only achieve a 1 to 2-log CFU/g reduction in bacterial population. As many published studies have demonstrated the health benefits of eating fresh produce, strategies to improve the microbial safety of fresh produce are clearly needed.

What has been done

The effect of ultrasound treatment at low acoustic power density [APD] on antioxidant capacity and overall quality of Romaine lettuce was evaluated. Whole leaf lettuce was treated with ultrasound [25 kHz] at APD of 26 W/L for 1 - 3 minutes and stored at room temperature for up to 150 hours. Quality indices examined included color, texture, total phenolics, antioxidant capacity, and sensory properties. Phenylalanine ammonia lyase [PAL] activity of lettuce from different treatments was monitored during storage.

Results

There were no differences in sample quality attributes between ultrasound treatment and control immediately after treatment. Lettuce treated with ultrasound exhibited an increase in PAL activity after storage for 60 hours, resulting in production of phenolic compounds as secondary metabolites and enhancement of antioxidant capacity. Ultrasound treated samples did not exhibit deterioration during storage, and under certain conditions it delayed enzymatic browning and maintained better overall quality. A hypothetical model for the effect of low APD ultrasound as an abiotic elicitor on fresh produce was proposed based on the findings of the present study and evidence from previous reports on response of cell cultures to ultrasonication.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
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
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #9

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

Determining Commercial Slicing Yields Of Bellies From Immunologically Castrated Pigs Relative To Slicing Yields Of Other Sex Classes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Comprehensive ideas are in demand to sustainably and economically stretch capabilities in food production while improving food healthiness and safety. The world human population is projected to grow to nearly nine billion people by the year 2050. During the same period of time, Dr. David Tilman projects the global demand for food to double. Processed meats are viable candidates to help meet the strain of a growing population. For example, over 80 percent of the pork currently produced in the United States is used in a further processed product.

The long-term goal of this project is to implement a strategy toward healthy, safe, and secure food

by further developing technologies that make the best use of resources available. The scope of this project will consider production and processing practices. During this reporting period, one project was completed. This project centered on determining commercial slicing yields of bellies from immunologically castrated pigs relative to slicing yields of other sex classes.

What has been done

One hundred and 192 barrows and gilts were fed throughout the growing-finishing portion of their lives in the fall of 2014. At the end of the finishing phase pigs were slaughtered and fabricated. Bellies were frozen, thawed, and transported to a bacon processing facility during the reporting period of 2015. Bacon fat quality and bacon slicing yield data were captured. There were no differences [p greater than or equal to 0.11] in belly length, width, thickness, flop distance, or thaw loss between bellies of meal and pellet fed pigs, indicating no differences in dimensional characteristics of bellies from pigs fed either a meal or a pelleted diet. Bellies from pellet fed pigs had greater [p less than or equal to 0.03] concentrations of linoleic acid [C18:2n6], alpha-linolenic acid [C18:3n3], and eicosatrienoic acid [C20:3n3]. Bellies from pellet fed pigs had decreased [p less than or equal to 0.05] concentrations of capric acid [C10:0], myristic acid [C14:0], myristoleic acid [C14:1], pentadecenoic acid [C15:0], palmitic acid [C16:0], palmitoleic acid [C16:1], margaric acid [C17:0], heptadecenoic acid [C17:1], and oleic acid [C18:1] compared with bellies from meal fed pigs. When compared with bellies from meal fed pigs, bellies from pellet fed pigs had a 2.89% greater [p < 0.0001] total PUFAs, 2.09% less [p < 0.0001] total MUFAs, and 0.89% less [p < 0.01] total SFAs.

Results

The greater concentration of PUFA resulted in a 3.08 unit increase [p < 0.0001] in IV of pellet fed pigs compared with meal fed pigs. This indicates pigs fed a pelleted diet had poorer fat quality compared with pigs fed a meal diet. Differences in fresh, skin-on belly weights were reflected in green weight, pumped weight, cooked weight, and sliced weight as bellies from pellet fed pigs were heavier [p less than or equal to 0.01] at all stages of processing compared with bellies from meal fed pigs. Despite differences in IV between the meal and pellet fed pigs, there was no difference in commercial bacon slicing yield calculated from green weight [p = 0.16] or calculated from cooked weight [p = 0.75]. Feeding pelleted diets to growing-finishing pigs increased the weight of fresh bellies, but negatively affected fat quality through increased proportions of unsaturated fat and consequently increased IV. However, the increase in IV did not negatively affect commercial bacon slicing yields. Feeding pelleted diets increased the fat content of bellies and also decreased the number of slices/kg of sliced bellies. Overall, pig producers can feed pelleted diets to improve growth performance without negatively affecting commercial bacon slicing yields.

4. Associated Knowledge Areas

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

Outcome #12

1. Outcome Measures

Incorporating Protein Into Extruded Or Puffed Snack Foods

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Most traditional snack foods [chips, crackers, puffs] are based on ingredients with high starch content. This is because starch-based ingredients are inexpensive and typically provide a neutral flavor profile suitable for additional flavors. Furthermore, starch-based ingredients compared to protein-based ingredients when used as a base material result in greater expansion of the extrudates, a key for creating acceptable textures in puffed snack foods. Incorporation of hydrolyzed protein blends possesses the potential key to solving the problems found with proteins inhibiting expansion by forming highly ordered matrices. From this study, we will determine the relationship between the degree of hydrolysis of the proteins in the formulation and the physical and sensory characteristics of the resulting high protein snack product, which will further demonstrate the potential for commercialization of high protein extruded snacks and increase utilization of whey and soy protein ingredients in a novel product concept.

What has been done

One hundred consumers rated their acceptance of the samples using the 9-point hedonic scale. Overall liking scores obtained from the consumer panel were used to generate a response surface model in the same method used for the descriptive analysis attribute scores. The model generated a constant score of 5.10, with increasing the total protein level and increasing percent whey detracting from that constant score in their linear terms. The validation terms for this model were fairly low, with an R2 value of 0.47. The overall acceptance score has high variability due to the variance in different consumers preferences, which would explain the inability for the model to predict scores with the accuracy seen in models for instrumental measurements and descriptive analysis attributes.

Models generated for instrumental measures show that increasing the protein level resulted in lower expansion, resulting in higher bulk density and lower diameter measurements, color changes, a decrease in water hydration capacity, and decreases in values for texture analysis

measuring the amount of force required to break the samples. Descriptive analysis attributes were also modeled, with the independent variables effect on expansion significantly affecting models for appearance and texture attributes and protein type significantly affecting models for aroma and aroma-by-mouth attributes. The model predicting consumer acceptance predicted lowering protein level and percent whey would increase hedonic ratings, though the R2 for this model was lower due to the variability of consumer preferences. These models can be utilized by food producers to understand basic trends that a similar food would undergo when varying protein level and protein type.

Results

This research can benefit food producers trying to incorporate protein into extruded or puffed snack foods at high levels. Most extruded snack foods are very low in protein, and increasing the amount could make them more marketable for consumers looking for more satiating snack options. Models generated can help food producers predict the changes a similar food will undergo when increasing the amount of protein or changing the type of protein. This will result in a snack with the right characteristics to make it more acceptable to consumers.

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

Outcome #13

1. Outcome Measures

Attracting Customers To The Farm By Identifying Rootstocks That Will Reduce Tree Height Without Compromising Fruit Quality

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Fruit trees are important sources of food and nutritive value worldwide. Illinois has a thriving fruit industry that dates back to the early settlers. Until the last three decades, the industry had depended mainly on wholesale marketing to grocery stores and brokers. However, in recent years the industry has been going through a major shift from wholesale to marketing directly to consumers. This shift in marketing dictates a shift in fruit production systems. Because of liability concerns, direct market fruit growers are looking for dwarf trees that can be harvested at ground level. The tree canopy structure has also seen a rapid change. Growers are interested in tree structures that will result in fruits growing towards the outside of the tree canopy so they can be accessible to U-pick customers. New varieties of superior quality are also of high demand by direct market customers. The objectives of this project are to attract more customers to the farm by helping growers identify rootstocks that will reduce tree height without compromising fruit quality. Another objective is to give direct market customers more selection of fruits that are tree ripened and of superior quality.

What has been done

This study has evaluated the bioactive compounds in five apple cultivars including four scab resistant cultivars Gold Rush, Pixie Crunch, Crimson Crisp, Wine Crisp, and a non-scab resistant cultivar Golden Delicious.

Results

Gold Rush, a late maturing green cultivar, has significantly higher total phenolics and antioxidants than the other four cultivars, with the standard cultivar Golden Delicious showing the lowest amount of total antioxidants and total phenolics. Pixie Crunch, an attractive red apple, has the highest amount of sugars [glucose and sucrose] and the highest amount of the sugar alcohol sorbitol compared to the other four cultivars. In contrast, Wine Crisp has the lowest amount of sugar. In general, with the exception of Wine Crisp, the four scab resistant cultivars have superior antioxidants and sugar content than the standard cultivar Golden Delicious.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
205	Plant Management Systems
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
603	Market Economics
701	Nutrient Composition of Food
704	Nutrition and Hunger in the Population

Outcome #14

1. Outcome Measures

Increased Knowledge Of Proper Processing Of Food Served At Home And Served/Sold To The Public To Prevent Food-Borne Illnesses

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	120

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Increased public interest in locally grown foods has also generated increased interest in home food preservation. University of Illinois Extension foods and nutrition educators have responded with programs focused on food safety practices to ensure that home preserved food is safe for consumption.

What has been done

Residents in nine Illinois counties participating in Yes! You Can: Preserving Safely, a one-hour presentation focused on food safety during home food preservation that concluded with pressure canner gauge testing by nutrition and wellness Extension educators.

Results

An evaluation completed by 133 program participants at the end of the programs indicated that 120 of them felt that the program was "excellent" [92 participants] or "good" [38 participants]. One hundred twenty [90%] planned to take from one to five actions as a result of participating in this program. Responses to five actions follow: [1] 87 [72%] plan to use tested recipes; [2] 72 [60%] plan to change how they preserve foods to reduce the risk of foodborne illness; [3] 62 [52%] plan to change how they grow, harvest, or handle fresh produce to reduce the risk of foodborne illness; [4] 34 [28%] plan to attend this class every year to receive up-to-date food preservation methods; and [5] 26 [22%] plan to attend this class every year to test their pressure gauge. When asked to describe other actions they plan to take, nine indicated they planned to start canning. Four commented on pressure canning - one participant learned the difference between pressure cooking/canning and hot water bath, one plans to buy a pressure canner, one plans to obtain a water bath canning system and later a pressure canner, and another never wants to use a pressure canner.

4. Associated Knowledge Areas

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

Outcome #15

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
2015	111

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. Increased demand for locally produced foods is well documented in Illinois. Despite increasing demand only 1.1% of all crop sales recorded in Illinois for 2007 were fruits and vegetables and the average age of those producers was 57.7 years. To meet the demands of consumers, their roles must be filled by new growers. High start-up costs and lack of sufficient knowledge of business planning, production details, and marketing are challenges that must be overcome in attracting new growers.

What has been done

A number of annual one-day Extension schools for commercial fruit and vegetable producers are held during the winter months throughout the state, as well as in conjunction with neighboring states. These include vegetable schools, fruit schools, strawberry, and small fruit schools. Extension educators and specialists assist in organizing, promoting, and teaching the latest research findings related to production, pest management, marketing, and safe food handling. Attendees are also able to visit with vendors and exhibitors. This past year a formal evaluation developed in 2012 was modified, distributed, and collected from participants at the end of the two Southern Illinois Tree Fruit Schools.

At the end of the three-year grant-funded Preparing for a New Generation of Illinois Fruit and Vegetable Farmers program 222 participants [new farmers, aspiring farmers, and educators] had

each completed one year of monthly classes with hands-on and in-field experiences in English at three locations in the state. In addition, 47 participants completed the Spanish-language programs also held at three sited locations. Twenty-seven participants used incubator plots to gain hands-on farming skills and 62 educators [Extension and others] attended one or more sessions during the three years. The teaching curriculum [40 Power Point presentations and associated online references] was made available online for viewing prior to classes to allow more in-class in-depth discussions and continue to remain accessible to the public at www.newillinoisfarmers.org. A questionnaire was distributed to all participants at the end of the year of training, the results of which follow.

Results

The approximately 150 attendees at the two Southern Illinois Fruit Schools were offered an option to rate the knowledge they gained for each of the individual topic sessions using a 1-5 scale with 1 = "none/already knew" and 5 = "learned a great deal". A total of 69 growers completed the evaluation. All of the 37 fruit producers who responded checked at least one topic as a 4 or 5. When asked what the most valuable part of the school was, one-half of the producers mentioned information regarding insect and disease management. In addition, when asked to share their plans to use the information gained, one-fourth of those who completed the evaluation indicated they plan to use the information regarding spraying and chemical handling. For additional information see the evaluation section of this planned program.

All but two of those who completed the past year-long Preparing for a New Generation of Illinois Fruit and Vegetable Farmers evaluation experienced a change in knowledge, abilities, skills, and/or farming. More than half adopted plans [business, production, marketing, or financial] or practices to increase their production efficiency. In addition, more than 80% knew how to access USDA programs and services, markets, business management support, production information, grower networks, and credit. The participants in this program will grow at least 90 acres of high-value fruits and vegetables in 2016, with nearly all sold direct-to-consumer. The gross sales for 2016 are estimated to exceed 1.1 million dollars.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
603	Market Economics
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #16

1. Outcome Measures

Increased Knowledge of Small Farm Production Options

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	110

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Owners of small acreages need assistance in determining how they can best put them to use.

What has been done

Extension educators with assigned responsibility for small farms and local foods education conducted [for a third year] Putting Small Acres to Work, a one-day program that addressed a variety of topics and was offered to help people who have a few acres learn ways that they can put them to use. One hundred fifty-two [152] individuals attended one of five workshops held at various locations in the state. An end-of-workshop evaluation form was distributed and collected from 143 of the participants at the five workshops.

Results

Respondents to the Putting Small Acres to Work end-of-program evaluation were asked to identify the degree to which their knowledge, confidence, and abilities were changed regarding putting their small acres to work. Using a scale from one to five [with 1 = "no change" and 5 = "greatly improved"], the average score for the 69 who responded was above a 3.5 for all the items. Responses to specific evaluation items addressed participant's: [1] Ability to effectively find and access resources to support their small acreage systems [4.19 average group score; 110 of 143 [77%] choosing a rating of 4 or 5]; [2] Knowledge of concepts and principles of managing small acreage [4.01 average group score; 102 of 141 [72%] choosing a rating of 4 or 5]; and [3] Ability to develop goals for their property [4.03 average group score; 105 of 139 [76%] choosing a rating of 4 or 5].

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

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

Serve It Safely

The University of Illinois Extension **Serve It Safely** program is designed for volunteer groups that sell food to the public, often as a fundraising effort. In order to determine the impact of the program, participants were sent a follow-up evaluation to complete three months after the program ended. Participants were asked to provide information on the adoption of eight food safety practices. For each practice, participants could respond with "always have", "have been since the program", or "does not apply". Also offered as responses were "plan to do", and "don't plan to do".

Practice Changes Adopted

Three-fourths of the 13 participants who responded indicated that they had changed their food handling procedures and adopted one or more practices to safely serve food at events. Seven [54%] of the thirteen now use a thermometer to check temperatures of foods and seven now wash their hands for at least 20 seconds using soap and warm water [25%]. For four other practices, one or more individuals adopted the following: [1] 6 [46%] now label items clearly when storing prepared food; [2] 3 [23%] now use a separate hand-washing sink; [3] 2 now make their own sanitizing solution; and [4] 1 now prepares all foods on-site.

None of the participants reported now using slow cookers only to hold hot foods hot and not to reheat foods and none reported now eliminating use of home canned foods in their operation. Ten [77%] indicated feeling more confident in preparing foods to serve to the public and 11 [84%] reported being more aware of basic food safety principles that can help reduce the risk of food borne illness. When asked to share the most important point, topic, or idea learned, their responses referenced sanitation procedures, checking food temperatures, cross contamination information, food labeling, hand washing, and learning that you don't need to wash poultry before you cook it.

Fruit And Vegetable Schools

The attendees [150] at the two Southern Illinois Commercial Tree Fruit schools once again were offered an opportunity 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".

Fruit Program Knowledge Gained

All but one of the 37 who responded checked at least one topic as a 4 or 5, while 22 checked a 5 rating for at least one session topic at the Southern Illinois Fruit Schools. All topics were rated 4 or 5 by half or more of those who responded. The list of topics that follows are those that were rated 4 or 5 by in order of percentage of those who circled that rating regarding knowledge gained: [1] Insect Management Update for Apples - Rated 4 of 5 by 25 of 31 individuals who responded [82%]; [2] Scab & Other Abnormalities in Apple Orchards in 2014 - Rated 4 or 5 by 26 of 32 individuals [81%]; [3] Managing Stone Fruit Diseases, Bacterial Spot & Brown Rot - Rated 4 or 5 by 28 of 37 who responded [76%]; [4] Insect Management Update for Peaches - Rated 4 or 5 by 24 of 37 individuals who responded [65%]; [5] 2014 Tree Assistance Program - Rated 4 or 5 by 15 of 21 individuals who responded [62%]; [6] Winter Pruning Techniques on Non-Productive Fruit Trees for Apples & Peaches - Rated 4 or 5 by 22 of 37 individuals who responded [59%]; [7] Drought & Its Impact on Fruit Production - Rated 4 or 5 by 17 of 30 individuals who responded [57%]; and [8] Small Orchard Development for Varieties & Rootstocks - Rated 4 of 5 by 18 of 37 individuals who responded [49%].

When asked to share their plans to use the information gained, one-fourth of those who completed the evaluation indicated they plan to use the information regarding spraying and chemical handling. Other responses included changing pruning techniques, more organic methods, revising a current orchard plan or creating a long-term plan, purchasing a couple of additional pesticide and marking disruption items, and signing up for the **Tree Assistance Program**.

Putting Small Acres To Work

An end-of-program evaluation was distributed to the 152 **Putting Small Acres to Work** participants and collected from 143 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 one to five [1 = "no change" and 5 = "greatly improved"], the average score for the 143 respondents was above a 3.5 for all the items: [1] Ability to effectively find and access resources to support their small acreage systems [4.19 average group score; 110 of 143 [77%] choosing a rating of 4 or 5]; [2] Knowledge of concepts and principles of managing small acreage [4.03 average group score; 102 of 141 [72%] choosing a rating of 4 or 5]; [3] Ability to develop goals for their property [4.01 average group score; 105 of 139 [76%] choosing a rating of 4 or 5]; [4] Knowledge about land stewardship and resource management [3.92 average group score; 94 of 140 [67%] choosing a rating of 4 or 5]; [5] Understanding about farming practices [3.84 average group score; 90 of 133 [68%] choosing a 4 or 5 rating]; [6] Confidence in using small acreage management principles [3.82 average group score; 92 of 142 [65%] choosing a rating of 4 or 5]; and [7] Preparedness to start a farming enterprise [3.67 average group score; 78 of 136 [57%] choosing a rating of 4 or 5].

When asked if their personal objectives for attending this workshop were met, 140

respondents provided a rating using a five part scale [1 = "not met", 3 = "satisfactorily met", and 5 = "extremely met"]. All except two of them [98.4%] chose a rating of 3 or above. Fifty-seven [41%] marked a rating of 5, 53 [38%] marked a rating of 4, and 28 [20%] marked a rating of 3.

When asked to list the most important ideas they plan to put into practice as a result of participating in the workshop, 81 [56%] responded. Most often mentioned were practices addressing beekeeping. Other responses being considered for implementation or enhancement included fruit and vegetable production, soil testing, use of low and high tunnels, pasture management and animal production, and business planning.

Key Items of Evaluation

Ten of thirteen [77%] of the **Serve It Safely** participants who returned the follow-up evaluation adopted one or more practices to safely serve food at events. Ten also indicated feeling more confident in preparing foods to serve to the public and 11 reported being more aware of basic food safety principles that can help reduce the risk of foodborne illness.

Fruit and Vegetable School participant responses collected through the evaluation forms evidenced a high level of knowledge gained regarding all the topics offered at the 2015 Southern Illinois Commercial Tree Fruit Schools. All topics received a 4 or 5 rating from 49% to 82% of those who completed the evaluation. When asked what the most valuable part of the school was, half of the producers mentioned information regarding insect and disease management. In addition, when asked to share their plans to use the information gained, one-fourth of those who completed the evaluation indicated they plan to use the information regarding spraying and chemical handling.

Primarily motivated by the desire to seek information about options for using small acreage, all but two of the 140 **Putting Small Acres to Work** workshop attendees who completed the evaluation felt that their objectives were met. Most notably, their responses to the end-of-workshop evaluation indicated increases in their ability to effectively find and access resources to support their small acreage system, knowledge of concepts and principles of managing small acreage, and developing goals for their property. Eighty-one participants shared what they learned and plan to install low or high tunnels to extend their growing season, test their soil, improve soil health if indicated, begin growing new plants, invest in raising animals, and adjust other plans to put their small acres to work.

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%		20%	
704	Nutrition and Hunger in the Population	20%		10%	
724	Healthy Lifestyle	10%		20%	
802	Human Development and Family Well-Being	20%		15%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	0%		10%	
805	Community Institutions, Health, and Social Services	10%		5%	
806	Youth Development	20%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.1	0.0	8.0	0.0
Actual Paid	0.0	0.0	11.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
867702	0	1948244	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
867702	0	1948244	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
7640637	0	5173823	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included a study that seeks to better understand the protective factors that maintain relationship quality during the transitions to marriage and parenthood, a project utilizing data from the Pathways Project to examine parenting in immigrant Latino families, work to identify which nutrition labels are most effective at influencing consumers to make healthier choices, the development of a measurement tool that identifies stay-at-home father and mother families and their type [choice and nonchoice] and measures the reasons leading these families to such paid-work and care arrangements, the characteristics of these families, and their well-being at the individual, couple, and family levels, ongoing studies utilizing a translational pig model to provide direct evidence for the importance of perinatal choline status in neurodevelopment, the determination that a high-fat diet and obesity differentially contribute to changes in intestinal epithelial stem cell proliferation and differentiation, work to identify the frequency of high-risk alleles on genes related to the early onset obesity phenotype using data from two ongoing research cohorts [**STRONG-KIDS** and **UP-AMIGOS**], and a project that fulfills a need to establish an evidence-based and school-friendly intervention to prevent overweight and diabetes in adolescence as well as providing teacher support at a time when school resources are being dramatically cut.

Activities also included work to provide an in vivo assessment of the selective actions of botanical estrogens in preclinical mouse models relevant to the metabolic health of menopausal women and breast cancer survivors, research building upon an existing cohort study examining the potential for family mealtime practices to moderate biological risk for childhood obesity in the first year of life, the development of a new instrument to assess parent's ability to work together as they rear siblings, the development of 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 [one desired outcome of this project is to translate the scientific energy balance evidence and parenting styles into practical and appropriate recommendations for training Extension health educators that work with parents], and ongoing work under the **Child Development Laboratory Research Database Project** [the intent of the CDL Research Database Project is to facilitate interdepartmental and cross-departmental investigations of child development].

Activities also included the development of an afterschool physical activity curriculum and template for implementation to effectively support healthy weight among Latino school children, ongoing work to complete Phase I and execute Phase II of the **Multidimensional Cultural Identity Study** [which is exploring the presence of, daily variations in, and well-being implications of multiple cultural identities among non-metropolitan youth ages 13-23], research to determine if individual differences in caregiver/child attachment and child temperament are associated with obesogenic family routines, an exploration of the frequency of polymorphic variants in the beta-carotene monooxygenase 1 [BCMO1]

gene and their association with risk factors for metabolic syndrome [recognition of genetic variants would allow identification of subjects in whom specific dietary interventions could have a positive effect in preventing obesity or cardiovascular disease], and a project with the overall goal of developing evaluation methods and criteria that support the identification of the highest quality nutrition education apps and then using these evaluation methods to test and compare attentiveness of two apps developed with high and low interactivity level.

Activities also included an exploration of the ecological changes in intestinal microbial communities that are induced with prebiotic and probiotic therapy in a parenterally-supported neonatal piglet model of intestinal failure, research that will contribute to our understanding of social-emotional development among young children from rural and suburban communities [because patterns of problematic interactions with peers begin to emerge during the preschool years and have implications for children's subsequent adjustment, it is important to pinpoint underlying processes that may contribute to children's peer difficulties], a study to see if graphically delivering information of select nutrients relative to a target would allow individuals to process the information in time-constrained settings more effectively than numerical information [objectives of the study are to determine the efficacy of the graphical method in improving memory of nutrient information and improving consumer purchasing behavior in a restaurant], a mixed methods study examining educator stress and resilience in addition to applying an intervention in a movement toward treatment of the epidemic of educator stress, work to identify methods for the fortification of staples in low-income countries [we conducted preliminary studies to characterize the use of a cast iron ingot as a method to fortify rice with iron; this method has been promoted in South East Asia for the fortification of rice with iron and has been shown to provide available iron for low-income populations], an investigation of the role dietary soy flour and purified isoflavones may play in treating breast cancer, a project 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 the identification of genetic factors influencing the accumulation of individual glucosinolates in broccoli florets to gain further insight into the regulation of glucosinolates in Brassica vegetables [and accelerate the development of vegetables with enhanced glucosinolate profiles tailored to promote human health].

Conference presentations included the United Nations President of General Assembly Dialogue, United Nations ECOSOC Youth Forum, First Global Forum on Youth Policies, American Studies Association, American Educational Research Association, Society for Research in Child Development, 14th Annual Cambio de Colores Conference, Northeast Agricultural and Resource Economics Association, European Association of Agricultural Economists - Agricultural and Applied Economics Association Joint Seminar, Institute of Food Technologists, 106th American Oil Chemist's Society Annual Meeting and Industry Showcase, American Society for Nutrition, Experimental Biology, Society for the Study of Ingestive Behavior, Benjamin Franklin Lafayette Seminar, University of Wisconsin Center for Child and Family Wellbeing, International Association of Laboratory Schools, American Educational Research Association, Society for the Study of Emerging Adulthood, International Association of Cross-Cultural Psychology, International Human Microbiome Conference, National Council on Family Relations 77th Conference, International Biennial Conference on Phonetics and Phonology, 27th Annual Convention of the American Psychological Society, Biennial Meeting of the Society for Research in Child Development, National Science Foundation Workshop on the Science of Nature-Based Learning, American Society for Biochemistry and Molecular Biology, and the National Kidney Foundation.

For the past eight years Extension programming on brain health continued to be expanded and remains a major focus of Extension family life educators. A new program, **Hold That Thought**, was developed this past year to provide information on strategies and techniques for building a better memory and was attended by 469 individuals. The delivery sites for a brain health series were expanded in 2015 to meet the needs of various audiences and included the following segments: [1] **Building a Better Memory for Everyday Life**; [2] **FIT WITS**; and [3] **Head Strong. Coming of Age: Explore Your Future**, another four-part series, continued to be offered and targeted to those who are considering retirement soon or are

newly retired to help them examine the social aspects of retirement, to identify their strengths and interests, and to plan for post-retirement activities. Resources related to aging and retirement were also available through: [1] **Long-term Care: Talking, Deciding, Taking Action**, an educational series and website that includes both family life and financial management topics for helping individuals and families plan effectively for their needs as aging adults; and [2] **Plan Well, Retire Well**, a comprehensive website that includes blogs, e-news, and monthly news articles.

Being Mindful in a Busy World was developed this past year to define and identify the benefits of mindfulness meditation. **Share Your Life Story**, a multi-week series, continued to be offered to provide a therapeutic approach to life renewal. In addition, **Making a Meaningful Nursing Home Visit** and **Simplify Your Life: Clear the Clutter & Your Stress** workshops were conducted for multiple groups throughout Illinois.

This past year participation in the state webinar series based on the **Your Young Child** research-based curriculum experienced a growth in attendance. One hundred forty-seven [147] parents and caretakers of infants and toddlers learned how to manage seven difficult stages and behaviors that are linked to child abuse and neglect. For a second year family life Extension educators engaged in a partnership with Pennsylvania State University and the University of Nebraska at Lincoln through the U.S. Department of Defense as grantor to deliver the **Childcare and Youth Training and Technical Assistance Project** [CYTTAP] that reached over 1,000 childcare professionals offering additional modules that addressed enhancing play times, children's nutrition building blocks, and physical movement and the brain. **Parenting 24/7** is a one-stop source of research-based information on the web that includes articles, breaking news and commentary, links to other resources, and video clips of real parents of children from birth through the teen years and focuses on challenges and solutions. **Just in Time Parenting** is an age-paced electronic newsletter that is the product of the national **eXtension** network of parenting and child development experts who provide online support to parents and professionals and is distributed monthly from birth to 12 months, and then bi-monthly until the child is five years old. **Parenting Again** topic-based discussion guides were made available for grandparents raising grandchildren.

Most Extension activities 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 774,430 youth who were taught healthy eating choices and 4,244 youth who were reached through **EFNEP** in 2015. The **SNAP-Ed** and **EFNEP** staff used the **CATCH** and **SPARK** curricula to educate elementary and preschool students in after-school and summer programs about healthy snacks, good nutrition, and the importance of physical activity. **OrganWise Guys** materials were used by **SNAP-Ed** staff with youth in K-2nd grade classrooms. For a second year interdisciplinary programming involving **4-H** in conjunction with the **Supplemental Nutrition Assistance Program Education** [SNAP-Ed] staff engaged teens to teach primarily fifth-grade youth to make healthy food choices through the program titled **4-H Food Smart Families** that was conducted in after school programs and summer camps.

Under the leadership of the **4-H** youth development staff members, the **Health Jam** program was conducted for 5th grade youth and offered support related to exercise, wellness, nutrition, and health careers information using an experiential learning approach. 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. Newly added **4-H Health Rocks!** programming, 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 398 youth.

Extension programs also focused on chronic diseases including heart disease and diabetes. **I on Diabetes**

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

Additionally, Extension educators focusing on nutrition and wellness, family life, and consumer economics reached out to residents in counties statewide by offering similar older adult focused "healthy living" programs. For example, an interdisciplinary series of 54 programs titled **Learning is Timeless** continued to be delivered by staff located in Chicago who made 714 direct contacts with participants to assist them in developing skills in community health, family life, horticulture, and computer training.

2. Brief description of the target audience

Members of the target audience included academic, medical, veterinary, industrial, and professional scientists and clinicians, young adult and midlife women, nutrition and dietetics professionals, governmental organizations, commodity groups, families in Champaign-Urbana and in rural areas, gestating women and those breastfeeding newborns, students and researchers in the areas of human obesity and animal production, nutrition Extension specialists, product developers who are interested in improving the health benefits of their products through microencapsulation technology, parents of toddlers and young children, educators, mental health counselors and other professionals who work with families, research scientists interested in obesity prevention, early childhood educators, youth program administrators and front line practitioners, nutritionists, pork producers, scientists and graduate students specializing in the fields of child development, family studies, linguistics, and psychology, clinicians and practitioners who serve children and families, food industry scientists, and the international food and nutrition scientific community.

Individuals at-risk for or coping with diabetes, obesity, or heart disease will be a priority recipient of Extension programming, as will families living in low-income and high-risk neighborhoods where programming will be adapted to reach racially, ethnically, and culturally diverse audiences and youth. Other target audiences include parents and child care providers, grandparents responsible for young children, caregivers of aging adults, and adolescent youth. Extension also targeted youth, teachers, parents, grandparents, caregivers of adults, retirees, childcare providers for children of off-installation military families, individuals with chronic diseases, and working couples.

3. How was eXtension used?

Sixteen 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

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	32862	68533	30765	0

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

Patent Applications Submitted

Year: 2015

Actual: 1

Patents listed

Patent Application TF12004-15: Modulation Of Immune Function By Dietary Bovine Lactoferrin.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	94	94

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2015	9

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 Practices To Foster That Behavior
3	Numbers Of Individuals Taking Recommended Actions To Manage Heart Disease And Diabetes Through Planning Menus/Choosing Foods Using The Food Guidance System
4	Number Of Children/Youth That Gained Knowledge About Eating Healthier Foods [Those Low In Fat And High In Fiber]
5	Number Of Children/Youth That Increased Physical Activity
6	Promoting Social And Emotional Health Among Young Children
7	Addressing Gaps In Student Achievement
8	Utilizing A Family Resiliency Framework To Address Childhood Obesity
9	Number Of Families/Caregivers That Gained Knowledge About Eating Healthier Foods [Those Low in Fat and High in Fiber]
10	Number Of Adults That Apply Skills As They Age In Maintaining Brain Fitness And Cognitive Health
11	Extension Of A Successful, Evidence-Based Approach For Strengthening Prosocial Sibling Relationships
12	An Evaluation Of The Effect Of Dietary Botanical Estrogens On Breast Cancer Growth And Progression
13	Development Of Dietary Strategies To Significantly Reduce Both The Incidence And Mortality Of Colon Cancer
14	Number Of Families/Caregivers That Gained Knowledge About Eating More Healthy Foods [Those Low In Fat Or High In Fiber]
15	Number OF Children And Youth Who Reported Eating More Of Healthy Foods
16	Preventing Weight Gain Through Nutrition Education
17	Investigating The Ability Of Tomato Powder, Broccoli Powder, And Soy Germ To Reduce The Progression Of Prostate Cancer

18	Comparing Protein Profiles Of Improved Common Bean Cultivars Grown In Mexico And Brazil
19	Determining How Perinatal Choline Alters Gene Expression And Cognitive Behaviors
20	The Use Of Bioactive Compounds Such As Resveratrol And Butyrate To Prevent And Alleviate Certain Disease States
21	Improving The Quality Of Programs For High-School-Aged Youth Through A Better Understanding Of The Strategies Used By Effective Program Leaders
22	Improving Our Understanding Of Social-Emotional Development Among Young Children From Rural And Suburban Communities
23	Reducing Obesity Through Improved Utilization Of Nutrition Information
24	Accelerating The Development Of Vegetables With Enhanced Glucosinolate Profiles Tailored To Promote Human Health
25	Increased Knowledge Of Healthy Lifestyle Choices And Consequences Of Actions With Respect To Healthy Lifestyle Choices
26	Number Of Youth That Increased Knowledge Of Bullying And Actions To Take In Dealing With A Bullying Situation
27	Increased Practices Related To Aging

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
2015	23

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The purpose of this project is for the continuation of the Child Development Laboratory [CDL] Research Database at the University of Illinois at Urbana-Champaign. This project has been designed to facilitate an interdisciplinary, longitudinal, and programmatic research agenda at the Child Development Laboratory in the areas of child development and family studies. The following objectives will be addressed by the project: [1] To refine and further develop a longitudinal database on enrolled children and their families for the purpose of enhancing research projects being implemented at the CDL; [2] To promote long-term, interdisciplinary collaborations among faculty within the Department of Human Development and Family Studies and from across campus via reciprocal exchanges of data through the database project; and [3] To support systematic student involvement in interdisciplinary research.

What has been done

The primary outcome of this project has been the research being generated by investigators that have accessed the CDL program and the CDL Research Database Project. The intent of the CDL Research Database Project is to facilitate interdepartmental and cross-departmental investigations of children's development. The infrastructure created as part of the project has been instrumental in the generation of new knowledge across a wide variety of disciplines [such as human development and family studies, curriculum and instruction, special education, community health, kinesiology, landscape architecture, speech and hearing sciences, communications, music education, nutritional sciences, and educational psychology].

Results

In accessing information from the CDL Research Database, investigators have been able to broaden the scope of their data collection procedures and enhance the type and quality of data they were able to gather. A secondary outcome of this project has been the increased understanding and appreciation of the research process that undergraduate students have been able to develop as a result of working with the baseline assessments conducted as part of the CDL Research Database project. These students developed a working understanding of the strengths and limitations of standardized assessments with young children, as well as competencies in how to use such tools when screening children. Such skills and understanding will serve them well as they begin careers providing support services to children and families. An additional secondary outcome of the project has been the multiple ways in which it has facilitated the generation of new knowledge broadly defined. This generation of knowledge took on many forms [such as undergraduate research, graduate student training, doctoral dissertation research, instrumentation projects, UIUC-industry collaboration, supporting of junior faculty investigators, pilot data collection/feasibility studies, and atypical disciplines supported]. 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 and being disseminated in several formats [journal publications, technical reports, press releases, and conference presentations]. Over the life of the project a total of 67 research projects, 14,333 student observations and 7,480 student class projects were implemented at the CDL and benefited from the support and data provided by the CDL Research Database project.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle
802	Human Development and Family Well-Being

803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions, Health, and Social Services
806	Youth Development

Outcome #2

1. Outcome Measures

Increased Knowledge Of Children's Behavior At A Given Stage Of Development And Parenting 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 Through Planning Menus/Choosing Foods Using The Food Guidance System

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	73

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Diabetes ranks as the seventh leading cause of death in Illinois according to the Illinois Department of Public Health. In fact, more than 969,000 adults [9.2%] in the state have been diagnosed with diabetes according to National Center for Disease Control.

What has been done

University of Illinois Extension's I on Diabetes is a series of face-to face sessions designed for anyone interested in preventing or managing diabetes. During the series held in Illinois this year, 99 participants received information on: [1] Diabetes treatment goals and self-monitoring; [2] Managing carbohydrates, sodium, cholesterol and fat portions; [3] Planning meals; and [4] Reading food labels. Food demonstrations, taste testing, and recipes assisted participants in using artificial sweeteners, low-fat products, and herbs and spices. Participants also completed a program evaluation to determine the impact of the program. Participants were asked to provide answers to four series of questions prior to and after the I on Diabetes sessions.

Results

All but two of the participants who completed all or sections of the pre- and post-evaluations indicated increasing their confidence, skills, or practices in managing their diabetes. Specifically:

Using a four-part scale ranging from "strongly disagree" to "strongly agree", 69 of 82 participants [84%] who completed the series of questions indicated that they improved their ability to manage diabetes in one or more areas.

Using another four-part scale ranging from "not confident" to "very confident", 73 of 82 participants [89%] indicated that they improved their confidence in managing their diabetes in one or more areas.

Using a four-part scale ranging from "never" to "almost always", 76 of 82 participants [93%] reported increasing their frequency in taking at least one recommended action to manage their diabetes.

Additional information regarding specific areas of changes in skills, confidence, and practices related to participants management of diabetes are included in the evaluation results section of this planned program.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Number Of Children/Youth That Increased Physical Activity

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Promoting Social And Emotional Health Among Young Children

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Addressing Gaps In Student Achievement

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Utilizing A Family Resiliency Framework To Address Childhood Obesity

Not Reporting on this Outcome Measure

Outcome #9

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 #10

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
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	449

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 Hold That Thought, a new workshop on brain health that addresses techniques in maintaining one's memory. Four hundred and sixty-nine [469] participants attended one of the 13 Hold That Thought workshops held in various locations in Illinois in 2015. At the end of the program, participants were asked to complete a one page evaluation consisting of seven questions including several open-ended questions that required qualitative analysis.

Results

When asked what they plan to do as a result of what was shared during the program, responses indicated that 93% of the participants intended to implement a skill or strategy that they learned at the workshop. Most frequently mentioned were plans by nearly one-fifth of the participants to stay focused on one thing at a time/to pay attention. Other frequently mentioned actions encompassed plans to practice memory exercises that were shared during the program, verbalizing and repeating things out loud, writing notes or journaling, increasing mental or physical exercises, and trying new and challenging activities.

When asked what was the single most valuable thing they learned from the program, 364 participants responded. More than one-third [132] appreciated learning that forgetting is normal, that everyone forgets, that its okay to forget, and that memories can be improved. Other responses included those mentioned in the responses to the above question on plans for taking memory enhancing actions.

Overall 431 [94%] of the participants rated the event as very good or excellent. All but nine [98%] of the 458 participants indicated that they had gained a deeper understanding of the brain health as a result of the workshop and all but ten [98%] had learned something new that will improve their quality of life. This participant feedback suggests that the series successfully addressed ways to alleviate concerns about aging and maintaining one's quality of life.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle

Outcome #11

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 Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

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 4- to 8-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 conflict 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

Progress has been made in the construction of the website, the design of the four parent engagement modules, and the design of the research component to be carried out in Year Two which will assess the effectiveness of these parent resources for enhancing children's sibling relationships. A new instrument was also developed to assess the quality of parents' abilities to work together as they rear the siblings.

In Year Two we will complete the construction of the website which will house the parent engagement modules and the research instruments. In addition, the evaluation of the effectiveness of the parent engagement modules will commence.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
805	Community Institutions, Health, and Social Services
806	Youth Development

Outcome #12

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Soy flour diet [MS] prevented isoflavones from stimulating MCF-7 tumor growth in athymic nude mice, indicating that other bioactive compounds in soy can negate the estrogenic properties of isoflavones. The underlying signal transduction pathways to explain the protective effects of soy

flour consumption were studied here.

What has been done

Ovariectomized athymic nude mice inoculated with MCF-7 human breast cancer cells were fed either MS or purified isoflavone mix [MI], both with equivalent amounts of genistein. Positive controls received estradiol pellets and negative controls received sham pellets. A GeneChip-Human-Genome-U133-Plus-2.0 Array platform was used to evaluate gene expressions, and results were analyzed using bioinformatics approaches.

Tumors in MS-fed mice exhibited higher expression of tumor-growth-suppressing genes ATP2A3 and BLNK, and lower expression of oncogene MYC. Tumors in MI-fed mice expressed higher levels of oncogene MYB and lower levels of MHC-I and MHC-II, allowing tumor cells to escape immunosurveillance. MS-induced gene expression alterations were predictive of prolonged survival among estrogen-receptor-positive breast cancer patients, while MI-induced gene changes were predictive of shortened survival.

Results

In summary, our findings suggest that dietary soy flour affects gene expression differently than purified isoflavones, which may explain why soy foods prevent isoflavones-induced stimulation of MCF-7 tumor growth in athymic nude mice. Therefore, the stimulatory in vivo effect observed with purified dietary isoflavones is likely different when the isoflavones are fed in a complex matrix such as defatted soy flour. The findings in the study need to be interpreted carefully for the consumption of purified dietary isoflavones by BC survivors.

These studies contribute to the understanding of how more complex dietary foods such as soy flour and purified dietary isoflavones impact BC tumor growth in a well characterized preclinical BC model. The impact of the studies suggests that soy flour containing diets have a different outcome than when the same level of purified dietary isoflavones are fed to mice.

4. Associated Knowledge Areas

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

Outcome #13

1. Outcome Measures

Development Of Dietary Strategies To Significantly Reduce Both The Incidence And Mortality Of Colon Cancer

Not Reporting on this Outcome Measure

Outcome #14

1. Outcome Measures

Number Of Families/Caregivers That Gained Knowledge About Eating More Healthy Foods [Those Low In Fat Or High In Fiber]

Not Reporting on this Outcome Measure

Outcome #15

1. Outcome Measures

Number OF Children And Youth Who Reported Eating More Of Healthy Foods

Not Reporting on this Outcome Measure

Outcome #16

1. Outcome Measures

Preventing Weight Gain Through Nutrition Education

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	81

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The overarching aim of this research program is to prevent the burden of adult obesity among women. The specific purpose of this research project is to identify determinants of weight gain prevention as guided by Social Cognitive Theory. It is hypothesized that compared to a wait-list control group, women who undergo a weight gain prevention intervention designed to increase self-efficacy, self-regulation, outcome expectations, and family and social support regarding weight gain prevention will maintain current body weight over 12 months. Further, it is expected that women in an intervention group led by a registered dietitian will have lesser weight gain over 12 months compared to women in an intervention group led by a counselor.

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. Women completed weekly nutrition education sessions that focused on nutrition education, intake of fruits and vegetables, and practical weight management skills. Fourteen women who were originally randomized to the wait-list control group are now undergoing the intervention phase. Data have been collected at baseline, month 3, month 6, month 9, and month 12. Variables include dietary intake, physical activity, anthropometric and blood pressure measurements, biochemical markers of health, eating behaviors and health perceptions, and mediators of behavior change. At baseline, women with higher grit have lower body weight and body mass index. Also at baseline, one in every five women misperceived their body weight classification. The entire group has been able to prevent weight gain, including women in the wait-list control group. Randomization to the registered dietitian or counselor group did not have any effect on weight gain prevention in this sample of women.

Results

The intervention has been completed, and the women who were in the wait-list control group are now undergoing the active intervention phase. Women have learned about vegetable consumption, planning ahead for food intake and portion control, and general nutrition information based on the 2010 Dietary Guidelines for Americans. A group of 81 women have prevented 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 relationship between grit and body mass and women's susceptibility to body weight misclassification.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle
802	Human Development and Family Well-Being

Outcome #17

1. Outcome Measures

Investigating The Ability Of Tomato Powder, Broccoli Powder, And Soy Germ To Reduce The Progression Of Prostate Cancer

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Castration-resistant prostate cancer [CRPC] is an aggressive and lethal form of prostate cancer, which occurs after failure of androgen deprivation therapy [ADT] to treat metastatic or locally recurrent primary disease. This is often facilitated by CRPC cell's acquired capacity for local androgen synthesis. Our group has previously shown that dietary tomato can reduce prostatic expression of androgen biosynthetic genes. Therefore, we questioned whether dietary tomato might be effective in preventing or controlling the progression of CRPC.

What has been done

We hypothesized that lifelong dietary intake of tomato, as well as an adjuvant dietary tomato intervention, would reduce tumor burden and growth rate in a mouse model of CRPC. TRAMP mice [three weeks of age, n=79] were acclimated to a powdered, AIN-93G diet [CON] for one week and then randomized to consume CON [n=28] or 10% w/w lyophilized tomato paste [TP; n=27] from four weeks of age until sacrifice. A third group, modeling adjuvant dietary intervention, consumed CON from four weeks of age until twelve weeks of age, and then 10% w/w lyophilized tomato paste from week twelve until sacrifice [TP-I; n=25]. All animals were castrated at twelve weeks of age. Mice were monitored longitudinally with biweekly 3-D ultrasound scans for tumor detection beginning at ten weeks of age. Upon tumor detection, mice were imaged weekly four additional times for volumetric tumor measurement and determination of tumor growth rate. Animals without a tumor at thirty weeks of age were sacrificed. At sacrifice, tomato intervention [TP-I], but not lifelong consumption [TP], reduced tumor weight approximately 30%.

Results

Longitudinal 3-D ultrasound tumor area under the curve [AUC] was reduced nearly 50% by TP-I and approximately 25% by TP. Both patterns of tomato consumption reduced tumor burden in this mouse model of CRPC, with adjuvant dietary intervention demonstrating the strongest effects.

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

Comparing Protein Profiles Of Improved Common Bean Cultivars Grown In Mexico And Brazil

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Common bean [*Phaseolus vulgaris* L.] is a good source of protein, vitamins, minerals, and complex carbohydrates. The objective of this project is to compare protein profiles, including anti-nutrient proteins, and potential bioactive peptides of improved common bean cultivars grown in Mexico and Brazil.

What has been done

Bean protein isolates [BPI] were prepared from 15 common bean cultivars and hydrolyzed using pepsin/pancreatin. Thirteen proteins were identified by SDS-PAGE and protein in-gel tryptic-digestion-LC/MS. Protein profile was similar among common bean cultivars with high concentrations of defense-related proteins. Major identified proteins were phaseolin, lectin, protease, and alpha-amylase inhibitors.

Results

Lectin [159.2 to 357.9 mg lectin/g BPI], Kunitz trypsin inhibitor [inh] [4.3 to 75.5 mg trypsin inh/g BPI], Bowman-Birk inhibitor [5.4 to 14.3 micrograms trypsin-chymotrypsin inh/g BPI], and alpha-amylase inhibitor activity [2.5 to 14.9 inh relative to acarbose/mg BPI] were higher in Mexican beans compared to Brazilian beans. Abundant peptides were identified by HPLC-MS/MS with molecular masses ranging from 300 to 1,500 Da and significant sequences were SGAM, DSSG, LLAH, YVAT, EPTE, and KPKL. Potential bioactivities of sequenced peptides were angiotensin converting enzyme inhibitor [ACE], dipeptidyl peptidase IV inhibitor [DPP-IV], and antioxidant capacity. Peptides from common bean proteins presented potential biological activities related to control of hypertension and type-2 diabetes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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- 703 Nutrition Education and Behavior
- 704 Nutrition and Hunger in the Population

Outcome #19

1. Outcome Measures

Determining How Perinatal Choline Alters Gene Expression And Cognitive Behaviors

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Research was conducted in a translational pig model to provide direct evidence for the importance of perinatal choline status in neurodevelopment. Data generated included hippocampus mRNA expression profiles of genes in four week old pigs exposed to the full factorial combination of prenatal and postnatal choline status. Pigs exposed to these treatments were also subjected to a spatial task of learning and memory involving the T-maze at the same age to provide a functional measure of neurodevelopment.

What has been done

All combinations of prenatal and postnatal choline statuses were used in these studies, so we were able to delineate which period was most important for brain development. Our findings suggest that prenatal choline deficiency causes greater deficits in hippocampal gene expression and performance on behavioral tasks compared with choline deficiency during the postnatal phase. Differences in cognitive processing due to prenatal choline status were not only evident at four weeks of age, but remained through twelve weeks of age in growing pigs. Of note was the decreased hippocampal expression of nerve growth factor [NGF], a classically-described gene integral in the growth, maintenance, proliferation, and survival of neurons, due to the main effect of prenatal choline status. Pigs exposed to prenatal choline deficiency also exhibited lower performance during the reversal phase of a hippocampal-mediated spatial T-maze behavioral task. Taken together, these data indicate that neurodevelopment was altered due to choline status, with the most dramatic effects being exhibited in pigs that received insufficient choline in utero.

Results

We experienced a change in knowledge as our data suggested that prenatal choline status is more important than postnatal choline status. Moreover, postnatal choline supplementation was unable to rescue pigs from the effects caused by prenatal choline deficiency, and this point has direct implications in the human clinical realm. Thus, as with folate, it appears that women of childbearing age need to be receiving adequate choline throughout pregnancy to ensure that proper neurodevelopment of the infant occurs. Finally, these studies have caused a change in action in that greater focus should be placed on choline status at the time of conception, because even minor alterations of the earliest neurodevelopmental events are magnified throughout the lifespan.

4. Associated Knowledge Areas

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

Outcome #20

1. Outcome Measures

The Use Of Bioactive Compounds Such As Resveratrol And Butyrate To Prevent And Alleviate Certain Disease States

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Microencapsulation technology is a very promising area to incorporate bioactive compounds into foods. Bioactive compounds, such as resveratrol and butyrate, can help to prevent and alleviate certain disease states. The incorporation of these compounds into food products can provide a convenient means to disseminate functional food health benefits to consumers.

Microencapsulation can also help to stabilize the compounds during processing, storage, and digestion and minimize negative sensory properties of the compounds.

What has been done

Butyric acid is an important short-chain fatty acid for intestinal health and has been shown to improve certain intestinal disease states. A triglyceride containing three butyric acid esters,

tributylin [TB], can serve as a source of butyric acid. However, the need to target intestinal delivery and mitigate unpleasant sensory qualities has limited its use in food. Microencapsulation, the entrapment of one or more cores within an isolating matrix, may provide a solution to the challenges mentioned above. This research primarily focused on the influence of: [1] Wall material: Whey protein and soy protein isolate [WPI and SPI, respectively] and gamma-cyclodextrin [GCD]; [2] Wall additives: Inulin of varying chain length; and [3] Processing method: Spray or oven drying [SD or OD, respectively] on the morphological properties and volatile retention of tributyrin within microcapsules.

Results

SPI-based microcapsules retained significantly less [p<0.001] TB compared to WPI-based microcapsules as measured by gas chromatography. The inclusion of inulin in the SD WPI-based microcapsules significantly [p<0.001] increased TB retention over WPI-based microcapsules without inulin. Inulin inclusion into WPI-based microcapsules resulted in a smoother, minimally-dented, circular morphology as compared to non-inulin containing WPI-based microcapsules as shown by scanning electron microscopy. The GCD and TB OD microcapsules retained significantly more [p<0.001] TB [94.5%] than all other WPI, WPI-inulin, and GCD TB SD microcapsules. When spray dried, the GCD-based microcapsules exhibited significantly less [p<0.001] TB retention than all other microcapsules, indicating the GCD may be unsuitable for spray drying. These findings demonstrate that microencapsulated TB in GCD can lead to minimal TB losses during processing that could be utilized in functional food applications.

4. Associated Knowledge Areas

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

Outcome #21

1. Outcome Measures

Improving The Quality Of Programs For High-School-Aged Youth 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
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Adolescents in the 21st century need to develop career and life skills 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. 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 that focused on positive youth development among high-school-aged youth. Longitudinal data are being collected from twelve programs in three geographic regions: Central Illinois, Chicago, and Minneapolis. Five programs are in rural areas [two are 4-H programs]. All engage youth in projects, including technology, leadership, and the arts. Six serve Latino adolescents.

What has been done

In previous years, we completed data collection with 26 leaders of 14 programs for middle-school-aged youth. This included 4 structured interviews with nearly all leaders [97 total interviews] and 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 SES mix. These additional leader interviews doubled the sample size for our analyses of leader practices, which greatly strengthens our ability to inform the field of youth practice. It also is allowing us to compare the practices and pedagogical strategies leaders employ in running programs for younger versus older adolescents.

Results

We have studied teens' work on projects in youth programs because they provide real-world-like contexts for understanding development of these skills. Our findings demonstrate how leader support facilitates youths' 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.

We sought to understand the processes through which youths' trust in leaders influences their program experiences. Data came from interviews with 108 ethnically diverse youth [ages 12-19] participating in 13 arts, leadership, and STEM programs. We found that trust: [1] Increased youths' confidence in a leader's guidance in program activities; [2] Increased youths' motivation in these activities; [3] Increased youths' use of leaders for mentoring on personal issues; and [4] Provided a useful model of a well-functioning relationship.

In the youth development field, it is often assumed that a strong inverse relationship exists between adult leaders' exercise of authority and youths' experience of agency. This assumption can lead novices into difficult situations. In this study we examined why, when, and how experienced practitioners yield and exert authority in daily practice through targeted interview questions with the 25 Pathways leaders. 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

youths' agency and skills for agency.

Culture, race, and family background profoundly shape adolescents' identities, expectations, and how they interpret experiences. Yet research on youth programs often fails to recognize the unique challenges faced by youth of color and recommendations for youth practice often ignore culture. In analysis of interview data from the 51 program leaders in the two studies, we first discovered four frequent cultural challenges occurring in leader's daily work [such as youth making culturally offensive remarks or conflicts between program and family practices]. Second, leaders differed in how directly they engaged with the cultural issues at stake. 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 the emotional comfort to address these cultural issues directly.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
805	Community Institutions, Health, and Social Services
806	Youth Development

Outcome #22

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A notable transformation takes place in children's understanding of people during the preschool period. That is, children come to understand that individuals have minds and that behavior is a predictable function of mental states, such as intentions, beliefs, desires, and emotions. Having a theory of mind is central to the successful navigation of social interactions and relationships.

Notably, previous research has highlighted the familial antecedents or peer outcomes associated with individual differences in children's theory-of-mind understanding, yet few studies have brought together these two lines of research. This project aimed to address this gap in the literature. Because patterns of problematic interactions with peers begin to emerge during the preschool years and have implications for children's subsequent adjustment, it is important to pinpoint risk factors and the underlying processes that may contribute to children's peer difficulties.

What has been done

Our first primary objective was to assess the extent to which child-mother attachment security at 32 months predicted theory-of-mind understanding from 3 to 5 years. To address this objective, a 3 [time point: 40, 54, 62 months] x 2 [gender] repeated measures ANCOVA was conducted with time as the repeated factor, gender as the between-subject factor, child-mother attachment security and child language at 32 months as continuous predictors, and theory-of-mind understanding as the dependent variable.

Our second main objective was to examine theory-of-mind [ToM] understanding as a predictor of children's observed friendship quality at 56 and 62 months of age. Child-friend dyads were observed in identical play sessions at 56 and 62 months and child-friend interaction was coded for coordinated social play, shared positive affect, and conflict intensity. A series of repeated measures ANCOVAs were conducted to examine longitudinal associations between ToM and each of the friendship interaction measures over the two time points, with 40-month ToM predicting observed friendship interaction at 56 and 62 months.

Our final objective was to test theory-of-mind understanding as a mechanism through which early child-mother attachment security was related to children's later friendship quality. Structural equation modeling was utilized to test the hypothesized indirect effects. Given the above findings that: [1] Attachment security was related to both ToM and emotion understanding; and [2] That ToM and emotion understanding were related to friendship quality, albeit different aspects of interaction, we tested ToM and emotion understanding as dual mechanisms in the same model. Moreover, we included child-friend coordinated play, shared positive affect, and conflict as outcome variables in the same model [error terms among these dependent variables were allowed to covary].

Results

A significant main effect of child-mother attachment security emerged, above and beyond a significant main effect of child language ability. Greater child-mother attachment security was associated with more advanced theory-of-mind understanding across the three assessment time points. The main effect of gender and the attachment security x time interaction were non-significant. Thus, we found support for our hypothesis that greater attachment security would be associated with more advanced theory-of-mind understanding.

Finally, with respect to Objective 1, in addition to considering children's theory-of-mind understanding, we examined child-mother attachment security as a predictor of children's emotion understanding at 40 months. A univariate ANOVA with child gender as the between-subjects factor and child-mother attachment security and child language at 32 months as continuous predictors indicated a significant main effect of attachment security. Greater attachment security at 32 months was related to greater emotional understanding at 40 months, and this association emerged above and beyond a significant main effect of child expressive language.

For Objective 2, we found that ToM made a significant contribution to child-friend coordinated play at both time points and a marginally significant contribution to child-friend conflict intensity,

but only at the 54-month time point. These associations emerged above and beyond contributions of child expressive language and child gender. As expected, greater ToM was related to higher levels of coordinated social play between friends and less intense child-friend conflict. ToM was a non-significant predictor of shared positive affect between children and their friends.

Complementing these analyses, we also assessed children's emotional understanding of child-friend interaction at 56 and 62 months and found that emotion understanding significantly predicted children's shared positive affect, but not child-friend coordinated play or conflict intensity. Thus, the contribution of ToM at 40 months to the quality of children's friendship interaction tends to be distinct from the contribution made by children's emotional understanding assessed at 40 months.

For Objective 3, we utilized the bootstrap procedure in Mplus 6.0 to examine bias-corrected confidence intervals [CIbc] to assess indirect effects, and results indicated a significant indirect effect from child-mother attachment security to child-friend coordinated play at 54 and 62 months via children's theory of mind understanding. The indirect effects of attachment security on child-friend conflict via ToM was also significant, but only with respect to child-friend conflict at the 56-month time point. Parallel tests of indirect effects of attachment-friend associations via emotional understanding at 40 months were all non-significant.

4. Associated Knowledge Areas

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

Outcome #23

1. Outcome Measures

Reducing Obesity Through Improved Utilization Of Nutrition Information

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Consumers have difficulty utilizing nutrition information. We hypothesized that graphically delivering information of select nutrients relative to a target would allow individuals to process information in time-constrained settings more effectively than numerical information. Objectives of the study were to determine the efficacy of the graphical method in: [1] Improving memory of nutrient information; and [2] Improving consumer purchasing behavior in a restaurant. Values of fiber and protein per calorie were two-dimensionally plotted alongside a target box.

What has been done

First, a randomized cued recall experiment was conducted [n=63]. Recall accuracy of nutrition information improved by up to 43% when shown graphically instead of numerically. Second, the impact of graphical nutrition signposting on diner choices was tested in a cafeteria. Saturated fat and sodium information were also presented using color coding. Nutrient content of meals [n = 362] was compared between three signposting phases: [1] Graphical; [2] Nutrition facts panels [NFP]; or [3] No nutrition label.

Results

Graphical signposting improved nutrient content of purchases in the intended direction, while NFP had no effect compared to the baseline. Calories ordered from total meals, entrées, and sides were significantly less during graphical signposting than no label and NFP periods. For total meals and entrées, protein per calorie purchased was significantly higher and saturated fat significantly lower during graphical signposting than the other phases. Graphical signposting remained a predictor of calories and protein per calorie purchased in regression modeling. These findings demonstrate that graphically presenting nutrition information makes that information more available for decision making and influences behavior change in a realistic setting.

4. Associated Knowledge Areas

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

Outcome #24

1. Outcome Measures

Accelerating The Development Of Vegetables With Enhanced Glucosinolate Profiles Tailored To Promote Human Health

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
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2015

0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Two classes of secondary metabolites found in Brassica crops are of particular importance for eliciting human health benefits: [1] Phenolic compounds; and [2] Glucosinolate hydrolysis products. These compounds have been demonstrated [among other things] to induce detoxification enzymes, mitigate inflammation, lower the risk of type II diabetes, and decrease cancer risk.

What has been done

In order to better utilize plants for the promotion of human health, a coordinated effort of advancement is needed in all related fields, including the genetic and environmental regulation of plant secondary product biosynthesis and the in vivo targets and mechanisms of action of phytochemicals in humans. This research addresses the genetic control of glucosinolate metabolism and phenolic compound accumulation in broccoli [*Brassica oleracea* L. var. *italica*]. Gas chromatography was utilized to quantify glucosinolate hydrolysis products in the broccoli mapping population VI-158. The same population was also evaluated for phenolic compound accumulation with three chemical assays: [1] Total phenolic content; [2] ABTS radical scavenging capacity; and [3] DPPH radical scavenging capacity. Quantitative trait loci analysis was employed for each of these phenotypes to identify genetic loci associated with variation in glucosinolate hydrolysis and phenolic compound accumulation. The genetic linkage map used for this analysis was saturated with single nucleotide polymorphism [SNP] markers anchored to the *B. oleracea* reference genome TO1000. Physical markers were utilized to identify putative candidate genes underlying the QTL effects.

Results

This work reveals several questions for further investigation and the potential challenge of improving metabolites that are responsive to environmental conditions, but also highlights potential target genes for breeding Brassica cultivars with greater health-promoting potential.

4. Associated Knowledge Areas

KA Code	Knowledge Area
704	Nutrition and Hunger in the Population

Outcome #25

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	154

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 delivery of 4-H Health Rocks!, a national healthy living program aimed at 8-16 year olds, with the goal of bringing youth, families, and communities together to reduce tobacco, alcohol, and drug use. The program was conducted at 9 sites. Trained teens and staff provided ten or more hours of educational hands-on activities in school classrooms, summer youth programs, and after school programs. In addition to learning the facts about drugs and the consequences of taking them, the youth engaged in educational activities that encompassed building life skills such as showing concern for others, making healthy life styles choices, managing stress, and developing refusal skills. A total of 312 of the 398 youth participants completed the 10 hours of required training. Two hundred and twenty-three [223] youth completed the retrospective post-pre evaluation comprised of seventeen items.

Results

At the last session of 4-H Health Rocks! youth were asked to rate the strength of their agreement with thirteen statements regarding drug usage and life skill development using a scale of 1-4 with 1 = "strongly disagree" and 4 = "strongly agree". They were instructed to provide a rating that reflected their increased agreement after the program and then provide a rating of their agreement before the program. One hundred fifty-four youth [69%] increased their agreement with at least one of the statements when comparing post-training ratings with pre-training ratings. One-third of the youth increased their agreement with the following statements: [1] Once you start smoking, it is hard to stop; [2] People who use drugs sometimes see or hear things that are not really there; [3] If a friend wanted to try drugs, I can talk them out of it [concern for others life skill]; and [4] Using drugs can ruin my relationship with my family and friends [knowledge of the consequences of actions]. In response to the final set of four questions regarding program satisfaction and experience, 3.69 was the average rating on the four-part scale for the statement "I learned a lot during the training". Complete findings can be found in the evaluation section of this planned program.

4. Associated Knowledge Areas

KA Code Knowledge Area

724	Healthy Lifestyle
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
806	Youth Development

Outcome #26

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	388

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

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

Results

Data from a subset of 460 students who completed both pre- and post-program evaluations in 2014 have continued to show increases in the number of students who definitely would: [1] Ask an adult for help - 237 [52%] additional students checked this on the post-test; [2] Confront a bully - 204 [44%] additional students checked this on the post-test; [3] Help someone who is being bullied - 194 [45%] additional students checked this on the post-test; and [4] Know actions I can take that will help with bullying situations when I encounter them - 151 [33%] additional students

checked this on the post-test. Sample responses when asked what they will do differently included "Thank you, you showed me that bystanders are the most powerful" and "I think that bullying should stop from what I've heard in Breaking the Code and at school. It helps me stop bullying".

4. Associated Knowledge Areas

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

Outcome #27

1. Outcome Measures

Increased Practices Related To Aging

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	46

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The U.S. Census Bureau estimates that all baby boomers will have reached age 65 or older by 2029. Consequently, in that year one in five Americans would be 65 or older, up from one in seven in 2015. The 2010 census reports that 13.9 percent of Illinois' population is age 65 or older.

What has been done

A new four-part program series Explore Your Future was designed for individuals who are considering retirement soon or are newly retired and was offered by Extension family life educators in April at three locations in Illinois. Participants spent the day examining the social aspects of retirement by identifying their strengths and interests and developed a game plan regarding whether they will volunteer, pursue a second career, or explore new activities. The average age of the 52 participants who provided data was 61.67 years old. At the end of the program, participants were asked to complete a survey designed to assess program quality with respect to improving the program, determining if the program met participant's expectations, and assessing knowledge gained. Forty-nine [49] participants completed this survey.

Results

When asked what the participants learned, more than one-third referenced learning about S.M.A.R.T. goals and goal planning, while many others mentioned learning new ideas and resources they could "tap" to explore their future. When asked what they liked about the program, more than one-third indicated benefiting from group interactions, self-disclosures, experiences, and stories that were shared. Nearly as many mentioned activities and tools that were used.

In response to six statements regarding their ability to relate to their sense of personal self-efficacy, the 46 respondents average group ratings were between "agreed" and "strongly agreed" with the highest being their belief in their ability to "always manage to solve difficult problems if they tried hard enough". When asked to rate statements related to their likelihood of applying/using what they learned during the workshop experience, the average group score was more than 4.00 with respect to believing they could implement the activity/action plan they developed during the program. Additional results can be found in the evaluation section of this planned program.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

I on Diabetes Chronic Disease Management

In 2015, pre- and post-evaluations consisting of four sections of questions were collected from 82 participants at the beginning and again at the end of **I on Diabetes** programs conducted in nine counties in Illinois. **I on Diabetes** is a series of 2 ½-3 hour face-to face sessions designed for anyone interested in preventing or managing diabetes. Content of the program series addresses diabetes treatment goals and self-monitoring, managing carbohydrates, sodium, cholesterol and fat portions, planning meals, and reading food labels. Food demonstrations, taste testing, and recipes assisted participants in using artificial sweeteners, low-fat products, and herbs and spices.

All of the 82 participants who completed all or some of the sections of the evaluation

indicated increasing their confidence, skills, or practices in managing their diabetes.

Improved Ability To Manage Diabetes

Sixty-nine [69] of 82 participants [84%] who completed the series of questions indicated that they improved their ability to manage diabetes in one or more areas. Using a four-part scale ranging from "strongly disagree" to "strongly agree", 48 [59%] reported they could now more easily select foods that fit their meal plan, 48 of 82 participants [59%] who completed the evaluations indicated they improved their ability to select healthier choices when dining out, and 38 [46%] indicated they could more easily prepare healthy foods. Thirty-seven [37] of 82 [45%] increased agreement that healthy foods taste good. Only 28 of 82 [34%] of the participants indicated increasing their ability to manage portion sizes and only 14 [17%] indicated feeling they had improved their ability to easily talk to the doctor about their diabetes.

Improved Confidence In Diabetes Self-Management

A second series of questions on the evaluation was designed to identify increases in the confidence of the participants to manage their diabetes using another four-part scale ranging from "not confident" to "very confident". Seventy-three [73] of 82 participants [89%] indicated that they improved their confidence in managing their diabetes. More than three-fifths of the 82 who answered these questions indicated an increased confidence in the following: [1] Estimating the amount of food you should eat [59 or 72%]; [2] Selecting foods that will reduce the risk for heart disease [58 or 71%]; [3] Knowing which foods have carbohydrates [58 or 71%]; [4] Following a healthy diabetes meal plan [54 or 66%]; and [5] Preparing foods that fit into their meal plan [52 or 63%]. Only 26 [32%] increased confidence in talking with their doctor about their health.

Increased Frequency Of Recommended Actions To Manage Diabetes

A final series of questions explored increased frequency in using recommended practices by the participants. Using a four-part scale ranging from "never" to "almost always", 76 of 82 participants [92%] reported increasing their frequency in taking at least one recommended action.

More than half of the participants revealed increasing the following practices: [1] Setting goals to help manage their diabetes [58 or 70%]; [2] Keeping track of the amount of foods with carbohydrates they eat each day [57 or 69%]; [3] Following a meal plan to help manage diabetes [52 or 63%]; [4] Using food labels to plan their meals [52 or 63%]; and [5] Trying to limit fat intake [48 or 58%].

Approximately forty percent indicated increasing their frequency in taking the following actions: [1] Trying to limit salt intake [35 or 42%]; [2] Increase physical activity [35 or 42%]; [3] Eating at least three regularly spaced meals a day [34 or 41%]; [4] Reading food labels [34 or 41%]; and [5] Trying to limit salt intake [19 or 32%].

4-H Health Rocks

Two hundred twenty-three [223] of the 398 youth participants in 4-H Health Rocks!, a national healthy living program aimed at 8-16 year olds with the goal of bringing youth, families, and communities together to reduce tobacco, alcohol, and drug use, completed a

retrospective post-pre evaluation comprised of seventeen items. In addition to learning the facts about drugs and the consequences of taking them, the educational activities encompassed building life skills such as showing concern for others, making healthy lifestyle choices, managing stress, and developing refusal skills. Thirteen of the 17 evaluation items addressed these skills using a scale of 1-4 with 1 = "strongly disagree" and 4 = "strongly agree". The youth were instructed to provide a rating that reflected their level of agreement after the program and then reflect back and provide a rating of their level of agreement before the program. One hundred fifty-four youth [69%] increased their agreement with at least one of the statements when comparing post training ratings and pre-training ratings. It should be noted that this evaluation tool has been designed for use nationally.

Data regarding the increases between before and after the program follow in the order of highest to lowest number of youth who increased their level of agreement with each of the thirteen statements: [1] 91 of the 223 [41%] increased agreement that "Once you start smoking, it is hard to stop"; [2] 84 [37%] increased agreement that "People who use drugs sometimes see or hear things that are not really there"; [3] 79 [35%] increased agreement that "If a friend wanted to try drugs, I can talk them out of it"; [4] 71 [32%] increased agreement that "Using drugs can ruin my relationship with my family and friends"; [5] 66 [29%] increased agreement that "When I feel stressed I am able to talk about it with people I trust"; [6] 57 [25%] increased agreement that "I need to think about how my choices will affect my future"; [7] 51 [23%] increased agreement that "I would help other kids like me to stay away from alcohol or other drugs"; [8] 46 [20%] increased agreement that "I feel good about myself"; [9] 45 [20%] increased agreement that "People who smoke can die from lung cancer"; [10] 45 [20%] increased agreement that "I have goals for myself"; [11] 40 [18%] increased agreement that "I am able to say no if others offered me cigarettes"; [12] 39 [17%] increased agreement that "It is important for me to stay focused on learning at school"; and [13] 35 [15%] increased agreement that "I don't have to drink or smoke even if some other young people do it".

In response to the final set of four questions regarding program satisfaction and experience, 3.275 was the average rating on the four-part scale for the statement "I learned a lot during the training".

Explore Your Future

All of the 52 participants in the **Explore Your Future** program designed for those who are considering retirement soon or are newly retired completed a pre-program survey and 49 completed a post-program survey. The pre-program survey was designed to collect information regarding the participants' demographics and work background or status and their perceptions of retirement by rating their degree of agreement with 20 statements. At the end of the program 49 participants responded to questions that addressed program quality/improvement, whether the program met their expectations, and assessing knowledge changed.

Two primary reasons participants cited for attending the program were: [1] To search for ideas for things to do now that they were retired; and [2] Their interest in developing a plan, strategy, or goals for retirement. With respect to program quality, 90% of the 49 participants who completed the post evaluation agreed or strongly agreed that the program met their expectations and that the activities in the program were helpful to achieve their purpose in attending.

When asked what they learned, more than one-third referenced learning about S.M.A.R.T. [specific, measurable, agreed upon, realistic, and timed] goals and goal planning, while many others mentioned learning new ideas and resources they could "tap" to explore their future.

Participants were asked to rate six statements regarding their personal self-efficacy using a 5-part scale with 1 = "strongly disagree", 2 = "disagree", 3 = "neutral", 4 = "agree", and 5 = "strongly agree". A summary of responses follows.

The following six statements average group rating scores ranged from 3.56 to 3.87 and are listed from the highest to lowest average: [1] 3.87 rating "I can always manage to solve difficult problems if I try hard enough"; [2] 3.83 rating "I can remain calm when facing difficulties because I can rely on my coping abilities"; [3] 3.80 rating "I am confident that I could deal efficiently with unexpected events"; [4] 3.74 rating "Thanks to my resourcefulness, I know how to handle unforeseen situations"; [5] 3.49 rating "It is easy for me to stick to my aims and accomplish my goals"; and [6] 3.46 rating "If someone opposes me, I can find the means and ways to get what I want".

Key Items of Evaluation

I On Diabetes Chronic Disease Management

All of the 82 participants who completed all or some of the sections of the evaluation indicated increasing their confidence, skills, or practices in managing their diabetes, especially with respect to selecting healthy food choices and following a healthier meal plan to manage their diabetes.

All but two of the participants who completed all or sections of the pre- and post-evaluations indicated increasing their confidence, skills, or practices in managing their diabetes. Specifically: [1] Using a four-part scale ranging from "strongly disagree" to "strongly agree", 69 of 82 participants [84%] who completed the series of questions indicated that they improved their ability to manage diabetes in one or more areas; [2] Using another four-part scale ranging from "not confident" to "very confident", 73 of 82 participants [89%] indicated that they improved their confidence in managing their diabetes in one or more areas; and [3] Using a four-part scale ranging from "never" to "almost always", 76 of 82 participants [92%] reported increasing their frequency in taking at least one recommended action to manage their diabetes.

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

Health Rocks

One hundred and fifty-four youth [64%] increased their agreement with at least one of the statements regarding learning facts about drugs and the consequences of taking them and building life skills such as showing concern for others, making healthy lifestyle choices, managing stress, and developing refusal skills when comparing post training ratings and pre-training ratings. It is worth noting that an examination of the data suggests that youth are challenged with using the post-pre evaluation format. Greater effort will need to be made by instructors to help them understand how to complete the ratings form.

Explore Your Future

When asked what the participants learned, more than one-third referenced learning about S.M.A.R.T. goals and goal planning, while multiple others mentioned learning new ideas and resources they could "tap" to explore their future. When asked what they liked about the program, more than one-third indicated benefiting from group interactions, self-disclosures, experiences, and stories that were shared. Nearly as many mentioned activities and tools that were used.

In response to six statements regarding their ability to relate to their sense of personal self-efficacy, the 46 respondents average group ratings were between "agreed" and "strongly agreed" with the highest being their belief in their ability to "always manage to solve difficult problems if they tried hard enough". When asked to rate statements related to their likelihood of applying/using what they learned during the workshop experience, the average group score was more than 4.00 with respect to believing they could implement the activity/action plan they developed during the program.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Natural Resources And The Environment

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	25%		15%	
112	Watershed Protection and Management	20%		10%	
123	Management and Sustainability of Forest Resources	5%		10%	
132	Weather and Climate	10%		10%	
133	Pollution Prevention and Mitigation	5%		10%	
134	Outdoor Recreation	0%		10%	
135	Aquatic and Terrestrial Wildlife	5%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	15%		10%	
405	Drainage and Irrigation Systems and Facilities	0%		5%	
605	Natural Resource and Environmental Economics	0%		10%	
806	Youth Development	15%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.0	0.0
Actual Paid	0.0	0.0	8.2	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
242375	0	1106678	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
242375	0	1106678	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
2134256	0	4071021	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included an assessment of active carbon pool levels within soil landscapes [this will provide us with new quantitative information about the effects of agroecosystems on soil productivity changes and global carbon balance], the collection of wetland input and output data that will allow for a full assessment of phosphorus retention and hydraulic loads to three wetlands, ongoing atmospheric deposition measurements conducted under the **National Atmospheric Deposition Program**, ongoing data collection with the ultimate goal of quantifying the costs and benefits of different urban agricultural systems [such as different soil management systems], a project that 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 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], a project that demonstrated the link between sub-lethal physiological metrics across a gradient of habitat qualities [results from this study demonstrated that the proportion of natural lands in a watershed was one of the strongest drivers of fish energetic status and resistance to oxidative stress], a content analysis of news reports about agricultural products of biotechnology in the U.S. and Ghana that was conducted to provide recommendations on how to improve the quality of reporting, the establishment of plots and initiation of experiments involving nitrogen additions to determine how resource availability affects *Microstegium* performance and impacts soil carbon storage, and a project analyzing spatial conservation-outcome forecasts for the Prairie Pothole Region and for two other conservation problems [Eastern birds and Appalachian salamanders] to identify the kinds of problems for which spatial conservation analysis is most useful.

Activities also included a study that estimates the value of biodiversity in the population of natural enemies in agricultural fields for controlling agricultural pests, work to elucidate the short term impacts of cover cropping in conventional as well as organic grain cropping systems, the development of improved methods for handling redox-sensitive samples, research with the goal of developing statistical models that can better predict restoration outcomes at a site given its landscape context and management and to develop a framework for establishing realistic restoration goals in the face of a rapidly changing global environment, work to improve management of lepidopteran corn pests, a study on habitat use by migrating birds and the factors that predispose some species to serve as hosts for the black-legged tick, work to improve and expand the use of entomopathogens in biological arthropod pest suppression, and a study of how a species of conservation concern [Grasshopper Sparrow] located newly created grasslands [these grasslands were created as part of a USDA program and we conducted an experiment to determine if social cues were needed to promote the discovery and establishment of birds on these sites; we found that social cues were used, however the species of interest would also find these grasslands without social

cues and so social cues simply sped up the process of establishing populations at these sites].

Activities also included a project to evaluate the effectiveness of a network framework for evaluating the capacity of environmental governance structures to accommodate multiple ecosystem services and the extent to which decentralized environmental governance networks are able to incorporate justice concerns into planning processes and outcomes, the establishment of self-sustaining vegetation on the USX [formerly United States Steel] brownfield in South Chicago [we utilized Illinois River dredged sediments and managed them to produce a fertile soil on the brownfield where natural vegetation was severely handicapped; what was once an unusable brownfield is now a lake side park thanks to the productive soils that were established], advances in the methods for mercury speciation analysis [in particular, we optimized conditions in the post-column wet chemical reactions of our high-pressure ion chromatography system and coupled the system to an ICP-MS [inductively-coupled plasma mass spectrometer] resulting in a system that is fully capable of performing speciated isotope dilution analysis for mercury [permitting us to measure rates of the biogeochemical processes of mercury in environmental samples]], the selection of privately owned farmland sites under contract [as well as state wildlife areas] for continued monitoring of avian populations and breeding success [in consultation with the Illinois Department of Natural Resources and FSA], and the exploration of the potential for regional near-infrared [NIR] and mid-infrared [MIR] libraries to be used for soil quality assessment using 468 topsoil samples collected from Illinois grain farms.

Conference presentations included the University of Illinois Institute for Government and Public Affairs, Agricultural and Applied Economics Association, Ecological Society of America, Society for Integrative and Comparative Biology, Illinois Chapter of the American Fisheries Society, American Agricultural Economics Association, Midwest Organic and Sustainable Education Service Organic Farming Conference, Illinois Specialty Crops Conference, Agronomy Society of America, Argentine Soil Science Congress, World Congress of Soil Sciences, New Perspectives on Agro-Ecology and Sustainability Symposia, University of Illinois Extension Crop Management Conferences, Crop Science Society of America, Soil Science Society of America, University of Illinois Agronomy Day, Livingston County Farm Bureau Agronomy Day, Organization for Economic Cooperation and Development, Society for Invertebrate Pathology, International Symposium on Society and Resource Management, Initiative on Climate Adaptation Research and Understanding through the Social Sciences IV: Causes of Vulnerability and Livelihoods of the Poor, Lincoln Park-Milwaukee Estuary Outreach Advisory Group, and the National Atmospheric Deposition Program National Conference.

Extension activities encompassed a variety of delivery methods to provide education regarding climate, soil and water management, forestry, and environmental stewardship. A description of some of these major areas of focus follows.

Sixteen self-study modules were made available online for Certified Crop Advisers [CCAs] to maintain their certification. Approximately half of the modules address natural resource area topics including nutrient management and soil and water management. The annual **Soil and Water Management Workshop** for CCA's was hosted via webinar in 18 locations in the state with approximately 140 in attendance and included topics that address the most current nutrient management research and recommendations to both increase nutrient efficiency and decrease nutrient losses. In addition, five pond management workshops were conducted and a new website addressing pond issues and information was created.

The **Illinois Master Naturalist** [ILMN] program completed an eighth year of statewide implementation. Using the 20 chapter curriculum that included one on weather and climate, training was offered in eleven multi-county locations to certify new Master Naturalists. The 705 Illinois Master Naturalists were actively engaged in a wide variety of projects as environmental stewardship instruction was delivered to 3,484 adults and youth. These Master Naturalists invested a total of 57,950 volunteer hours, 6,504 of which involved educational efforts and 43,073 hours were devoted to natural resource stewardship activities.

These numbers reflect a 19% growth in volunteer hours and a 16% growth in the number of volunteers as compared to the previous year. A web-based reporting site is used to collect information on all Master Naturalists' and Master Gardeners' training, volunteer hours, contacts, and projects. Based on the value of a volunteer hour of \$23.08 from the Independent Sector, Master Naturalists' volunteer service reflects a value of \$1,337,486.

A climatologist with the Illinois State Water Survey presented "Weather Conditions in 2014 and the Outlook for 2015" at the six **Corn and Soybean Classics** and "Climate Variability in Illinois and How to Plan for It" at the four regional **Crop Management Conferences** as well as at the **Northern Illinois Forestry Association Annual Meeting**. An Extension educator presented "Climate Change: A Livestock Perspective" at the **Midwest Climate and Agriculture Workshop**. Additional topics presented at the **Crop Management Conferences** that were related to natural resources included soil health and a review of what was learned over 50 years of tillage and fertility research. **Weather Observer Course** classes were held in two counties this year to provide information on the weather for teachers as well as training for the public on the volunteer precipitation monitoring program that is part of the national precipitation monitoring program. Two additional YouTube videos on weather and climate topics were developed this past year [bringing the total number of weather-related videos to 17] with a high of 9,723 views in April. Climate and soil education was also a part of the **Master Naturalist** and **Master Gardener** training.

Educational efforts carried out with respect to air quality included eight radon testing programs attended by over 70 individuals. The workshops were supported using grant dollars and through partnering with the Illinois Department of Public Health with leadership provided by an Extension staff member.

Extension campus and field staff continued to conduct eight **First Detector** trainings delivered across the state this year that focused on increasing awareness of invasive plant species in Illinois [also discussed in the Plant Health, Systems and Production planned program evaluation section]. The Extension pesticide training program reached 3,265 private [farmer] pesticide applicators and 9,879 commercial applicators this past year providing information on proper and safe use of pesticides that is vital to protecting public health and the environment.

The majority of forestry-related education focused on forest landowner education and outreach that extends beyond management to include urban forestry, forest product marketing and utilization, and carbon sequestration by providing technical assistance through 38 woodland owner conferences, additional seminars, workshops, field days, and Extension forestry bulletins. Many of the face-to-face programs included information on control of invasive plant species in woodlands. The Illinois Extension forestry website received over 253,000 views [a 53% increase over FY 2014]. Eighteen [18] chainsaw safety and directional felling classes/trainings enrolled approximately 245 woodland owners, farmers, and college students. University of Illinois Extension again partnered with Iowa and Wisconsin to offer the 21st **Tri-State Extension Forest Stewardship Conference** with concurrent sessions that addressed knowledge and skills needed by landowners to manage woodlands using good stewardship principles. Over 500 landowners and tree enthusiasts attended the conference.

Youth Conservation Days with hands-on activities were held in many locations in the state with additional outreach in 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 1,691 third through fifth graders [also discussed in the evaluation section of this planned program]. Through a partnership with Cornell University Lab of Ornithology 23 staff and volunteers trained another 61 Master Gardeners and/or Master Naturalists and 11 Teen Teachers in the **Pathways to Science Through Nature** program. These volunteers then conducted the **Nature Detectives and Habitat Connections** topical units through **4-H SPIN** [special interest] clubs or other program delivery methods that engaged 917 youth. **Nature Detectives** was incorporated into the **I Think Green** curriculum this past year. The Cook County Extension educators who focus on science, technology,

engineering, and math [STEM] as a priority issue continued to expand the **Inquiry Adventures** program, an inquiry-based nature exploration project for youth. A total of 571 urban youth from seven different public and private elementary or middle schools received instruction on the inquiry process [part of the Science and Engineering Practices in the Next Generation Science Standards] and an opportunity to practice the process and develop positive attitudes toward local nature and the environment on a subsequent field trip to a nearby Cook County Forest Preserve site. Training was provided to teachers or volunteers who "coach" the field trip experience by Cook County field staff.

2. Brief description of the target audience

Members of the target audience included ranchers and farmers, land managers, policy makers, scientists, landscape practitioners, designers, college students, professional insect taxonomists, Extension specialists, professional insect diagnosticians, amateur naturalists, insect ecologists, conservation practitioners and managers, communication practitioners, journalists and reporters, the communication officers of agricultural research centers and institutes, environmental NGOs, water and land management agencies, agricultural producers with an interest in cover cropping, scientists studying the physical and chemical properties of soils, academic ecologists, restoration practitioners, government agency personnel involved in planning, implementing, and regulating wetland restoration programs, Illinois and Corn Belt corn producers, crop consultants, seed technology and biotechnology professionals, natural resource professionals, scientists interested in avian ecology and the spread of infectious diseases, apiculturists, private land owners interested in managing their land for wildlife, low income residents receiving urban gardening assistance designated for low income populations, low income and minority communities experiencing environmental remediation in nearby rivers, individuals with an interest in soil management and conservation, and scientists and regulators working in the area of agricultural non-point pollution control.

Extension activities targeted pesticide applicators, forest landowners, crop producers, public officials, representatives from land management agencies, residents interested in natural resource stewardship, home owners, 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

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	34517	74266	70082	0

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

Patent Applications Submitted

Year: 2015
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	38	38

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2015	7

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	Actions Taken By Program Participants To Protect The Environment [Water Quality, Air Quality, Soil Loss, Wildlife, And Natural Vegetation]
3	Development Or Revision Of Climate-Relevant Databases
4	Dissemination Of Air Quality And Atmospheric Data Through Web Hits On The National Atmospheric Deposition Program Website
5	Improvement Of Fertilizer Usage Recommendations To Increase Profitability And Reduce Environmental Impacts
6	The Design And Evaluation Of Resource Management Policies That Are Cost-Effective And Maintain Or Improve Environmental Conditions
7	The Removal Of Emerging Contaminants That Have Been Detected In Wastewater Discharges From Various Human And Livestock Sources
8	Exploring The Mechanisms Through Which Climate Change Affects Agriculture And Civil Conflict
9	Improving The Ability Of Economic Entomologists And Quarantine Officers To Manage Potential Pests
10	Demonstrating The Usefulness Of Sub-Lethal Physiological Metrics In Assessments Of Habitat Quality And Restoration Success
11	Manipulating The Charge Of Iron In Clay Minerals And Analyzing The Consequences With Respect To Soil Fertility And Environmental Remediation
12	Improved Understanding Of A Previously Unidentified Isolate Impacting Light Brown Apple Moths
13	Research On Dynamic Soil Properties
14	Number Of Pesticide Applicators Making Decisions To Avoid Harming The Environment
15	Value Of Staff And Volunteer Hours In Helping Urban Youth Gain Knowledge Of The Environment

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
2015	370

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Increasing concern over degradation of the environment addresses a critical issue related to sustaining life for future generations.

What has been done

The I Think Green curriculum was developed by 4-H and horticulture Extension specialists to engage 3rd-5th grade youth in investigating how living things interact with each other and with their environment. This program includes four tracks: [1] Worms; [2] Butterflies; [3] Insects; and [4] Nature detective track [new this past year]. All four tracks follow a sequence of four 40-60 minute investigations in which youth practice observation skills, conduct hands-on investigations with living things, explore different life cycles, identify how living things function/adapt/change, and compare how living things interact with each other and with their environment. The objectives of the program include: [1] To develop youth skills in scientific observation; [2] Increase youth knowledge of concepts that explain how living things function, adapt, change, and interact within the environment; and [3] 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 1,691 youth this past year.

Results

In responding to a ten-question evaluation given to the youth participants at the end of each of the four tracks, 77% [989] of the butterfly track participants reported that the activities helped them learn how butterflies contributed to the environment; 75% [834] learned more about how worms contributed to the environment; 74% [383] learned more about how insects contributed to the environment; and 86% [146] learned more about how birds contributed to the environment. It should be noted that some youth participated in more than one track. In addition, 79% of the youth in all the tracks [1,260] reported being more excited about helping to care for the environment and 77% [1,233] reported having more ideas about ways they could help care for the

environment after participating in I Think Green.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
806	Youth Development

Outcome #2

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Development Or Revision Of Climate-Relevant Databases

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1294307

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Since 1978, the NADP has provided fundamental measurements to support informed decisions on environmental and agricultural issues related to the ambient concentration and wet deposition of atmospheric pollutants in North America. For this project year, NADP data were cited in over 200 peer-reviewed publications and book chapters [236 in 2014 and 172 in 2015 thus far; annual listings are at nadp.isws.illinois.edu/lib/bibliography.aspx]. Data from the NADP's five monitoring networks were downloaded over 28,018 times by approximately 34,019 registered data users. We recorded 23,921 downloads of our maps and summaries. These data users consistently represent federal and state agencies [40% of users], universities [36%], K-12 students and educators [16%], and others [8%]. Each year, NADP data are used by policy makers to make informed decisions on agriculturally important topics, including the impact of atmospheric pollutant fallout on the North American food supply. Data are also used in science, technology, engineering and mathematics [STEM] curricula on the elementary, secondary, and post-secondary level. All data are available free of charge [nadp.isws.illinois.edu].

What has been done

Within this national research support project [NRSP-3], there are three stated goals: [1] Management and coordination of the five NADP monitoring networks; [2] Site support, chemical analysis, and data validation for network sites directly supported by this agreement; and [3] Quality assurance and quality control activities to ensure consistent operation and standard operational procedures.

Results

Our principal output is the collection and analysis of precipitation chemistry and atmospheric chemistry samples. For all of these networks, over 26,000 samples were collected from the four network types [National Trends Network, Atmospheric Integrated Research Monitoring Network, Mercury Deposition Network, and the Ammonia Monitoring Network], along with over 52,000 observations from the Atmospheric Mercury Network.

The NADP makes our collected data available to support research and education. We do this through a web-available database and through our annual map series and map summary. All of these analytical results, organized by site and date, are made available online [nadp.isws.illinois.edu/data/]. Each calendar year the NADP produces a series of 23 national maps of wet deposition concentration and flux maps for all of our analytes and networks. Each map summary is also made available [nadp.isws.illinois.edu/lib/dataReports.aspx], and the 2015 map summary will be produced in the summer of 2016 after all normal data processing.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife
405	Drainage and Irrigation Systems and Facilities

Outcome #5

1. Outcome Measures

Improvement Of Fertilizer Usage Recommendations To Increase Profitability And Reduce Environmental Impacts

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Estimates of the value of natural resources and environmental amenities are critical for guiding resource management decisions, designing environmental policy, and evaluating the costs and benefits of policies that are proposed. This project is needed to fill several gaps in society's knowledge of the value people place on some natural resources [such as grasslands, aquatic habitat, and remediation of degraded areas].

What has been done

This project also makes important advances needed to improve the methodologies economists use for valuation. Finally, recent increases in droughts and wildfire yield pressing needs in research on natural hazards. Our research helps society understand the costs of ecosystem service losses from climate change and how decision makers can use a portfolio approach to reduce the uncertainty in environmental quality associated with climate change.

Results

We have published a paper that estimates the value to agriculture of improved biocontrol of pests in row crop agriculture and applies that model to generate dollar values for two crops [cucumbers

and squash]. The paper "Simple-But-Sound Methods for Estimating the Value of Changes in Biodiversity for Biological Pest Control in Agriculture" was published in Ecological Economics in 2015.

This project is analyzing spatial conservation-outcome forecasts for the Prairie Pothole Region and for two other conservation problems [Eastern birds and Appalachian salamanders] to identify the kinds of problems for which spatial conservation analysis is most useful. Also, we have published a paper that shows how to use an iterated portfolio analysis algorithm to find nearly efficient portfolio allocations at a fine spatial scale even when data are only available for a small number of climate scenarios. The article "Downside Versus Symmetric Measures of Uncertainty in Natural Resource Portfolio Design to Manage Climate Change Uncertainty" was published in Land Economics in 2015.

We also drafted a paper on the results of choice experiment surveys conducted to estimate the values people place on reduced flooding, improved water quality, and improved aquatic habitat in and around the Chicago and Portland metropolitan areas.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife
211	Insects, Mites, and Other Arthropods Affecting Plants
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

Outcome #7

1. Outcome Measures

The Removal Of Emerging Contaminants That Have Been Detected In Wastewater Discharges From Various Human And Livestock Sources

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Exploring The Mechanisms Through Which Climate Change Affects Agriculture And Civil Conflict

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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 greater poverty. Climate change poses challenges for agriculture as well as for conflict resolution and therefore has the potential to severely exacerbate this vicious cycle.

What has been done

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.

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 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.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
132	Weather and Climate
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

Outcome #9

1. Outcome Measures

Improving The Ability Of Economic Entomologists And Quarantine Officers To Manage Potential Pests

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Empoasca is one of the most economically important genera of leafhoppers, with the potato leafhopper and other polyphagous species causing substantial damage to field and horticultural crops annually. The current lack of reliable identification aids and doubts about the identities of numerous previously described species hinders the ability of economic entomologists and quarantine officers to manage these potential pests and prevent accidental introductions of invasive species. Because few specialists are available to do routine identifications [there are only three full-time leafhopper taxonomists in North America] user-friendly identification tools that can be used by non-specialists are urgently needed. Because they require only internet access and basic knowledge of insect morphology, online interactive keys provide the means for non-specialists to identify insects quickly and efficiently.

What has been done

Morphological data were compiled for 140 genera and subgenera of the leafhopper tribe Empoasini and 617 species of Empoasca. Images [ca. 39,700 total] were uploaded and linked to database records for each of the genera/subgenera and nearly all of the included species. Morphological data were scored for each included genus and species and also included in the database. By including these data we enabled the automated creation of detailed, dynamic taxon pages for all included taxa and interactive keys to all included genera and species.

Results

The 3i cyberinfrastructure that powers the project website generates these internet-accessible products automatically from data incorporated into the database. These products constitute the online virtual revision that was the primary goal and final product of the project.

4. Associated Knowledge Areas

KA Code	Knowledge Area
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #10

1. Outcome Measures

Demonstrating The Usefulness Of Sub-Lethal Physiological Metrics In Assessments Of Habitat Quality And Restoration Success

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

With the degradation of aquatic systems at an all-time high, extinction rates of fresh water fauna are over five times that of terrestrial species. With the widespread popularity of extensive habitat restoration projects, it is imperative that we quantify how restoration efforts affect the health of ecosystems, and which restoration activities are most effective at achieving restoration goals. Knowledge of successful restoration activities, as well as information on which practices should be avoided in the future, will help improve the outcome of restoration activities, conserve valuable resources, and provide decision tools to strategically guide future restoration activities. The current practice of on-the-ground monitoring of species abundances and/or habitat quality following restoration has proven ineffective at quantifying success, and simple counting of species present as a proxy for restoration success is replete with inconsistencies and shortcomings. Therefore, a critical need exists 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.

Physiological metrics allow researchers to assess the ability of an organism to perform ecological functions within its environment, which is the true indicator of whether or not it is occupying a suitable habitat, and also have the potential to increase our ability to quantify restoration success and help inform future restoration activities at a national scale. Despite this potential, the use of physiological metrics to specifically quantify restoration success has not received a great deal of attention, leaving its efficacy unproven.

What has been done

From a "basic" perspective, this project accomplished its stated objective and demonstrated links between sub-lethal physiological metrics across a gradient of habitat "qualities" [forested, urban, and agricultural]. The tools that were used included blood-based metrics of nutrition [cholesterol and triglycerides] as well as antioxidant capacity and stress. In addition, the project successfully developed and demonstrated the value in using measures of cortisol in the whole body of small fish for questions related to conservation and restoration. The application of whole-body cortisol for small fish is both unique and powerful. Previously, most questions related to stress in fish [whether they were lab-based or field-based] used cortisol metrics derived from blood, as blood can be drawn easily and non-lethally. Unfortunately, the use of blood-based cortisol precluded the use of small fish as it is difficult to obtain blood samples from small individuals. As a result, small-bodied fish such as minnows or juveniles were not included in stress-related work, which excluded many populations and/or locations from sampling. The application of whole-body cortisol measurements of stress has demonstrated the potential for this metric to be incorporated into studies of restoration and conservation, providing new opportunities and an expanded "toolbox" for conservation practitioners to define the impacts of land use and restoration on aquatic communities.

Results

From an "applied" perspective, results from this study demonstrated that the proportion of natural lands in a watershed was one of the strongest drivers of fish energetic status and resistance to oxidative stress [as opposed to the amount of disturbed habitat present], such that more natural areas [more forests and more wetlands] resulted in better fish health. The impacts of habitat condition on the stress response varied depending on the species being examined such that some species displayed an attenuated stress response, while others showed an elevated stress response. In general, however, low habitat quality [defined as agricultural lands, urbanized land, etc.] tended to result in elevated baseline stress for some species and a reduced stress response for others.

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

Outcome #11

1. Outcome Measures

Manipulating The Charge Of Iron In Clay Minerals And Analyzing The Consequences With Respect To Soil Fertility And Environmental Remediation

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Methods for handling redox-sensitive samples were improved and described in detail during the course of this project. One of the areas of application of this study is in wetlands. The natural state of wetland soils is a rich environment for cycling oxidation and reduction [redox] reactions, which can be properly characterized and evaluated only if the methods of analysis do everything possible to preserve the redox balance during sampling and analysis. Iron and Mn are highly susceptible to redox cycling in such natural systems. One of the publications from this project reviewed known methods for handling redox-sensitive samples, for measuring the amount of the respective oxidation states of these two elements, and sample preparation methods for various types of characterizations. The primary oxidation states for Fe in minerals are II or III, whereas Mn in minerals may exist in oxidation states of II, III, or IV. Proper sample handling to minimize redox transformations depends on the use of a septum-sealed inert-atmosphere reaction centrifuge tube [IRT] in which the sample can be reacted and then separated from suspension without being opened to the atmosphere. The fluids can then be removed and replaced without opening the IRT by using a controlled-atmosphere liquid exchanger.

What has been done

Virtually all 2:1 clay minerals in soils and sediments contain some Fe in their crystal structure, which may undergo redox reaction with surrounding redox-active species causing potentially significant changes in the chemical and physical properties of the clay mineral and its surrounding matrix. This phenomenon was originally of interest mostly as a laboratory experiment using strong inorganic reduction agents, but the discovery that the structural Fe could be reduced by microorganisms in natural soils and sediments opened the way for this to become a practical method for altering the chemical and physical properties of soils and sediments in situ.

Studies of microbial reduction of structural Fe in smectites have revealed the extent of reduction, effects on chemical and physical properties, reversibility [or lack thereof] of microbial reduction, stoichiometry, possible reaction mechanism, and types of organisms involved. Some organisms are also capable of oxidizing structural Fe, such as in biotite or reduced smectite, while one appears to be able to do both. Illitic layers resist reduction by microorganisms, but this can be partially overcome by the presence of an electron shuttle compound such as anthraquinone-2,6-disulfonate, which also enhances the extent of reduction in smectites. Microorganisms may be employed as an in situ reducing agent to drive redox cycles for structural Fe in constituent clay minerals of soils and sediments, which in turn can serve as an abiotic source for redox-mediated remediation of environmental contaminants.

Results

An example of the application of redox active clay minerals is in the removal of nitrate from agricultural waters. The presence of nitrate and other redox-active anionic contaminants in terrestrial ecosystems poses a significant risk to humans and other forms of life. The purpose of the present study was to test a potential in situ system, using poly-[D] glucosamine [chitosan] adsorbed to mineral surfaces under redox-active conditions in order to degrade nitrate to lower oxidation states.

Chitosan is a linear polysaccharide derived from the chitin found in the shells of shrimp and other shellfish. Five different loadings of chitosan [0, 0.075, 0.25, 0.50, and 1.0 g/L; labeled C0, C1, C2, C3, and C4, respectively] were adsorbed to ferruginous smectite [SWa-1] to form chitosan-SWa-1 composites [CSC] in the pH range 5.84. The CSC was then reduced by Na₂S₂O₄ in a citrate-bicarbonate buffered dispersion and washed free of excess salts under inert-atmosphere conditions. Upon addition of the nitrate, the solution pH remained slightly acidic, ranging from 5.5 to 4.7. Samples were analyzed for Fe[II] content, reacted with a NaNO₃ solution, and then re-analyzed for structural Fe[II] content. Supernatant solutions were analyzed for nitrate and ammonium. In samples C1 to C4, extensive concentrations of nitrite were observed in the supernatants with a corresponding increase in the reoxidation of structural Fe[II], proving that a coupled redox reaction had occurred between the nitrate and the structural Fe in the clay mineral. The most efficient loading, defined as the largest percentage of adsorbed nitrate reduced to nitrite, occurred in sample C1. The total amount of nitrate reduced and Fe[II] reoxidized followed the trend 0 = C0 < C2 < C3 < C4 and C1. Chitosan showed the potential to reverse the surface charge of constituent clay minerals, thereby enabling the CSC to remove nitrate anions from aqueous mineral systems via redox reactions with structural Fe[II] in clay minerals.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
405	Drainage and Irrigation Systems and Facilities

Outcome #12

1. Outcome Measures

Improved Understanding Of A Previously Unidentified Isolate Impacting Light Brown Apple Moths

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The light brown apple moth [LBAM], a leafroller with a host range of over 500 plants, was introduced from Australia and first detected in California in 2006. A microsporidian pathogen closely related to *Nosema fumiferanae*, a pathogen of the spruce budworm [*Choristoneura fumiferana*] was detected in large numbers of LBAM larvae in the field. Studies were undertaken to describe the new isolate and compare it to *N. fumiferanae*.

What has been done

The isolate was sequenced, characterized, and named a subspecies, *Nosema fumiferanae postivittana*, of the *C. fumiferana* pathogen. *N. fumiferana postivittana* increased LBAM larval developmental time, and reduced survivorship of larvae and pupae. Infected females had reduced longevity and daily fecundity, and percent egg hatch was also reduced.

Results

Studies on honey bee noseosis were published showing that competition of mixed infections between *Nosema apis* and *Nosema ceranae* probably do not drive dominance of *N. ceranae* in U.S. honey bees, but production of spores may be higher in *N. ceranae*. Commercial bumble bees placed in apiaries acquired honey bee diseases including *N. ceranae* and black queen cell virus, indicating that transmission of pathogens among *apis* species in the field may be more efficient than previously known.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
211	Insects, Mites, and Other Arthropods Affecting Plants
605	Natural Resource and Environmental Economics

Outcome #13

1. Outcome Measures

Research On Dynamic Soil Properties

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Soils provide the base for agriculture and regulate the cycling of matter and energy at the earth's interface between the atmosphere, hydrosphere, and lithosphere. Research on dynamic soil properties that can serve as indicators will benefit Illinois and the region by helping farmers, business entities, and policy makers care for one of our greatest assets. This project will build 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.

What has been done

We explored the potential for regional near-infrared [NIR] and mid-infrared [MIR] libraries to be used for soil quality assessment using 468 topsoil samples collected from Illinois grain farms located in five soil regions using conventional tillage, conservation-tillage, or organic practices that were expected to vary in soil quality. Partial least squares regression [PLSR] and random forest [RF] algorithms were used to predict SQ indicators, including soil organic carbon [SOC], total N [TN], soil C and N ratio [C: N], soil pH, particulate organic matter [POM], potentially mineralizable nitrogen [PMN], fluorescein diacetate [FDA] hydrolysis, and soil nutrient [P, K, Ca, Mg, Fe] abundance using the whole NIR or MIR spectra and spectral features associated with organic functional groups. Monte Carlo feature selection [MCFS] was used as a variable selection tool for PLSR model refinement. Relationships between selected SQ indicators and crop productivity were explored using normalized difference vegetation index [NDVI].

Results

Model performance was not improved when spectral ranges primarily associated with organic functional groups were used, but variable selection did generally improved model performance. NIR models slightly outperformed MIR models, and both NIR and MIR methods were better able to predict SOC, Ca, TN, Mg, and PMN than other SQ indicators. RF models slightly outperformed PLSR models for estimating SQ indicators in NIR regions except for extreme values. Soil regions accounted for greater variability among samples than management, revealing how infrared [IR] features associated with soil mineralogy dominate information obtained from this technique. This evaluation of steps used to develop IR models to quantify soil quality in Illinois soils found proper interpretation of prediction models relies not only on careful interpretation of statistical techniques but of their physical meanings. Correlation between SQ indicators and NDVI demonstrates that ancillary information is needed to effectively use IR technology to assess soil quality contributions to crop productivity.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
605	Natural Resource and Environmental Economics

Outcome #14

1. Outcome Measures

Number Of Pesticide Applicators Making Decisions To Avoid Harming The Environment

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	11339

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The use or application of pesticides can have adverse impacts on the environment, crops grown, and the pesticide applicator.

What has been done

Pesticide training sessions focused on pesticide characteristics, correct application procedures, problems that may occur with the use of pesticides, where information can be obtained, and steps to take if a problem occurs with the use of a pesticide. Private applicator training was delivered by Extension staff in 18 settings across the state to a total of 3,265 individuals in 2014-2015 that included agricultural producers, agriculture and horticulture sales associates, and Extension master volunteers. Commercial applicator training was offered by Extension staff through clinics located in 17 settings across the state to a total of 9,879 individuals that included operators and applicators who apply pesticides to turfgrass, field crops, ornamentals, and road right-of-ways. Following these trainings, Illinois Department of Agriculture staff administered a certification test.

Results

Based on findings from a 2013 survey mailed to a random sample of commercial pesticide training participants, 90% of this year's 9,879 Commercial Pesticide Applicator training participants likely improved one or more of their practices as a result of training participation. In addition, based on previous findings on improvements in practices, more than sixty percent of the participants most likely improved calibration procedures, improved pest control decision-making,

improved mixing pesticides properly, and improved compliance with laws.

Based on findings from a survey of 16 practice changes that was conducted in 2010, 2011 and 2012 at the private applicators safety education programs, three-fourths of this year's 3,265 private applicator training attendees will likely have: [1] Read and followed label directions for proper pesticide application; [2] Taken precautions to minimize spray drift when applying pesticides; [3] Scouted to determine proper identification of pests before determining if control is needed; and [4] Understand how pesticides can cause contamination and took steps to prevent it. Using the average figure of \$11,000 from the three-year study regarding training participant's estimate of dollars saved by being able to protect their production and apply appropriate pesticides when necessary, the total estimated dollars saved for the six percent [196] of the training attendees last year may exceed two million dollars.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #15

1. Outcome Measures

Value Of Staff And Volunteer Hours In Helping Urban Youth Gain Knowledge Of The Environment

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	12088

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

In its third year, the Inquiry Adventures program continued to provide Cook County youth with a unique and academically relevant outdoor education field trip experience at Forest Preserves near their schools. The program components encompassed training on the inquiry process for teachers and volunteers. Each of seven schools and one community center participated in an hour-long pre-trip session at their school or center and a four-hour field trip to a Cook County Forest Preserve. It is worth noting that an additional 42 teachers have recently been involved in learning about Inquiry Adventures. Teacher surveys were provided after the program completion.

Results

Teacher training is valued by teachers as evidenced by their willingness to wait to get on the schedule for participating and their desire to repeat the experience. In addition, teacher training was a very effective tool for recruiting schools to participate. Six teachers completed the survey. The most important factors influencing the teacher's decisions to involve their class in the program were: [1] The chance to experience nature; [2] The chance for students to engage in open inquiry; and [3] Transportation reimbursement and cost. The following comments were received in response to the differences teachers noticed in their students after participating in the program.

They often refer back to what they did in the inquiry. It is also a great common experience when referencing inquiry.

They have a much clearer idea regarding how to carry out an investigation much earlier in the school year and with a topic that is more compelling than other investigations we do in our lab inside.

My students are more comfortable with nature after the adventure. They are city kids and they are afraid of the forest. They are very excited about going out into natural areas.

This was much more extensive than I have done [in class]. Students are now willing to dig deeper as a result and are not afraid to ask questions and explore to find the answer. In the past, an open-ended question or a problem without an obvious path to the answer would frustrate and confuse them and they would shut down.

Although it is difficult to put a monetary value on the impact of the Inquiry Adventures program on student attitudes and learning, it should be noted that schools and the community group participated in the program at no cost since personnel and transportation reimbursement were provided. Conservatively, the value of the staff and volunteer coach time spent conducting the field trips is estimated at \$12,088 based on the 2015 Independent Sector value of a volunteer hour [23.07/hr.].

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
211	Insects, Mites, and Other Arthropods Affecting Plants
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

In 2015 a total of 1,691 youth participated in the **I Think Green** program. A ten-question evaluation was completed by 1,596 youth comprised of 1,284 who participated in the butterfly track, 1,112 in the worm track, 518 in the insect track, and 157 in the Nature Detective track. Response tallies follow.

Environmental Related Questions

[1] 77% [1,133] of youth reported having more ideas about ways they could help care for the environment; [2] 79% [1,260] of youth reported being more excited about helping to care for the environment; and [3] 77% [1,133] of youth reported that they would like to get involved in food composting, recycling or other activities to help take care of the environment in their community.

Participation Related Questions

[1] 90% [1,436] of youth reported that the **I Think Green** activities were fun to do; [2] 82% [1,308] of youth reported that they would like to do more activities like the ones in **I Think Green**; and [3] 66% [1,053] of youth reported that they would like to help with a community garden project.

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

Butterfly Track Specific Questions [n=1,284]

[1] 72% [924] of the youth in this track reported that they were encouraged to ask questions about butterflies and the environment; [2] 94% [1,206] reported that the activities helped them learn about butterflies and how they grow; [3] 80% [1,027] reported that the activities help them to learn how butterflies interact with other living things; and [4] 77% [989] reported that the activities help them learn how butterflies contribute to the environment.

Worm Track Specific Questions [n=1,112]

[1] 60% [667] reported that they were encouraged to ask questions about worms and the environment; [2] 95% [1,056] reported that the activities helped them learn about worms and how they grow; [3] 77% [856] reported that the activities help them to learn how worms interact with other living things; and [4] 75% [834] reported that the activities help them learn how worms contribute to the environment.

Insect Tract Specific Questions [n=518]

[1] 61% [314] reported that they were encouraged to ask questions about insects and the environment; [2] 84% [435] reported that the activities helped them learn about insects and how they grow; [3] 82% [425] reported that the activities helped them learn how insects interact with other living things; and [4] 74% [383] reported that the activities helped them learn how insects contribute to the environment.

Nature Detective Track Specific Questions [n=157]

[1] 69% [108] reported they were encouraged to ask questions about birds and the environment; [2] 95% [149] reported that the activities helped them learn about birds and how they live; [3] 87% [134] reported that the activities helped them learn how birds interact with other living things; and [4] 86% [146] reported that the activities helped them learn how birds contribute to the environment.

Key Items of Evaluation

Nearly all of the youth participants [94% and 95%] in **I Think Green** learned about how butterflies and worms grow, interact with other living things, and contribute to the environment. Although fewer youth reported changes in how they felt, ideas gained, and interest in how they could care for the environment, more than 90% of those responding did report changes in one of the three questions related to the environment.

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Plant Health, Systems And Production

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	5%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		15%	
205	Plant Management Systems	20%		10%	
206	Basic Plant Biology	20%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	15%		10%	
212	Pathogens and Nematodes Affecting Plants	15%		13%	
213	Weeds Affecting Plants	15%		12%	
216	Integrated Pest Management Systems	10%		10%	
402	Engineering Systems and Equipment	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	10.0	0.0
Actual Paid	0.0	0.0	10.8	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
639870	0	1116177	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
639870	0	1116177	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
5634436	0	11667524	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included work to determine the role of small RNA, sigma factors, and protein lysine acetylation in regulating virulence factors in *E. amylovora* [fire blight, caused by the bacterial pathogen *E. amylovora*, is a destructive disease of apple and pear; in the United States, regional losses to fire blight and cost of control average over \$100 million annually], research focusing on the structure and molecular function of protein molecules [this information was used to uncover patterns of molecular and organismal diversification by using a novel comparative genomics strategy and canonical phylogenomic methods], the testing of over 1,300 individual waterhemp plants from over 330 fields for specific herbicide resistance traits [information was provided back to weed management practitioners, enabling them to make site-specific weed management decisions] and the confirmation of the existence of resistance to a group of herbicides known as PPO inhibitors for the first time in Palmer amaranth, the development and testing of a system to measure respiration and dry matter loss rates of corn and soybeans, research that identified a waterhemp population that demonstrates resistance to herbicides from five site-of-action families, and a project with the goal of determining if the use of cover crops in a corn-soybean rotation is effective for reducing disease severity levels in soybean [providing soybean producers with another tool to manage important diseases].

Activities also included research to improve our understanding of the biology of *X. cucurbitae* and determine the etiology and epidemiology of bacterial spot for developing effective strategies for management of the disease, ongoing work under the Illinois **Long-Term Selection Experiment** [ILTSE] for grain protein and oil concentration that has produced populations with the known phenotypic extremes for these traits [the strains created from this experiment provide an excellent genetic resource for studying the genetic basis for the response to phenotypic selection], research through the University of Illinois soybean breeding program that developed new experimental lines and tested these lines for yield, agronomic traits, and disease and pest resistance, work to implement genomic selection into Illinois breeding programs [the advantages of genomic selection in maize breeding programs have been demonstrated, and it is expected that similar advantages will exist for dedicated soybean genomic selection breeding programs], wheat breeding research designed to evaluate experimental genotypes for agronomic performance and disease resistance [in the 2014-15 growing season about 100 advanced experimental breeding lines were evaluated in replicated tests], and work that builds on an existing record of pest abundance [primarily beetle abundance] in corn and soybean fields going back to 1998.

Activities also included research to evaluate different cover crop rotations, green manures, and tillage practices for their potential to develop weed suppressive soil legacies [we have evaluated 376 different combinations of cover crops and soil management for their capacity to suppress germination and seedling growth against 12 different weed species and determined that ridge tillage produces more weed-

suppressive soils than chisel plow tillage regardless of whether or not cover crops are used], an effort to develop a rapid approach to discovering new viruses in plant parasitic nematodes [a method was developed to physically disrupt nematodes and then recover viral particles on a small scale], work to develop sounder planting date guidelines and improve decisions on row spacing and on the use of fungicide plus insecticide in order to improve management of these inputs, the development of detailed information associating root architectural characteristics with plant performance under biotic and abiotic stresses, and results illustrating that a waterhemp biotype is resistant to mesotrione and atrazine, from both preemergence and postemergence applications, mainly due to rapid metabolism of mesotrione and atrazine [these research findings are particularly significant and relevant to crop production and weed management with postemergence herbicides in *Zea mays* because several other waterhemp populations have recently been identified in seedcorn fields throughout the Midwest that possess this unique form of multiple, non-target, site-based herbicide resistance].

Conference presentations included the University of Illinois Crop Management Conference, American Phytopathological Society, Society of Nematologists, First International Workshop On The Molecular Basis of Fire Blight, Third International Erwinia Workshop, 13th International Conference of Plant Pathogenic Bacteria, 7th Workshop on Mechanisms Controlling Flower Development, Second International Symposium on Evolutionary Biology, NASA Astrobiology Science, Congresso Brasileiro de Engenharia Agricola, American Society of Agricultural and Biological Engineers, Iowa Soybean Association, Soybean Breeder's Workshop, United Soybean Board, Brazilian Soybean Conference, Jimma Research Institute in Ethiopia, Ecological Society of America, AgMasters, Livingston County Farm Bureau Agronomy Day, Monsanto Focus on Corn, University of Illinois Agronomy Day, North Central Weed Science Society, Weed Science Society of America, and the Third Plant Genome Congress.

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 505,263 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 distance education programs titled **Four Seasons Gardening** was offered via webinars at Extension offices throughout the state during the fall and spring with a total attendance of 1,373. Topics included sempervivums, beekeeping, edible indoor gardening, sustainable landscapes, garden myths, straw bale gardening, native plants, garden photography, weed control, vegetative propagation, and biotic versus abiotic diseases. In addition, University of Illinois Extension staff members conducted **The Good, the Bad, and the Lovely Plants** webinars in February and then again in April that focused on educating horticulturists and gardeners about garden biodiversity by addressing common landscape plants that have invasive qualities, how and why to control them, landscape native alternatives, and the benefits of native plants to pollinators [also discussed in the evaluation section of this planned program].

Extension Master Gardeners gave countless hours to providing horticulture information to the public. This past year, 520 new Master Gardeners completed training at various locations in the state [102 were trained via the online program]. In total there were 3,200 active Master Gardeners in Illinois who made more than 164,000 direct teaching contacts and contributed more than 178,000 volunteer hours with an overall economic value of their contributions estimated to be \$4.1 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 and grow food and to enjoy nature.

A series of online training **Integrated Pest Management** modules which cover pertinent plant pests, weeds, and diseases are focused on pests that are newly emerging, exotic, or invasive. Each module includes information on how to identify the pest as well as current management options [stressing those methods which offer the best long term control with minimal environmental impact]. This past year one new module [Lantern fly] was added to the existing 12 modules. The 13 modules were developed for

Master Gardeners but were available to home gardeners and green industry professionals. Master Gardeners throughout the North Central region have been using these modules as credit towards required continuing education hours and as a reference to answer client home gardening questions.

The **University of Illinois Plant Clinic** provided service to the citizens of Illinois as a source of unbiased diagnosis of routine, unusual, and exotic plant problems and to provide educational support to manage those pest issues. In 2015 the clinic handled a total of 8,527 diagnostic service contacts that included approximately 1,900 telephone inquiries, 2,500 email and app requests, and 650 walk-in consultations. The majority of diagnoses were for field crops and field crop soil. The clinic discovered two new corn diseases this past year [Tar Spot, a new disease to the United States and Bacterial Stripe, a new disease in Illinois]. Clinic staff members also made presentations and provided demonstration materials for numerous outreach programs that included the campus **Crop Sciences Agronomy Day**, **Master Gardener Plant Disease Diagnostics** and **IPM training** courses, multiple statewide horticulture conferences, and training for the Illinois Department of Agriculture inspectors. Clinic staff also assisted with the eight [8] **2015 Illinois First Detector** invasive pests statewide workshops conducted throughout the state in conjunction with the Illinois Natural History Survey, the Illinois Department of Agriculture, and the Illinois Department of Natural Resources [discussed in further detail in the evaluation section of this planned program]. In addition, 30 articles were prepared for inclusion in one or more of the issues of the **Home Yard and Garden newsletter**. A new **Plant Clinic blog** was begun and 12 new blog articles were submitted in 2015. The **Plant Clinic Facebook page** is one of the top 10 most viewed of the University of Illinois Extension statewide social media accounts, with 1,472 followers who are interested in breaking pest news.

The Extension **Digital Diagnostic System** continued to provided outreach to homeowners and commercial producers in diagnosing and providing solutions for 268 samples of invasive and exotic species pests. The Extension **Pesticide Safety Education** training program reached 3,265 private [farmer] pesticide applicators and 9,879 commercial applicators this past year and provided information on proper and safe use of pesticides that is vital to Illinois residents with respect to public health protection and environmental stewardship.

2. Brief description of the target audience

Members of the target audience included nematologists, plant pathologists, growers, crop consultants, members of general public, scientists in the fire blight research community and related enterobacterial areas, general microbiologists, apple growers, animal biologists, graduate students in food engineering, researchers and practitioners in the grain harvest, handling, transportation, and storage industries, weed management practitioners, agronomic crop producers, agrichemical retail applicators, certified crop advisors, agronomic commodity organizations, professional weed science societies, agricultural media organizations, Extension personnel, crop production professionals, soybean breeders, vegetable industry personnel, chemical industry personnel, scientists engaged in studies of plant evolution, genetics, and breeding, farmers producing wheat in the Midwestern United States, researchers working in the areas of soil ecology, microbial ecology, weed science, and agroecology, commercial entomology and crop protection/pest management professionals, agricultural biotechnology company representatives, crop producers who make decisions on cropping systems and tillage practices, and plant breeders who wish to improve rice productivity.

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?

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

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	59409	27721	21677	0

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

Patent Applications Submitted

Year: 2015
 Actual: 6

Patents listed

Patent Application TF12121-CON: Compositions And Methods Of Gene Silencing In Plants. Patent Application TF14049-PRO: Development Of A Rapid Test For Measuring Virulence In The Soybean Cyst Nematode, Heterodera Glycines. Patent Application TF14049-PRO2: Development Of A Rapid Test For Measuring Virulence In The Soybean Cyst Nematode, Heterodera Glycines. Patent Application TF14127-PRO: Copy Number Detection And Methods For Breeding. Patent Application TF14127-PRO2: A Genetic Marker Technology To Measure Copy Number Of The Soybean Cyst Nematode Resistance Locus Rhg1. Patent Application TF14186-PRO: Modulation Of YEP6 Gene Expression To Increase Yield And Other Related Traits In Plants.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	44	44

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2015	6

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	More Informed User Of Pesticides
2	Improved Control Of Waterhemp
3	Studying The Interaction Of Photosynthesis, Genotype, And Environment To Improving Maize Production
4	Development Of New Soybean Breeding Lines
5	Evaluating The Effectiveness Of Cover Crops In Reducing Disease Severity
6	Ongoing Evaluation Of The Illinois Soil Nitrogen Test [ISNT]
7	Research For Improved Weed Management
8	Improved Resistance To Western Corn Rootworm
9	Choosing Plant Varieties That Are Known To Be Resistant To Insects and Diseases
10	Documenting The Occurrence And Distribution Of Herbicide-Resistant Weed Populations In Illinois
11	Developing Alternative Soybean Disease Management Practices
12	Evaluating The Effect Of Cover Crops On Diseases And Pathogens In A Following Soybean Crop
13	Identification Of New Microbial Pathogens Of Plant Parasitic Nematodes Important In Illinois
14	Associating Root Architectural Characteristics With Plant Performance
15	Number Of Individuals Increasing Knowledge Related To Detecting And Managing Invasive Pests
16	Number Of Individuals Increasing Knowledge Related To Detecting And Managing Emerging Pathogens And Insects
17	Number Of Individuals Implementing Practices Related To Lawn And Garden Plant Systems Practice Changes

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 Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Waterhemp [*Amaranthus tuberculatus*] is a difficult-to-control weed in Illinois soybean and corn production systems. This is in part due to the evolution of multiple herbicide resistances in waterhemp, which is facilitated by its dioecious nature, outcrossing, prolific seed production, and high degree of genetic diversity. A population of waterhemp [designated MCR] from a seed corn field in McLean County, Illinois displays resistance to mesotrione and other 4-hydroxyphenylpyruvate dioxygenase [HPPD] inhibitors, as well as to atrazine and certain ALS-inhibiting herbicides.

What has been done

Our results showed that this waterhemp biotype is resistant to mesotrione [plus all commercial HPPD-inhibiting herbicides used for weed control in corn] and atrazine, from both preemergence and postemergence applications, mainly due to rapid metabolism of mesotrione and atrazine [albeit by different detoxification mechanisms and enzymes]. The fact that this population is resistant to both HPPD inhibitors and atrazine suggests the ability to achieve herbicide synergism for enhanced weed control may be attenuated under field conditions.

Results

These research findings are particularly significant and relevant to crop production and weed management with postemergence herbicides in Zea mays because several other waterhemp populations [and a related weedy amaranth, A. palmeri] have recently been identified in seedcorn fields throughout the Midwest that possess this unique form of multiple, non-target, site-based herbicide resistance. Additional achievements are the identification of a single glutathione S-transferase [GST] gene that appears to confer metabolic-based atrazine resistance in the MCR population, and a cytochrome P450 gene that appears to be involved with mesotrione resistance in MCR. These P450 and GST genes can be used as molecular markers to rapidly screen waterhemp populations for mesotrione or atrazine resistance, respectively.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
206	Basic Plant Biology
213	Weeds Affecting Plants

Outcome #3

1. Outcome Measures

Studying The Interaction Of Photosynthesis, Genotype, And Environment To Improving Maize Production

Not Reporting on this Outcome Measure

Outcome #4

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
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

This research is important because soybean is the most important protein and oilseed crop in the world. The U.S. is the largest producer of soybean internationally with a production of over 90 million metric tons in 2011. The demand for soybean is expected to grow and the U.S. must continue to improve its soybean production efficiency to compete in the global market. These improvements include increasing both the yield potential and pest resistance of cultivars. Although research efforts in soybean breeding and genetics are in progress in many states, these efforts are needed in Illinois because each state has its own unique production environments and pest problems. The ultimate beneficiaries of this research are soybean producers who receive the technology developed through this effort in publicly and privately developed varieties.

What has been done

The University of Illinois soybean breeding program developed new experimental lines and tested lines for yield, agronomic traits, and disease and pest resistance during 2015. The program grew almost 4,700 4-row yield test plots, over 7,500 2-row yield test plots, and over 8,600 plant row plots. These plots were planted in field locations that include the main South Farm on the University of Illinois campus, the Northern Illinois Agronomy Research Center near Shabbona, Illinois, the Brownstown Agronomy Research Center near Brownstown, Illinois, and on land rented from farmers near Pontiac and Arthur. The most advanced lines from the program were evaluated in regional tests in locations throughout soybean growing regions in the north central and eastern U.S. Data from these tests are being analyzed and selections will be made to decide what lines will be tested in experiments planned for 2016. Those lines with the greatest yield and resistance over the past few years were selected and 11 new potential cultivars were released to a cooperating seed producer for increase and potential commercialization. All 11 are non-GMOs, and could be useful in filling the need for non-GMO soybean cultivars.

Results

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

The program is continuing to develop new experimental lines with resistance to soybean aphid. Using genetic markers during 2015, the breeding program tested 6,837 F4 plants for the aphid resistance gene Rag1 and selected 1,990 plants, 1,595 were tested for Rag2 and 371 were selected, and 6,064 plants were tested for having the combination of both Rag1 and Rag2 [Rag1+Rag2] and 779 plants with this combination were selected. Lines homozygous for the Rag genes that were selected in previous years were evaluated in the UI advanced yield tests which included 15 experimental lines with Rag1, 24 with Rag2, and 16 with Rag1+Rag2. In the 2015 uniform tests, the UI program submitted five lines with Rag1, four with Rag2, and nine with Rag1+Rag2. Some of these lines included the Roundup Ready gene, but most were non-GMOs. In the 2015 UI prelim tests, 128 lines had Rag1, 24 had Rag2, and 269 lines had Rag1+Rag2. There are currently two varieties developed by the University of Illinois that are commercially marketed that have the Rag2 gene. Seed is being increased in 2015 for two new lines that could be commercialized next year that each have the Rag1 gene.

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 #5

1. Outcome Measures

Evaluating The Effectiveness Of Cover Crops In Reducing Disease Severity

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Ongoing Evaluation Of The Illinois Soil Nitrogen Test [ISNT]

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Research For Improved Weed Management

Not Reporting on this Outcome Measure

Outcome #8

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
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Soybeans in annual rotation with corn are a fundamental tactic to manage field crop insect pests. Soybean fields are principal locations for the monitoring and/or management of key corn pests like the crop rotation-resistant western corn rootworm [WCR]. Growers also may need to manage other pests that use soybean and corn, like Japanese beetles [JB], 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 or JB. For both WCR and JB, movement influences the severity of pest impact.

What has been done

Soybean pest abundance monitoring has been ongoing since 1998. The 2015 WCR abundance per sweep was down compared to 2014, which was lower than average following the record cold temperatures in the 2013-2014 winter. Mean WCR abundance in soybean was very low [0.006 ± 0.001 WCR/sweep \pm SEM]; in 2014 the peak collection rate was 0.33 WCR/sweep - a 55-fold reduction! Peak monthly WCR abundance in soybean occurred during August, as it has every year except 1998 when it occurred in June. A total of 34 beetles [6 males and 28 females] were collected in a total of 5,400 sweeps. Compared 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 abundance is incredibly low - so low that the use of corn rootworm Bt hybrids in rotated corn is likely unneeded. The extreme wet conditions also seem to have affected other insects that sometimes require management like JB and BLB [bean leaf beetles]; both were collected at low rates. Only 39 JB and 497 BLB were collected [0.007 ± 0.001 JB/sweep and 0.097 ± 0.009 BLB/sweep].

Results

Besides the wet weather, the high rate of Bt corn adoption is also likely reducing the background abundance of WCR. A survey of local cornfields within 0.75-1.0 miles of the "Lost 40" study field [in Urbana, Illinois] found that 11/13 were planted with a pyramided Bt hybrid expressing Cry3Bb1 and Cry34/35Ab1 toxins. An additional field was planted with a single traited hybrid expressing just Cry3Bb1 [like Genuity VT3Pro]. Only one field did not express Cry3Bb1, and that field contained plants that expressed only the Cry34/35Ab1 toxin. In spite of evidence for local development of Bt resistance to single traited hybrids expressing Cry3Bb1, 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. Combined with the wet weather, locally, WCR were essentially absent from most fields. In 2015, the weather acted like a very effective mode of action against WCR.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

Choosing Plant Varieties That Are Known To Be Resistant To Insects and Diseases

Not Reporting on this Outcome Measure

Outcome #10

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
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The vast majority of Illinois acres devoted to corn and soybean production are treated with herbicides one or more times each growing season. Even with the occurrence of herbicide-resistant weed populations, herbicides continue to be important and widely utilized weed management tools. The development of herbicide resistance in weed populations can result in significant economic losses for growers. Growers, however, frequently continue to use a successful herbicide program until it fails instead of proactively implementing herbicide resistance management strategies. The greatest economic loss a farmer faces due to selection of herbicide-resistant biotypes likely occurs during the first year of a large-scale weed control failure; the farmer assumes the herbicide product used in the past will control weeds during the current season only to discover the level of control is unacceptable due to the presence of resistant plants. The long-term economic consequences of herbicide resistance include loss of herbicide performance and shifts in weed populations. It has been argued that preventing the selection of herbicide-resistant weed biotypes can often cost a producer significantly less than the costs incurred in dealing with resistance once it has developed.

What has been done

The evolution of weed biotypes and populations demonstrating resistance to herbicides continued to increase across many areas of Illinois during 2015. 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]. Perhaps even more daunting is the occurrence of multiple herbicide resistances within individual plants and/or fields. Research in 2015 was conducted with a waterhemp biotype that was not effectively controlled with herbicides from five site-of-action families.

Results

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. Collectively, the research identifies a waterhemp population that demonstrates resistance to herbicides from five site-of-action families.

4. Associated Knowledge Areas

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

Outcome #11

1. Outcome Measures

Developing Alternative Soybean Disease Management Practices

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Soilborne diseases, including charcoal rot, Phytophthora rot, Rhizoctonia rot, soybean cyst nematode, and sudden death syndrome, cause significant annual reductions in soybean yield in Illinois and throughout the soybean growing regions of the U.S. Yet soybean production usually relies on only three limited disease management strategies: [1] Crop rotation; [2] Resistant varieties; and [3] Fungicides. These methods all have limitations, and may not be useful for all diseases. Developing alternative soybean disease management practices would contribute to the development of sustainable disease management strategies, resulting in increased yield and yield stability.

What has been done

Disease severity levels of Rhizoctonia root rot on field grown soybean seedlings were found to be lower in rye cover crop plots when compared to those in fallow plots at some locations. No differences in symptoms of sudden death syndrome resulting from cover crop treatments were seen in the field plots. Lower levels of Rhizoctonia root rot and sudden death syndrome were associated with soils collected from rye and rape-seed cover crop plots in greenhouse bioassays, but the results were not consistent among all locations. QPCR analysis showed no impact of cover crop treatments on population levels of selected soybean pathogens. ARISA analysis found differences in microbial community structures in soils collected from the different locations in the study, but did not detect any differences associated with the cover crop treatments.

Results

The goal of this project was to determine if the use of cover crops in a corn-soybean rotation is effective for reducing disease severity levels in soybean. This will provide soybean producers with another tool to manage important diseases. Managing diseases, weed problems, and increasing soil health through the use of cover crops will increase the sustainability of the corn-soybean rotation system, and increase the profitability of soybean production by reducing yield losses resulting from disease problems.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
213	Weeds Affecting Plants

Outcome #12

1. Outcome Measures

Evaluating The Effect Of Cover Crops On Diseases And Pathogens In A Following Soybean Crop

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A follow-up project evaluating the effect of cover crops on diseases and pathogens in a following soybean crop was initiated in 2014 and continued in 2015. Treatments include several fall planted cover crops including cereal rye, hairy vetch, hairy vetch/rye mix, mustard, and a fallow control superimposed on tillage treatments of ridge-till and chisel plowing.

What has been done

Root of soybean seedlings [R3] were evaluated for disease when the plants were nearing maturity [R6-7]. Soybean roots, bulk soil, and rhizosphere soil were collected from plants grown in cover crop tillage experimental plots when the soybean plants were in the seedling [R3] stage. DNA was extracted from the roots and rhizosphere soils taken from the fallow and rye plots in both the ridge-till and chisel-plow treatment main plots. DNA extracts from the 2014 season were assayed for soybean pathogen populations using qPCR, and they were also used to evaluate microbial community structures using a method involving Illumina sequencing. Due to cost constraints, only the DNA extracts from selected treatments were evaluated. DNA was extracted for PCR amplification, targeting 16s bacteria and archaeal, ITS, ammonia monooxygenase, nitrous oxide reductase, and ammonia generating nitrite reductase genes for subsequent high throughput sequencing.

Results

Our results showed no significant differences in microbial populations of the cover crop treatments. However, there were several notable differences with the tillage treatments. Chisel plowed plots had increased levels of the genera, Verrucomicrobia, Glomeromycota, Proteobacteria, and Actinobacteria. Ridge tilled plots show increased levels of Streptophyta, Firmicutes, and Crenarchaeota. These differences show that there are several factors that play important roles in shaping the structure of microbial disease suppressive communities as related to SDS. DNA extracts still need to be collected from the 2015 soil samples. Once this is done a similar process will be used to compare the effects of treatments on microbial community structure. Unusually wet soil conditions during the 2015 growing season resulted in fairly high levels of sudden death syndrome in all treatment plots, with no discernable effect of cover crop or tillage treatments on disease severity levels.

4. Associated Knowledge Areas

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

212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems

Outcome #13

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

Recently 20 field populations of the soybean cyst nematode [SCN] were tested over multiple generations for the presence and dynamics of five viruses. It was found that high initial levels of viruses predicted lower virus titers in the next nematode generation. This result suggests that high levels of nematode viruses are killing the nematodes and thus the virus population drops along with the SCN population in the proceeding generation. This type of cyclical population increases and decreases are common in predator-prey dynamics and suggests nematode viruses harm nematodes in the population. Monitoring of SCN populations in the field from Spring to Fall also showed some populations, isolated in a particular geographical region, that experienced population declines when grown on susceptible soybean. Since this is the opposite of what one would expect and the fact that these populations had SCN viruses, it suggests a biological agent could be causing wide spread damage to SCN populations in the field.

Results

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

4. Associated Knowledge Areas

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

Outcome #14

1. Outcome Measures

Associating Root Architectural Characteristics With Plant Performance

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In previous field experiments we showed that root system complexity in maize is under considerable genetic control. However, no detailed information is available reliably associating root architectural characteristics with plant performance under biotic and abiotic stresses.

What has been done

To close this knowledge gap, we evaluated the performance of three maize hybrids with root systems of low complexity and three hybrids with highly complex root systems under drought and

low nitrogen stress. All experiments that observed biomass production and partitioning at four to six particular plant developmental stages were conducted in controlled greenhouse experiments.

Results

For all stresses, we were able to identify significant relationships between root complexity and tolerance. To further investigate the physiological and genetic basis of these root-mediated stress responses, we initiated the development of segregating populations derived from crosses between maize inbreds with high and low root complexity. Crosses were performed this summer in our breeding nursery. From each cross we will develop doubled haploid lines. We envision that first experiments using these doubled haploid genotypes will be conducted in the field in 2017.

4. Associated Knowledge Areas

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

Outcome #15

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	25

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Invasive plants are harming garden biodiversity and disrupting pollinators who are reliant on native plants.

What has been done

University of Illinois Extension staff members conducted webinars in February and then again in April that focused on educating horticulturists and gardeners about garden biodiversity by addressing common landscape plants that have invasive qualities, how and why to control them, landscape native alternatives, and the benefits of native plants to pollinators. The programs were also uploaded to the University of Illinois Extension YouTube Channel. A combined total of 390 people attended the live sessions of the series and 255 views of the YouTube postings were

recorded. Three months following the series of webinars, the 390 webinar participants were sent an email with a link to the post-survey evaluation.

Results

A total of 65 individuals responded to the post-survey. When asked if they know the difference between invasive, natives, and noxious weeds, 97% [all but two] of the respondents indicated 'yes'. As a result of the webinar series, 25 [39%] reported removing non-native or invasive plants from their landscape with the majority removing ten or fewer plants, five removing between 11 and 50 plants, two removing 100 plants, one removing 250 plants, and one removing 1,000 invasive plants. Ninety-two percent [92%] plan to incorporate or have planted native plants in their landscape with two-thirds listing at least one and as many as 14 names of native plants they plan to or have planted [additional findings are in the evaluation section of this planned program]. These actions that cultivate the biodiversity of our natural Illinois landscape help ensure survival of wildlife [birds, insects, and mammals].

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
206	Basic Plant Biology

Outcome #16

1. Outcome Measures

Number Of Individuals Increasing Knowledge Related To Detecting And Managing Emerging Pathogens And Insects

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	143

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Emerging pathogens and insects can cause serious damage and loss to Illinois trees 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 again offered for a third year at eight [8] locations in Illinois focused on training tree care professionals, Master Gardeners, Master Naturalists, arborists, foresters, landscapers, garden center owners or employees, and conservationists to: [1] Increase their awareness of invasive species; [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. Extension specialists delivered course elements for pests that included the following areas of knowledge: [1] Identification/detection; [2] Life cycle/biology; [3] Hosts; [4] Sampling; [5] Management; [6] Commonly confused look-alikes; and [7] Regulation. Following the training 143 of the 222 participants completed an evaluation that asked them to compare their degree of understanding of these topics before and after the training sessions using a 1 to 5 scale [1 = "very little" and 5 = "a lot"].

Results

With respect to knowledge related to ornamental viruses, all of the 143 evaluation respondents increased their degree of understanding regarding at least one of the knowledge areas. All average scores regarding invasive insects topics were above 3.86 after the training as compared to 1.90 and below before the training. Eighty-four percent [121 of 143] increased their degree of understanding in at least one of the Invasive Plant knowledge areas. Regarding regulation of invasive pests, comparison of group ratings of degree of knowledge revealed a 66.7% increase by 130 of 142 [91.5%] of the respondents.

4. Associated Knowledge Areas

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

Outcome #17

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	85

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Home owners and gardeners need and seek assistance regarding lawn and garden assistance or resources for growing fresh food and protecting the environment [soil, water, air] through maintaining landscape plants that also enhance the value of their residences.

What has been done

University of Illinois Extension Master Gardeners [3,200] contribute volunteer hours to provide horticulture education in a variety of ways [often by fielding phone calls or office visits from homeowners and gardeners seeking assistance with problems they have encountered or resources on lawn and gardening practices]. In order to assess the use and impact of the assistance provided, a small group of Extension horticulture educators volunteered to conduct phone interviews with a sample of those who sought Extension assistance during the growing season.

Results

Interview results conducted by Extension Master Gardeners with a sample of 142 individuals who contacted the county Extension offices to seek information to help them solve a horticulture-related problem indicated that 60% of them used the information given to them. Several indicated that no action was needed. Using a scale of 1-5, 53 [73%] indicated they were "very satisfied" with the information provided and 32 [52%] had shared information they received with others. For additional findings see the evaluation section of this planned.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The Good, The Bad, And The Lovely Plants Webinars

Following the completion of **The Good, the Bad, and the Lovely Plants** webinar series focused on education horticulturists and gardeners about garden biodiversity by addressing common landscape plans that have invasive qualities, how and why to control them, landscape native alternative, and the benefits of native plants to pollinators an email was sent to 390 participants with a link to an online evaluation. A total of 65 participants responded to the survey. The results of their responses to the nine survey questions follow: [1] When asked if they know the difference between invasive, natives, and noxious weeds, 97% [all but two] of the respondents indicated "yes"; [2] All of the respondents indicated that they think invasive species/potential invasive plants are a problem in Central Illinois; [3] As a result of the webinar series, 39% removed non-native or invasive plants from their landscape with the majority removing ten or fewer plants, five removing between 11 and 50 plants, two removing 100 plants, one removing 250 plants, and one removing 1,000 invasive plants; [4] 92% plan to incorporate or have planted native plants in their landscape with two-thirds listing at least one and as many as 14 names of native plants they plan to or have planted; and [5] 72% of the respondents reported that they had shared knowledge gained through this series with an average of 150 others.

First Detector

An evaluation was distributed and collected from 143 participants in the eight one-day **First Detector** programs. The evaluation asked them to compare their degree of understanding of various topics related to invasive species before and after the training sessions using a 1 to 5 scale [1 = "very little", 5 = "a lot"]. The topics included the following areas of knowledge: [1] Identification/detection; [2] Life cycle/biology; [3] Hosts; [4] Sampling; [5] Management; [6] Commonly confused look-alikes; and [7] Regulation.

With respect to knowledge related to **Ornamental Viruses**, all of the 143 evaluation respondents increased their degree of understanding regarding at least one of the knowledge areas. Based on an average group rating score on each topic before and after the training, a comparison of the scores revealed that the topic that generated the greatest change in knowledge [103.6%] was "identification/look-alikes" followed by "management".

Respondent changes in knowledge of Invasive Insects "management" and "identification" were 57.1% and 55.3% respectively. It is worth noting that all average scores regarding these topics were above 3.86 after the training as compared to 1.90 and below before the training.

When reviewing the knowledge areas for **Invasive Plants**, the before training average group scores for topics related to these pests ranged from 2.62-2.66 and after training scores ranged from 3.90-4.07. However, percentage changes in knowledge areas of this topic were lower for these invasive plants, ranging from 39.7% [for basic ecology] to 57.1% [for management]. Eighty-four percent [121 of 143] increased their degree of understanding in at least one of the invasive plant knowledge areas.

Regarding **Regulation** of invasive pests, comparison of group ratings of degree of knowledge revealed a 66.7% increase by 130 of 142 [91.5%] of the respondents. When asked to indicate the number of people they encounter involved in tree care as many as 25,700 people could be reached by these trained first detectors.

Master Gardener Hotline/Help Desk

In order to assess the use and impact of the assistance provided by Master Gardeners who fielded calls or office visits from homeowners and gardeners seeking information to help them solve a horticulture related problem or seeking a resource, a small group of Extension horticulture educators volunteered to conduct an evaluation. The process involved recruiting Master Gardeners to conduct phone interviews with a sample of those who sought assistance during the growing season. Instructions for selecting the participants, a form for completing information on the selected participants, and an introductory script for the phone call to gather the responses to nine questions was developed for the interviewers use. Information pertaining to the reason for the original contact and that was gathered through the interviews was then entered into an online template for analysis. One hundred forty-two [142] interviews were conducted in four counties. The findings follow. It should be noted that interviewers were not necessarily paired with calls they had fielded.

A total of 142 interviews were completed. In response to the first question when asked if the interviewees used the information provided 85 of 142 [60%] of the interviewees answered "yes" and 49 answered "no". Of the others, 18 indicated they would use the information in the spring/next growing season or if the situation occurred again and several of the others indicated that no action was needed. Using a scale of 1-5 with 5 = "very satisfied", 139 interviewees responded as follows: 101 [73%] indicate they were "very satisfied"; 17 [12%] chose a "4" rating; 14 [10%] chose a "3" rating; and only seven chose a rating of "2" or "1" [not satisfied].

Of the 134 who indicated how they will use the information in the future, eleven referenced knowing what to do if they have a similar problem in the future [identify and treat earlier] and seven referenced protecting trees. Others mentioned planning actions regarding composting, researching tree and plant choices, when to plant, harvesting, fertilizing, and watching for reoccurrence of plant pests. When asked if the interviewees had shared information they received with others, 82 of 142 [57%] answered "yes".

Key Items of Evaluation

The Good, The Bad, And The Lovely Plants Webinars

Interview results conducted by Extension Master Gardeners with a sample of 142 individuals who contacted the county Extension offices to seek information to help them solve a horticulture related problem indicated that 60% of the interviewees used the information given to them. Several indicated that no action was needed. Using a scale of 1-5, 53 [73%] indicated they were "very satisfied" with the information provided and 32 [52%] had shared information they received with others.

First Detector Programs

All of the evaluation respondents increased their knowledge related to ornamental viruses, invasive insects, invasive plants. Participants perceived knowledge in identifying look-alikes increased by more than 100% for ornamental viruses and by more than 55% for invasive insects. Average scores for management of invasive insects and invasive plants increased by 57%. Knowledge of regulations of invasive pests increased by two-thirds. The potential for sharing the knowledge they gained by people they encounter involved in tree care numbered nearly 28,000.

Master Gardener Hotline/Help Desk

Interview results conducted by Extension Master Gardeners with a sample of 142 individuals who contacted the county Extension offices to seek information to help them solve a horticulture related problem indicated that 60% of the interviewees used the information given to them. Several indicated that no action was needed. Using a scale of 1-5, 53 [73%] indicated they were "very satisfied" with the information provided and 32 [52%] had shared information they received with others.

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Sustainable Energy

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
133	Pollution Prevention and Mitigation	5%		15%	
136	Conservation of Biological Diversity	5%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		15%	
206	Basic Plant Biology	35%		15%	
402	Engineering Systems and Equipment	35%		20%	
601	Economics of Agricultural Production and Farm Management	5%		10%	
603	Market Economics	0%		10%	
801	Individual and Family Resource Management	5%		0%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	5%		5%	
806	Youth Development	5%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.0	0.0
Actual Paid	0.0	0.0	3.6	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
38780	0	614564	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
38780	0	614564	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
341481	0	3215490	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included an analysis of the role of biofuel policies in Brazil on incentives to produce sugarcane ethanol, the development of an integrated framework to determine and compare greenhouse gas [GHG] intensities and production costs of cellulosic ethanol derived from corn stover, switchgrass, and miscanthus grown on high and low quality soils for three representative counties in the eastern United States, an examination of the design of long term contracts for inducing the production of perennial energy crops as a feedstock for the emerging cellulosic biofuel industry, the development of results that suggest that the problem of the rigid flux partition toward ethanol production during the production of acetyl-CoA derived biofuels and chemicals can be bypassed through using xylose instead of glucose as a carbon source, work to improve our understanding of the fundamental causes of increased fouling in maize processes [evaporator fouling is a common, chronic problem during maize starch and ethanol production resulting in increased capital costs and environmental impacts], the development of an efficient method for the separation and recovery of XOS from the prehydrolyzates [this provides an excellent opportunity for better utilization of cellulosic material and for value-added co-product production], the evaluation of twenty-one perennial woody species for their potential as short rotation bioenergy feedstocks, and the use of transcriptome sequencing methods to characterize developmental changes in response to nitrogen among the related C4 grasses maize, sorghum, and Miscanthus.

Activities also included efforts to improve our understanding of how plant genetic variation affects diazotroph associations and natural nitrogen fixation [our preliminary data indicates that plant genetics play an important role; the results of this study are expected to facilitate efforts to breed Miscanthus for improved efficiency of plant-microbe interactions], the development of a pilot plant to convert biowaste into biocrude oil via hydrothermal liquefaction, nucleolus organizer region [NOR] site analysis that was determined to be a method of measuring stability in new polyploidy species of Prairie Cordgrass [this will allow breeders to pick only those lines that have the genetic stability for breeding programs], the quantification of substantial genotypic variation for winter-hardiness, flowering time, autumn dormancy, and yield in Miscanthus germplasm panels and F1 mapping populations, and the development of high-density genetic maps for four F1 mapping populations using RAD-seq to obtain thousands of single nucleotide polymorphism [SNP] markers [using these high density genetic maps, we identified quantitative trait loci [QTLs] for each of the traits of interest which should improve the efficiency of future breeding efforts].

Conference presentations included the International Forum on Development and Ecological Issues in Western China, Stockholm Fuel Tax Symposium, Small and Medium Sized Farms/Entrepreneurship and Rural Development Meeting, Yangling International Agri-Science Forum, International Food Policy Research Institute, National Center for Science Education, International Food Security Initiative, Illinois

Agricultural Leadership Program, Federal Aviation Authority Workshop, Advanced Bioeconomy Leadership Conference, 8th Berkeley Bioeconomy Conference, Advanced Bioeconomy Feedstocks Conference, International Conference of Agricultural Economists, American Institute of Chemical Engineers, Corn Technology Conference sponsored by the Confederation of Indian Industry, International Starch Technology, International Heat Exchanger Fouling and Cleaning XI, Science and Engineering for Biobased Industry, Center for Sorghum Improvement Seminar Series, Maize Genetics Conference, American Seed Trade Association, Sorghum Seed Research Conference, American Soybean Association, Soil Science Society of America, Crop Science Society of America, Fluid Fertilizer Forum, Phytobiomes 2015, 14th International Symposium on Nitrogen Fixation with Non-Legumes, Illinois Pork Producers Association, and the International Plant and Animal Genome XXIII Conference.

In December of 2013, the University of Illinois launched the Institute for Sustainability, Energy, and Environment [iSEE] on the Urbana-Champaign campus. The Institute was created to lead an interdisciplinary approach to researching solutions for the world's pressing sustainability, energy, and environmental needs of today and tomorrow. The goal of iSEE is to help the campus become a model of sustainability, energy efficiency, and environmental friendliness and to prepare students to be leaders in these fields and/or good Earth citizens when they leave campus. An example of such includes a biomass gasification burner unit sited on the campus farm based on availability and cost consideration information provided by Extension.

Extension had continued to work with the Illinois Department of Transportation [IDOT] to provide a project implementation plan and extension of the three-year roadside biomass utilization project that serves to produce energy for one of the IDOT state facilities. In addition, Extension has supported the development of two Department of Energy grant applications associated with biomass energy feedstocks and their capacity to serve as building blocks for transportation fuel feedstock materials [one grant was recently funded] and in addressing water quality/nutrient management. Extension also supported an effort to develop economic data to determine production choice thresholds of cropland conversion and use prioritization.

The **Dudley Smith Initiative** continued to provide financial support to create a positive loop and feedback relationship between researchers on campus and agriculturalists and leaders in the community regarding biomass energy generation. Over 75 attended a program held on a local farm where information was shared on biomass heat and power field day activities. Funding is being sought to use the **Dudley Smith Initiative** farmland to launch a new effort to develop the site as a field lab [concept] for water and nutrient management projects in the future.

A display of energy grasses and related renewable energy projects in Illinois was a part of the College of Agricultural, Consumer, and Environmental Sciences participation in the three-day **Farm Progress Show** held near Decatur, Illinois. Projects with Illinois staff and the Illinois Department of Transportation were part of the highlighted efforts by the media from across the Midwest. In addition, Extension educators interacted directly with approximately 150 of the estimated 600 attendees at the **Southern Illinois Sustainable Living Expo** held at the University of Illinois College of ACES Dixon Springs research center and delivered presentations on renewable energy and energy efficiency homes. A solar livestock watering system and a solar 'power pack' were featured demonstrations.

An Extension educator also helped with a booth and served as a member of the closing panel discussion at the **Northern Illinois Renewable Energy Summit** and served on a planning committee partnering with the Illinois Wind Working Group, Illinois Biomass Working Group, Illinois Solar Association, and the Illinois Geothermal Association in conducting the **Illinois Renewable Energy Conference**. This same field staff member is serving on the advisory committee for the U.S. Forest Service grant **The Potential for Fuel Switching to Wood in Illinois**. Environmental and energy stewardship Extension educators also engaged groups of participants in five **Be Energy Smart** programs during the year.

The **Illinois Energy Education Council**, a cooperative effort of University of Illinois Extension and the investor-owned electric utilities, rural electric cooperatives, and municipal power suppliers, continued to promote their website as a source of information to increase energy efficiency through presentations, videos, games, and links. Enrollment in the **4-H Wind Energy** project provided an opportunity for 91 youth to learn about an alternative energy source.

2. Brief description of the target audience

Members of the target audience include policy makers, producers, academic audiences, scientists and graduate students in the field of industrial microbiology and biotechnology, fuel ethanol production facilities, researchers working on improving efficiency of fuel ethanol production, the corn wet milling and corn dry grind industries, the enzyme bioindustry, dry grind and cellulosic ethanol producers, energy crop scientists, commercial energy crop producers, government officials, biomass conversion specialists, undergraduate and graduate students, sorghum breeders, plant physiologists, crop modelers, agricultural scientists, corn, soybean, and cattle farmers, scientists engaged in studying the structure and function of genomes for C4 grasses used for bioenergy, scientists conducting research on plant responses to extreme environmental stress, conservation biologists, wildlife ecologists, agronomists, and land managers.

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?

Two Extension staff were members of the Sustainable Ag Energy or Wood Energy eXtension Communities of Practice

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	6287	2493	1769	0

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

Patent Applications Submitted

Year: 2015

Actual: 1

Patents listed

Patent Application TF13135-US: Separation Process Of Oil And Sugars From Biomass.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	62	62

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2015	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number Of Program Participants Increasing Knowledge Of Bio-Energy Production/Harvesting/Storage Systems
2	Determination Of Sustainable Practices For The Establishment And Nitrogen Management Of Switchgrass For Biomass Feedstock Production
3	Understanding The Causes Of Evaporator Fouling In Maize And Ethanol Production Systems
4	An Economic Analysis Of The Implications Of Cellulosic Biofuel Production
5	Improving Biomass And Yield Per Unit Of Nitrogen And Per Acre
6	Bypassing The Problem Of The Rigid Flux Partition Toward Ethanol Production During The Production Of Acetyl-CoA Derived Biofuels And Chemicals
7	Toward An Improved Understanding Of How Biofuel Crops Will Impact Habitat Connectivity
8	Breeding Miscanthus Cultivars With Improved Winterhardiness And High Yield Potential In The Midwest

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	60

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Energy sustainability is a concern of consumers as well as environmentalists and scientists who are seeking identifiable and cost effective renewable energy sources.

What has been done

Extension collaborated with a local farm family, campus researchers, and area agricultural entrepreneurs to deliver a "biomass heat and power" field day and site tour. Over 75 adults and high school science and environmental studies students attended the field day activities, viewed equipment and participated in systems demonstrations, interacted with renewable energy grass researchers, and discussed environmental sustainability challenges in an open forum led by Extension staff. In addition, a variety of research project posters were on display. Illinois Biomass Working Group and Omni Ventures members [Illinois Farm Bureau leaders from surrounding counties] detailed current and past support of Extension programs, projects, and activities. As a result of this effort, 35+ students and 40+ adults were introduced to concepts of environmental sustainability at the farmstead level and the associated critical linkages to production agriculture that are often taken for granted within the community.

Results

Questions and answers during the program revealed an improved and enhanced level of integrated energy and environmental stewardship concepts were attained by most participants. A desire was expressed for additional agroecology programs and demonstrations at the school and general public levels. A survey of adults attending the program indicated that only half were directly engaged in production agriculture and about one-third of all adults attending were considering installing integrated renewable energy systems other than strictly solar.

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity
402	Engineering Systems and Equipment
806	Youth Development

Outcome #2

1. Outcome Measures

Determination Of Sustainable Practices For The Establishment And Nitrogen Management Of Switchgrass For Biomass Feedstock Production

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Many processes using agricultural commodities as raw material inputs use water intensively. As a result, process streams carry nutrients consisting of proteins, carbohydrates, vitamins, and minerals. Typically, these process streams are large in volume, are dilute, and carry nutrients with potential value. These conditions create challenging recovery and low or negative economic value of recovered solids. Conventional evaporation and drying processes [water separations] are inherently energy intensive because of the phase change with evaporation of water. As the biofuels industry grows, efficient utilization of water and energy and recovery of nutrients will become increasingly important. Developing higher value for coproduct solids in process streams is needed to retain bioprocessor competitiveness and can be accomplished through new process designs, improved efficiency, and incorporation of new technology.

What has been done

Evaporator fouling is a common, chronic problem during maize starch and ethanol production. To compensate for the consequences of fouling, capital costs are increased, operating costs are incurred, and environmental impact is increased. Despite these issues, the fundamental causes of increased fouling in maize processes are not well understood. A batch system was used to simulate the evaporation process. An annular fouling probe was used to measure fouling resistance for varying test conditions of bulk fluid temperature [60 to 80°C] and initial probe surface temperature [100 to 120°C]. Fouling characteristics of commercial thin stillage and a model thin stillage were observed.

Results

Test conditions of 60°C bulk temperature and 120°C initial probe temperature were found to provide rapid, repeatable fouling data. These conditions can be used in future testing. Steepwater samples from a commercial wet milling process were tested to determine general fouling behavior of this bioprocess stream. Steepwater fouling resistance was found to increase linearly with short induction periods.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
136	Conservation of Biological Diversity
206	Basic Plant Biology
402	Engineering Systems and Equipment
601	Economics of Agricultural Production and Farm Management

Outcome #4

1. Outcome Measures

An 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
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

First, we will investigate the technical and economic potential for sugarcane ethanol production in Brazil and its land use implications. We will analyze the outlook for expansion of ethanol production in Brazil while considering its land resources, technology, market conditions, and government policies. We will assess the supply-side potential for biofuel production in Brazil taking into account the availability of suitable land, the potential for intensification of cattle production, and the implementation of the Brazil Forest Code as well as alternative fuel conversion technologies.

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. We will also examine the effect of these policies on food and fuel prices, the consumption of alternative fuels, and the net economic and environmental benefits.

Third, we will examine the effects of riskiness of energy crops compared to conventional crops and its implications for crops, contracts, and location choices for refineries. We will estimate the yield and revenue distributions of energy and conventional crops and the return premiums needed to induce a switch from conventional crops to energy crops. We will also examine the optimal contract choice between refineries and landowners and the optimal location choice for a refinery within a region.

What has been done

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

We developed an integrated framework to determine and compare greenhouse gas [GHG] intensities and production costs of cellulosic ethanol derived from corn stover, switchgrass, and miscanthus grown on high and low quality soils for three representative counties in the eastern United States. This information is critical for assessing the cost effectiveness of utilizing cellulosic ethanol for mitigating GHG emissions and designing appropriate policy incentives to support cellulosic ethanol production nationwide.

We examined the design of long term contracts for inducing the production of perennial energy crops as a feedstock for the emerging cellulosic biofuel industry. We developed a framework to analyze the determinants of landowner choice among a land leasing contract, a fixed price contract, and a revenue sharing contract for energy crop production. We examined the effect of heterogeneous landowners' risk and time preferences and land quality on the optimal mix and equilibrium terms of these contracts that jointly maximize the net benefits of the refinery and landowners in a region; this has implications for the extent to which energy crop production is likely to be vertically integrated or independently contracted by a biorefinery.

Results

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

We found considerable variation in GHG intensities and production costs of ethanol across feedstocks and locations mostly due to differences in yields and soil characteristics. As compared to gasoline, the GHG savings from miscanthus-based ethanol ranged between 130-156% while that from switchgrass ranged between 97-135%. The corresponding range for GHG savings with corn stover was 57% to 95% and marginally below the threshold of at least 60% for biofuels classified as cellulosic biofuels under the Renewable Fuels Standard. Estimates of the cost of producing ethanol relative to gasoline imply an abatement cost of at least \$48 Mg⁻¹ of GHG emissions [carbon dioxide equivalent] abated and can be used to infer the minimum carbon tax rate needed to induce consumption of cellulosic ethanol.

We found that the refinery can potentially earn a higher profit by offering a menu of contracts rather than a single type of contract only; by allowing self-selection of contract type based on landowner risk and time preferences, the contract terms needed to induce production of energy crops are reduced. Although it is optimal for vertically integrated and contracted production to co-exist, we found that the share of the former is predominant across a range of assumptions about the distribution of risk preferences, time preferences, and relative riskiness of conventional and energy crop production. We also found that the impact of having a menu of contracts to choose from on landowners' welfare is ambiguous.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
601	Economics of Agricultural Production and Farm Management
603	Market Economics
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #5

1. Outcome Measures

Improving Biomass And Yield Per Unit Of Nitrogen And Per Acre

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Bypassing The Problem Of The Rigid Flux Partition Toward Ethanol Production During The Production Of Acetyl-CoA Derived Biofuels And Chemicals

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Saccharomyces cerevisiae, a workhorse strain of the biotechnology and food industries, has been engineered for implementing economic processes for producing biofuels and chemicals.

However, this yeast has limited capabilities for producing biomolecules which are derived from acetyl-CoA because of strong flux towards ethanol production during glucose metabolism. Even after introducing heterologous pathways for the biosynthesis of target molecules via acetyl-CoA, ethanol still remains as a major product.

What has been done

In this project, we investigated the effect of using glucose or xylose as a carbon source on the production of isoprenoids in engineered *S. cerevisiae*. To this end, we constructed efficient xylose fermenting *S. cerevisiae* strains with an enhanced mevalonate pathway and compared the production of squalene from glucose and xylose. In order to construct an efficient xylose-fermenting *S. cerevisiae*, a xylose fermentation pathway from *Scheffersomyces stipitis* was introduced into *S. cerevisiae* and the promoter of transaldolase [TAL1] was substituted with a strong constitutive promoter in order to improve the xylose assimilating capability. The resulting strain was able to ferment xylose efficiently and rapidly. In order to increase metabolic fluxes toward the production of squalene, overexpression cassettes of a truncated HMG-CoA reductase 1 [tHMG1] and acetyl-CoA C-acetyltransferase [ERG10] were introduced into the xylose-fermenting *S. cerevisiae*. Amounts of accumulated squalene in the engineered yeast after cultivation on glucose and xylose were measured as an indicator of metabolic fluxes in the mevalonate pathway.

Results

Overexpression of tHMG1 resulted in a drastic increase in the specific squalene content of the engineered cells regardless of a carbon source, but the positive effect was more outstanding under the xylose conditions as compared to glucose conditions. While overexpression of ERG10

did not lead to any increase in squalene content regardless of carbon source, there was a synergistic effect on squalene production when both tHMG1 and ERG10 were overexpressed simultaneously. Specific squalene content in the engineered yeast was five-fold higher in the cells grown on xylose compared to the cells grown on glucose. As a result, the tHMG1 and ERG10 co-expressing engineered yeast produced 472 mg/L of squalene with a productivity of 6.30 mg/L-h.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
206	Basic Plant Biology
402	Engineering Systems and Equipment

Outcome #7

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Meeting the proposed increase for bioenergy crops will pose difficult challenges for biodiversity conservation in agroecosystems. Dispersal is crucial for maintaining demographic and genetic connectivity in fragmented landscapes. Comprehensive assessments of biofuels and wildlife require a focus on landscape connectivity. Many wildlife species in agroecosystems are retained within remnant semi-native habitat patches. Nevertheless, these species must disperse across croplands that function as "matrix habitats" between patches of their primary habitat. Hence, biofuel crops may facilitate or hinder movements of animals and thus have a significant impact on landscape connectivity. We are using replicated, experimental microlandscapes to assess how animal movements are affected by biofuel crops. Our focal species is the meadow vole, a grassland species that is absent from current row-crop agriculture in the Midwest region.

What has been done

During the reporting period, we continued a large field experiment designed to evaluate how biofuel crops affect movement of wildlife and landscape connectivity. The experiment includes three spatial blocks that each contains four vole enclosures [12 total enclosures]. Within each enclosure, there are two grassland habitat patches [each 20 x 35 meters] with a single patch located on opposite ends of the enclosure. The intervening habitat [40 x 35 meters] separating the two grassland patches is planted in one of four matrix types [corn, switchgrass, miscanthus, and mixed grassland] that are replicated across the three blocks in a balanced design.

Results

During October 2014, we completed the field season by livetrapping voles in each enclosure for a final session [4 nights of checking and setting traps per plot]. This effort resulted in > 100 captures of meadow voles and contributed to the > 1,000 captures of meadow voles during the sampling season. Any new individuals captured were marked with ear tags. In general, the densities of meadow voles in the experimental enclosures remained low [well below stocking levels] for unknown reasons.

During the summer of 2015, we conducted preliminary livetrapping to gauge whether the vole populations had recovered from the unexpected decline. Vole densities remained relatively low. Thus, during the fall of 2015 we designed and conducted a pilot research study using an alternative approach for assessing how biofuel crops affect animal movements and landscape connectivity. The new approach is focused on the individual level instead of the population level. Voles are captured in a grassland patch, radio-collared, and translocated across the crop matrix habitat and released in another grassland patch. This translocation experiment takes advantage of the homing behavior of voles and allows us to ask if the different matrix habitats affect the likelihood of voles returning home and the length of time required. For this experiment, we will not use juvenile voles that might not have established a home range yet. We initiated pilot trials in October 2015 and will describe the results of those efforts in next year's report.

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity

Outcome #8

1. Outcome Measures

Breeding Miscanthus Cultivars With Improved Winterhardiness And High Yield Potential In The Midwest

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
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2015

0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There is a critical need to breed additional *Miscanthus* cultivars with improved winterhardiness and high yield potential in the central and northern Midwest and to develop near-infrared [NIR] spectroscopy as an inexpensive and high-throughput method for evaluating quality characteristics of *Miscanthus* genotypes. Without the appropriate cultivars, Midwest farmers will be unable to effectively fulfill their role in responding to government policies that are intended to positively impact human health, global warming, and national security.

What has been done

We have quantified substantial genotypic variation for winter-hardiness, flowering time, autumn dormancy, and yield in *Miscanthus* germplasm panels and F1 mapping populations. We have developed high-density genetic maps for four F1 mapping populations using RAD-seq to obtain thousands of single nucleotide polymorphism [SNP] markers. Using these high density genetic maps, we identified quantitative trait loci [QTLs] for each of the traits of interest, which should improve the efficiency of future breeding efforts.

Results

An F2 mapping population was developed and phenotyped for photosynthetic tolerance to low temperature; the population was also established in a replicated field trial and is being phenotyped over several years. New sterile triploid *Miscanthus x giganteus* genotypes have been bred and they are being field tested to determine their suitability for release as new biomass cultivars. Additional diploid and tetraploid selections have been made to be used as improved parents for future crosses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology

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 formal evaluations were conducted this year.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

4-H Youth Development

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

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

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	0.0
Actual Paid	0.0	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
1570590	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1570590	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
13829980	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

4-H Club enrollment in Illinois totaled 26,571. Nearly 157,000 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 forty Youth Development Extension Educators, as well as local program coordinators, also focused on creating opportunities for inclusion of youth of Hispanic ethnicity and in expanding opportunities for teens to assume leadership roles as advocates for change, planning activities, promoting 4-H impact, advising partnering councils, mentoring peers, or teaching others. Educational priorities for all 4-H delivery systems remain focused on: [1] College and career readiness; [2] Food access; [3] Environmental stewardship; [4] Leadership; and [5] Health.

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 spent three days exploring the college campus and engaging in hands-on workshops conducted by professors and graduate students in career fields of their choice. **Welcome to the Real World**, a multi-disciplinary curriculum and simulation that allows youth ages 12-18 to explore careers and money management [balancing income and expenses] in adult life, was on-going [also discussed in the Agricultural and Consumer Economics planned program].

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 third year of training **4-H Citizen Scientists** raised the total youth participants from 69 in 2014 to 100 junior and senior high youth in 2015 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.

Illinois has placed strong emphasis on engaging youth in science. This past year 150 **4-H National Youth Science Day** events involved some 3,500 Illinois youth participants. The events included the opportunity to complete a **Motion Commotion** physics experiment that combined a speeding car collision and a distracted driving demonstration, an activity that explored the physical and human factors of motion. The 4-H robotics project increased in enrollment again this year with 7,938 youth enrolled in one of five project options. Fifty-five teams [400 youth] participated in the seventh annual Illinois 4-H **State 4-H Robotics Team Competition**. **4-H Tech Wizards**, an initiative designed to establish mentoring programs for at-risk, underserved youth in an after-school setting, continued to engage youth participants at seven multi-county sites this past year. State and national partners played an important role in providing grants to support these science experiences and opportunities for awarding college scholarships.

Cook County continued to offer youth science classes through its **Mobile Science Laboratory** [bus]. The **4-H Incubation and Embryology** program engaged youth in experiencing hands-on science concepts while caring for and observing the growth process of chicken embryos. **Science Siesta**, designed for girls in grades 4 through 6, introduced 184 of them to fun hands-on science activities and career opportunities. **Advanced Science Siesta** was two days in length and conducted on the University of Illinois College of Engineering campus for 42 female participants. This program aims to dispel myths that science is too difficult, not fun, and more suited to males.

Building youth leadership skills is both a national and Illinois area of focus. At the state level opportunities and training were provided for the state **Youth Leadership Team** members to plan and conduct conferences and to articulate the impact of the 4-H program to legislators. Youth participants in **Speaking for Illinois 4-H** also demonstrated their skills in articulating the impact of the 4-H program to legislators. Illinois 4-H is also focusing on developing teens as teachers. For a second year a grant-funded national program, **4-H Food Smart Families**, partnered 4-H with the **Supplemental Nutrition Assistance Program Education** [SNAP-Ed] in supporting 315 teens who taught more than 2,300 youth at after school programs and summer camps to make healthy food choices. What began in four metro areas expanded with support from the Illinois 4-H Foundation to more than 550 Teen Teachers who developed, planned,

and delivered lessons on such topics as STEM, gardening, nutrition, and more. **Youth Science Ambassadors** were involved in leading and facilitating the **Motion Commotion 4-H National Science Day** event and a group of 20 youth were recruited and trained to form the new Illinois **4-H Livestock Ambassadors** who are charged with telling the story of Illinois agriculture.

Volunteer Training is 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 21,294 volunteers gave their time and talents to the 4-H Youth Development program in Illinois with slightly less than 4,700 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. Eighty-seven [87] Illinois 4-H volunteers also participated in the Southern Illinois 4-H Leaders Volunteer Forum to learn more about team building, officer training, club retention, and helping members choose projects, as well as 4-H program and activity opportunities beyond their county. Illinois 4-H volunteers also participated in the North Central 4-H e-forum.

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

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	100355	0	378241	606669

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

Patent Applications Submitted

Year: 2015
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
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Actual	0	0	0
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V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased Knowledge About Science And Health Careers
2	Increased Knowledge Of Positive Youth Development
3	Pursuit Of Higher Education Including Science, Engineering, And Technology Careers
4	Number Of 4-H Youth Applying Leadership Skills
5	Presence Of 4-H Club Experiences That Foster Positive Youth Development
6	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]

Outcome #1

1. Outcome Measures

Increased Knowledge About Science And Health Careers

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	10815

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

The 4-H Incubation and Embryology project has been carried out in elementary school classrooms for over two decades using hands-on science concepts in caring for and observing the growth process of chicken embryos from the inception of the eggs through hatching of chicks. The majority of youth participants were students in K-2 classrooms, but youth in grade 3-12 were also engaged in activities in this program. Curriculum development and teacher training was provided by the Extension poultry faculty member and local educators. Evaluations were collected from 232 teachers in ten counties in Northeastern Illinois to determine their perceptions of impact related to their 12,290 students' science ability gains.

Results

Using a scale of 1-4 [1 = "not at all"; 2 = "sometimes"; 3 = "usually"; and 4 = "always"], grades K-2 teachers were asked to rate their students' level [as a group] with respect to five [5] science abilities, and grades 3-12 teachers were to rate their students' level on ten [10] science abilities after participating in the multi-week 4-H Incubation and Embryology project. Observed increases in at least one of these skills were reported by 88% of the 195 teachers who answered these questions. For more detailed finding see the evaluation section of this planned program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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806 Youth Development

Outcome #2

1. Outcome Measures

Increased Knowledge Of Positive Youth Development

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Pursuit Of Higher Education Including Science, Engineering, And Technology Careers

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number Of 4-H Youth Applying Leadership Skills

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Presence Of 4-H Club Experiences That Foster Positive Youth Development

Not Reporting on this Outcome Measure

Outcome #6

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]

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	158

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Youth need positive experiences TO develop into productive adults.

What has been done

Teens were recruited and trained as teachers to conduct programs for primarily 8-11 year olds. The teens used materials related to teaching healthy living through cooking schools, STEM [Science, Technology, Engineering, and Math] camps that focused on electricity, robotics, and 3-D printing, and agriculture awareness of where food originates. In addition to being trained to conduct educational activities related to these topics, the teens were engaged in formal training that addressed learning about leadership, BIG M, technology, and teaching techniques. At the end of their teaching experience, the teen teachers completed a questionnaire that included 20 4-H Common Measures statements designed to describe the impact of their experience as a teen teacher.

Results

The responses to the evaluations were collected from 159 teen teachers who taught healthy living, STEM, or agriculture awareness of food origins. Using a four-part scale with "always", "usually", "sometimes", and "never" response options, all but one who completed the evaluation indicated that through this teaching opportunity they "always" or "usually" do the following: "I took responsibility for my actions" [157].

The teen teachers were asked to rate additional statements as "strongly agree", "agree", "disagree", or "strongly disagree". All but one of the teen teachers reported that they "strongly agree" or "agree" that "I am someone who wants to help others" [158]; all but three [156] reported that "I learned things that help me make a difference in my community"; and all but four [155] reported "I have talents to offer others."

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

Brief Explanation

Successful recruitment of donors to the Illinois 4-H foundations and grants from the National 4-H Council have facilitated the expansion of outreach to youth and their subsequent positive youth development experiences.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

4-H Incubation And Embryology

Using materials developed by the University of Illinois poultry specialist in conjunction with state and local 4-H staff, 232 teachers in ten Northeastern Illinois counties responded to a survey asking them to share their perception of the impact of the multi-week **4-H Incubation and Embryology Program**. A reported 8,787 students were enrolled in grades K-2 and 3,403 students were enrolled from grades 3-12. Two surveys were tailored around grade level science skills learning standards for the two grade level groupings [5 science skills for K-2 and 10 for grades 3-12].

With respect to the science abilities of students in grades K-2, 120 [86%] of the 140 teachers who answered this question indicated a perceived increase in at least one of five [5] science abilities. More than three-fifths of the teachers reported perceived increases in their students' observation ability [77% of the teachers], comparing/contrasting ability [72%], hypothesizing ability [67%], organizing/ordering/classifying ability [66%], and predicting ability [64%].

With respect to students in grades 3-12, 51 [93%] of the 55 teachers who answered this question indicated a perceived increase in at least one of the ten [10] science abilities. More than three-fifths of the teachers reported perceived increases in their students' data collecting ability [71%], observation ability [67%], hypothesizing ability [65%], predicting ability [65%], ability to evaluate [64%], and interpreting/analyzing/reasoning ability [60%].

More than one-half and less than 60% of the teachers reported perceived increases in their students' ability to problem solve [58%], communication/demonstration ability [56%], and questioning ability [54%]. In addition, nearly one-half of the teachers perceived increases in their students' ability to summarize [45%].

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

Teens As Teachers

Illinois 4-H is focused on creating positive experiences in developing youth as leaders including providing opportunities to be trained and then engage in a teaching experience. At the end of the teaching experience, the teens teaching STEM, agriculture awareness of where food originates and healthy living were asked to complete a questionnaire that included 4-H Common Measures statements designed to describe their experience as a teen teacher. Using a four-part scale with "always", "usually", "sometimes", and "never" response options, **slightly more than 89% the 159 youth** who completed the questionnaire indicated that through this teaching opportunity they "always" or "usually" do the following: [1] 157 "I take responsibility for my actions"; [2] 148 "I work well with other youth"; [3] 147 "I set goals for myself"; [4] 146 "I use information to make decisions"; and [5] 142 "I can work things out when others don't agree with me".

The teen teachers were asked to rate additional statements as "strongly disagree", "disagree", "agree", or "strongly agree". **Ninety-three percent [93%] of the 159 youth rated the following statements as either "agree or "strongly agree"** as a result of their experience in the Teens as Teachers 4-H program experience: [1] 158 "I can work successfully with adults"; [2] 158 "I am someone who wants to help others"; [3] 157 "I can explain my decisions to others"; [4] 157 "I can change my plan when I need to"; [5] 156 "I learned things that helped me make a difference in my community"; [6] 156 "I have friends who care about me"; [7] 156 "I have adults in my life who care about me and are interested in my success"; [8] 155 "I have talents to offer to others"; [9] 155 "I like to work with others to solve problems"; [10] 155 "I am comfortable with my own decisions"; [11] 155 "I am connected to adults who are not my parents"; [12] 155 "I have a plan for reaching my goals"; [13] 151 "I helped with a project that made a difference in my community"; [14] 150 "I don't let my friends talk me into doing something I don't want to do"; and [15] 148 "I know how to deal with stress in positive ways".

Key Items of Evaluation

4-H Incubation And Embryology Key Findings

After conducting the **4-H Incubation and Embryology** program in their classrooms, more than two-thirds [145] of the K-2 and grades 3-12 teachers perceived increases in their students' observation skills. More than three fifths [90] of the K-2 teachers also reported observed increases in their students' comparing/contrasting, hypothesizing, predicting, and organizing/ordering/classifying abilities. In addition, more than half of the grades 3-12 teachers [30] reported observed increases in their student's ability to collect data, observe, hypothesize, predict, evaluate, interpret/analyze/reason, problem solve, communicate/ demonstrate, and question.

Teens As Teachers Key Findings

More than 98% of the teen teachers indicated that through their teaching activity they always or usually take responsibility for their actions. The teen teachers were asked to rate additional statements as "strongly agree", "agree", "disagree", or "strongly disagree". All but one of the teen teachers reported that they "strongly agree" or "agree" that "I am someone who wants to help others" [158]; all but three [156] reported that "I learned things that help me make a difference in my community"; and all but four [155] reported "I have

talents to offer others".

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

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