2014 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 committed to exceptional scholarship and program quality. Academic program reviews in three of our seven academic departments have been very positive on balance. Illinois is the largest food and agricultural economy in the region and the University of Illinois has arguably 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. 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 maintained fiscal discipline, increased student enrollment, and managed contraction of its human capacity and statewide organizational structure. Overall, our recurring state budget increased slightly in FY 2015, as compared to previous years, during which ACES had experienced significantly disproportionate cuts relative to other units on campus. The campus assessed permanent reductions of 2% for campus programs, administration and common costs. A 2.5% salary program was also implemented, and salary caps were applied as directed by campus guidelines. The salary program was covered in part by increased tuition revenue, allocated differentially among departments. The tuition increase was approximately 1.7% of the base tuition. For FY 2015, the campus provided 0.5% of the filled faculty base for compression, market, equity, and retention issues.

Aggregate expenditures by the college during FY 2014 showed a significant increase of 7.6% [+$12,476,628] over the previous year, reflecting a large transfer of funds, $2.9 million, from general ICR accounts to plant accounts for the renovation of Turner Hall [home to the Department of Crop Sciences and the Department of Natural Resources and Environmental Sciences], the food science pilot plant renovation, and the Monmouth research and education center, in addition to the significant rebuilding of the statewide Extension organization and previously deferred expenditures stemming from earlier budget reallocations and reductions. This growth rate in expenditures will not continue in the current or subsequent years, since those investments were either for non-recurring opportunities or for staffing needs that resulted from reorganization. We will likely see some revenue streams decrease, for example revolving funds related to 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, Law, and 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 to academic departments. The Office of Research also oversees the research programs funded from grant, 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.

With passage of the FY 2015 federal continuing resolution and omnibus appropriations, USDA funding for formula and competitive research programs was maintained at levels equal to or above FY 2014. From all sources, the combined research activities of IAES/ACES accounted for $60,186,095 [35%] of the FY 2014 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 the statewide system of field research and education centers. These centers, operated on the south farms and in several strategic locations around the state, provide essential 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. As development occurs on the south campus, related to expansion of the 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 its 160 field-based multi-county Extension County Directors and Extension Educators that include 18 grant-funded positions and another 12 statewide 4-H Extension Educators and 4-H Extension Specialists this past year. In addition, normal/expected staff turnover levels have allowed for continued infusion of staff that bring new expertise through their academic and work experiences. Extension also continued to enhance educational outreach through several new programs developed by teams of educators, as well as interdisciplinary programs that are required to address the issues reflected in this annual report.

Use of synchronous and asynchronous distance delivery continued to increase in FY14. Extension websites generated 176,341 average daily page views. Direct teaching contacts for FY14 also increased and numbered 1,640,278 as compared to 1,531,932 in FY 2013. Few 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 and the challenges in identifying program impact [knowledge, practices, and condition changes] and in gathering this information from the distance delivery participants.

Although Illinois is the most populous state in the North Central Region, Illinois's 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 9.75 FTE academic professionals with Extension appointments located in campus departments. Research translation and program delivery from campus-based specialists remains important and is a concern in maintaining a critical mass of campus-based specialists to provide the educational content for programs. That concern has been an impetus in the campus initiative to build relevant Extension programs that explore new areas of outreach education with faculty from non-traditional units. This cross-campus University of Illinois Extension and Outreach Initiative involved issuing a university-wide call for proposals that sought 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 connections with stakeholders; [2] Creating a model for working across campus units to support and expand the university's land-grant mission of outreach; [3] Developing collaborative, change-oriented projects that respond to or address a need evident or identified at the community level; and [4] Fostering or developing outreach from interdisciplinary work. In late summer of 2014 eight of 70 proposals were selected and announced for funding for up to two years. These projects involved collaborations with the College of Business, Graduate School of Library and Information Science, Illinois Sustainable Technology Center, School of Art and Design, Spurlock Museum, Department of Computer Science, College of Education, and the Department of Recreation, Sport and Tourism along with multiple community entities.

Local funding for Extension, decreased slightly in FY2014 [-1%] and state general revenue funds decreased 3%. Federal funding for Extension programs remained relatively flat during the federal fiscal year. Extension provided funding for the Cross Campus Initiatives, splitting the overall funding with the Office of the Provost for the eight cross-campus initiative projects. The state deficit continues to be a very serious concern with significant reductions proposed for higher education and Extension funding for FY 2015 and FY 2016 that will require involvement of our volunteers, participants, and other stakeholders in sharing the value of Extension's education outreach and impact.

Changes in the College of ACES

Dr. George Czapar completed his first year as the Associate Dean of Extension and Outreach and has given strong leadership in increasing the university administration and the campus community's awareness of Extension's mission: To enable people to improve their lives and communities through learning partnerships that put knowledge to work. In addition, a Communications Director position has been established to enhance awareness of Extension's impact both internally and externally.

Changes in FTE Calculations

Research - On the NIFA Financial Report [formerly the AD-419] scientist effort is listed as including Assistant Professors and above. On the NIFA Progress/Final Report [formerly the AD-421] scientist effort can be allocated by the PI to any individual who played a significant role in working with the PI in establishing the goals or developing the methodology of the project [including postdocs and graduate students as opposed to just faculty members]. This broader definition was used in determining the FTE total for scientist effort.

Extension - Per guidelines spelled out in the August 13, 2015 NIFA AREERA State Plan of Work Newsletter, NIFA asks 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 FTEs 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 used to support salaries. The only exception is a 0.3 FTE appointment listed for the Human Health and Human Development planned program based on the relatively new directions for reporting FTE's distributed by NIFA.

The Planned Programs:

Agricultural and Biological Engineering - Activities in 2014 included promotion of the Illinois Manure Management Plan [IMMP] planning and record-keeping tools and website, ongoing **Extension Illinois Certified Livestock Manager** training, and presentations of research on calibrating sprayer quality requirements for crop producers who apply pesticides as a topic at the statewide **Crop Management Conferences**. Research activities included an ongoing project with a focus on improving the efficiency of liquid agricultural chemical application systems, the development of a novel handheld impedance analyzer system for use in animal health applications, an effort to characterize the emissions from livestock buildings, and a recent study 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.

Agricultural and Consumer Economics - Activities in 2014 included new Extension program efforts focused on consumer decision-making [including a series of webinars and recordings targeted for college students to help them manage their finances and the training of **Money Mentor** volunteers who worked with 67 mentees who sought help with basic money management]. Research activities included the completion of a major project that compared household finance between U.S. households and Chinese households with special attention to the impact of mandatory saving for housing, ongoing progress toward understanding farm programs and providing communication, education, and outreach to farmers about programs in the farm bill, research findings suggesting that the impact of Dodd-Frank on agricultural producers, and on agribusiness entities that deal directly with producers, may be much smaller than previously estimated, and research focusing on examining the riskiness of energy crop production for farmers and the impact of farmer risk and time preferences on their willingness to grow energy crops.

Animal Health and Production - Activities in 2014 included work to identify a minimally-invasive, easy-to-perform, and efficient means of providing pain management to piglets undergoing painful agricultural practices such as castration and tail docking, work demonstrating that an in vitro embryo production [IVP] technology can be utilized across two distant country borders, research with the goal of improving the quality of stover so it can be used as a forage replacement for feedlot cattle without impacting performance, work to educate poultry producers about the feeding of spray-dried bovine plasma protein on laying hen performance when exposed to high environmental temperatures, and studies to develop an average in vivo MRI-based atlas specific for the 4-week-old piglet and probabilistic tissue classification maps. 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 - Activities in 2014 included a study investigating 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 and ongoing work under a project with the goal of 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. Extension activities included data gathering and process management assistance to communities for engaging residents in decision making and planning that included implementing a new initiative to strengthen the Southeastern Illinois regional economy and expansion of buying locally programming. The **Age Matters** program developed in the previous year to build participants' skills in targeting and developing business marketing approaches based on characteristics and preferences of various generations was expanded this year to include additional modules targeted for

volunteers, employers, and consumers to assist them in understanding the values of the various generations. New initiatives also included a pilot program for encouraging youth entrepreneurship that begins by identifying and living their dreams and uploading to the web a program on social media for businesses.

Food Safety and Food Security - Activities in 2014 included a study with the overall goal of developing and field testing effective fortification technologies that are low-cost, easy to use, and that do not change feeding habits of populations in developing countries, a study conducted to determine the optimum conditions for combined treatments of ultrasound and mild heat to improve the microbiological safety of alfalfa seeds while maintaining satisfactory germination rates, research to improve the safety of Hispanic-style fresh cheeses, and the generation of high-quality draft genome sequences and genome maps for two Et strains which may promote the identification of virulence factors as well as determinants of host specificity [this is the first report of genome sequences for Et strains]. Extension activities continued to focus on food safety training for employees of establishments and 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. Food security programming encompassed field crop and fresh produce management and production and hunger mediation for limited-resource families. New programs were developed to address food preservation and joining a neighboring state in collecting fresh produce prices to assist producers in pricing their products for sale at farmers markets. 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 2014 included a research program aimed at preventing adult obesity among women, laboratory studies to identify physiological and biological factors related to healthy family interactions during mealtimes and healthy outcomes in children, the generation of information on how immigrant Latino parents raising adolescents in the U.S. navigate discontinuities between their culture of origin and the family's new environment, and continued development of the Fun with Sisters and Brothers suite of programs that are aimed at enhancing children's sibling relationship quality. Extension activities included web-based parenting education resources, and workshops and resources addressing food choices and management of chronic diseases. New programs supported by the National 4-H Council were implemented on reducing youth tobacco, alcohol, and drug use and family food choices involving youth as teachers. Other new efforts addressed building bridges across generation gaps, childcare provider training for off-installation military families, a four-part series for those retired or nearing retirement, meaningful nursing home visits, and a workplace wellness multi-session program. Impact studies encompassed the chronic disease programs, programs on building a better memory, stress reduction, bullying prevention, effective childcare and development, and youth knowledge of healthy eating habits, physical exercise, and the dangers of drug abuse.

Natural Resources and the Environment - Extension activities encompassed soil and water management, forestry, environmental stewardship, climate change, and tornado recovery addressed through workshops, conferences, expansion of Master Naturalist training, youth conservation days, a new series of YouTube videos on weather, and a program on large predators. Impact evaluations for the youth **I Think Green** curriculum documented knowledge and practice change with respect to protecting the environment. Research activities included wet atmospheric deposition monitoring at three sites in Illinois as part of a nationwide project, preliminary analysis of data that will provide information about short-term agronomic responses to urban soil management systems, continued monitoring of the success in establishing new soils in a brownfield that was formerly the U.S. Steel production facility in South Chicago, research focused on determining how landscape level cues affect the occupancy and density of grassland birds, research to estimate the value of grassland restoration and exploring how conservation planning could be improved by incorporating an understanding of leakage into its practice, and the development of new knowledge about how forest ecosystems respond to disturbances associated with pest-induced tree mortality.

Plant Health, Systems and Production - Extension activities encompassed a significant number of websites and webinars addressing horticulture topics, Master Gardener volunteer training and contributions, plant pest diagnostics programs including two new online modules, and an evaluation of the impact of plant pest first detector programs and the online modules. Activities also included the development of a system to measure respiration rates of corn and soybeans, studies to observe the effects of the addition of cover crops on organic grain production systems, the testing of over 1,300 individual waterhemp plants from over 320 fields for specific herbicide resistance traits, research with the overall goal of understanding the biology of X. cucurbitae and determining the etiology and epidemiology of bacterial spot for developing effective strategies for management of the disease, the development and testing of new experimental lines for yield, agronomic traits, and disease and pest resistance under the University of Illinois soybean breeding program, ongoing improvement of the Varietal Information Program for Soybeans [VIPS] database, and the development of improved winter wheat varieties adapted to Illinois.

Sustainable Energy - Activities in 2014 included research examining the riskiness of energy crop production for farmers, a study focused on developing a welfare economic framework to analyze the rationale for fuel policy choices in Brazil, an investigation into the possibility of developing sustainable biomass production systems on marginal land, and efforts to develop information on the genome size, ploidy level, and genomic polymorphisms among accessions of the genus Miscanthus. Extension activities included presentations, demonstrations, tours, displays, surveys, and field days focused on biomass and nutrient management strategies, biomass heat and power with small farm applications, woody biomass systems, biomass and cover crop strategies, use of solar power and wind energy, and a new effort to deliver programs to homeowners on residential energy efficiencies. Notable is the assistance provided by an Extension Educator resulting in the installation of a biomass gasification burner unit on the university Energy Farm, on a private farm site, and on one of several Illinois Department of Transportation [IDOT] regional maintenance sites.

4-H Youth Development - Activities in 2014 focused on continuing to expand staff and programs in metro areas with an additional intentional outreach to Hispanic youth, expanded opportunities to engage teens as teachers, and volunteer training to ensure positive youth development. A variety of delivery systems and enhanced and expanded educational curricula were designed to increase the number of youth involved in: [1] Learning employment skills using simulations and career exploration; [2] Becoming physically fit; [3] Thinking green by engaging youth in investigations of living things and their environment; and [4] Engaging in science. Of note, five statewide data collection studies were initiated related to youth participants' interest in: [1] Science; [2] Workforce preparation; [3] Healthy living; [4] Service learning and civic engagement; and [5] Metro program experience. Preliminary impact results for two of these studies are included in the evaluation section for this planned program. Programs and impacts related to the environment are noted in other planned program sections of this report.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	110.0	0.0	280.0	0.0
Actual	187.0	0.0	191.6	0.0

II. Merit Review Process

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

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

2. Brief Explanation

Hatch proposals are first peer reviewed at the department level before being submitted to the Office of Research and then final peer review through submission to NIFA via the REEport system. In the Department of Food Science and Human Nutrition [FSHN], proposals are sent to two experts for internal peer review as well as being reviewed by the Department Head. In the Division of Nutritional Sciences [DNS], proposals are reviewed by both the Director and the Assistant Director. In the Department of Human and Community Development [HCD], Hatch proposals are most typically reviewed by the Department Head. Under select circumstances [such as for a specialized field of study], the Department Head would request input or review by another Full Professor in the Department [the review 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 as well as confirming that the scientist submitting the proposal is capable of conducting the proposed project and that the timeline is feasible]. In the Department of Crop Sciences, proposals are reviewed by the Department Head as well as two faculty members. In the Department of Agricultural and Biological Engineering [ABE], every proposal is reviewed by two external peers with knowledge in the subject area. In the Department of Natural Resources and Environmental Sciences [NRES], faculty members are asked to provide the names of two or three individuals to conduct a peer review [while the majority of the reviewers are within the department, other University colleagues may serve as reviewers]. Reviewers are asked to comment on the following six areas with recommendations and suggestions as well as final remarks 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? and [6] Are the users of the results [clientele] identified?

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 [9.75 FTEs] delivered face-to-face traditional statewide programs that encompassed the latest research, and in limited instances, engage with individuals and teams of Extension Educators to carry out applied research. However, as the new organizational structure has 'settled' in, teams of Extension Educators have been the primary developers of new programs guided by program leaders 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.

Using an online 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 under-served 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

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of the general public

Brief explanation.

The college office of News and Public Affairs [NPA] plays a crucial role in informing the public and its stakeholders about the research and outreach activities in the college. NPA maintains an e-mail list of almost 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 Globe and Mail, and locally in the Champaign-Urbana News Gazette. These placements are also due to memberships in subscription services with Eurekalert [a distribution service with AAAS] and AlphaGalileo [a British news distribution service].

NPA also produces special printed publications. **ACES@Illinois** is a 28-page magazine that is delivered in print or electronically 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/files/Fall-Issue_2014_web_0.pdf.

In 2014, NPA also produced a 44-page full-color publication entitled Food for Thought 2 to share research projects and findings with the public and invite feedback. Food for Thought 2 featured ACES research and Extension activities on alleviating world hunger. The publication was

also distributed at the 2014 Agronomy Day. A pdf of Food for Thought 2 is available at http://research.aces.illinois.edu/sites/research.aces.illinois.edu/files/FoodForThought2_web.pdf.

NPA also produces approximately 200 radio feature stories per year and 40 to 50 video segments that are distributed to 60 outlets representing over 1,500 stations nationwide and locally on Illinois Public Media WILL AM 580 and the website WILLAG.org.

In NRES, the Biomass Market Access Standards Group [BMAS] encourages stakeholder involvement [farmers, biorefineries, government, and academic] in developing sustainability standards for energy biomass. In addition, an NRES research team participated in the 2014 Illinois Mosquito and Vector Control Association annual meetings. In ABE, faculty members interact actively with stakeholders on issues that may be addressed using engineering and technical methods. ABE industry partners represent a substantial portion of research funding; therefore, a substantial effort is made to engage with industry. ABE also has several projects that involve institutions in other countries, and as a result these institutions have become very important international stakeholders. In the Department of Crop Sciences an established State Advisory Committee [SAC] plays a significant role.

County Directors were expected to seek input from Extension multi-county councils regarding identifying priority issues for educational programming. Ten of the twenty-seven County Directors formally reported seeking input from their council members regarding prioritizing issues to be addressed and reviewing data and conducting discussions regarding under-served audiences. This input was used to update local Plans of Work. In one unit, personal visits were made with each council member to explain and encourage their participation in identifying program needs and opportunities. In two additional units, council members were invited to serve on on-going task forces to provide their input on programming. In a fourth Extension multi-county unit council members were invited to join other key stakeholders in public meetings to identify key issues facing their county.

Extension Educators and County Directors continued networking and interactions with agencies, organizations, and other external groups and individuals in their Unit helped them to stay abreast of emerging issues and programming opportunities as well as helping to identify individuals to serve on the Extension council. In one unit, a needs assessment tool was developed and distributed to council members to use as a key information survey of other stakeholders. In addition to personal invitations to public meetings mentioned above, two County Directors distributed invitations to key stakeholders to attend an Extension open house during which they were asked for ideas or concerns that Extension might address. One hundred and six-eight invitees attended the Cook County open house to celebrate Extension's 100th anniversary.

In addition, all educators enhanced their efforts to seek feedback through end-of-program evaluations completed by program participants regarding their additional educational needs, as well as feedback on the quality of the current programs. Efforts have also been made to collect names of participants that can be used to invite additional feedback and participation in future programs.

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

1. Method to identify individuals and groups

- Use Advisory Committees
- Open Listening Sessions
- Needs Assessments
- Use Surveys

Brief explanation.

The Dean of the College of ACES [Dr. Robert Hauser] and the Associate Deans for Research [Dr. Neal Merchen] and Extension [Dr. George Czapar] interact frequently and significantly with a number of stakeholders, both individual and organizational, external to the College of ACES. Key stakeholders include groups both within Illinois and across the nation. In general, stakeholders include individual producers, commodity organizations, state and federal legislators, academic and corporate partners, and other individuals and organizations within the University of Illinois.

The Dean and the Associate Dean of Research 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 representing a broad cross-section of interests. The development, corporate relations, and public engagement offices in our colleges and on campus also play a significant role in identifying and engaging with stakeholders.

In ABE input is sought from faculty members who are in frequent contact with stakeholders. The departmental External Advisory Committee also plays an important role in identifying stakeholders. Attendance at regional, national, and international conferences [oftentimes by invitation] is another avenue through which stakeholders and their high-priority issues can be identified. In FSHN, a thirteen-member External Advisory Committee is established where members serve up to two three-year terms. Effort is made to represent all disciplines within the department [food science, human nutrition, dietetics, and hospitality management]. Faculty collaborations with members of industry, the federal government [USDA], and other academic institutions also influence the direction of Hatch projects. In NRES, faculty in human dimensions conducted meetings with community partners as well as social ties and event presence through these organizations. Networks from the National Great Rivers Research and Education Center, Illinois-Indiana Sea Grant and Illinois Water Resource Research Center have been utilized. Faculty members participate in national and statewide events and committees throughout the year in addition to contact with local organizations. Work with State of Illinois agencies, in particular the Illinois Department of Natural Resources, has provided funding opportunities in wildlife research. Wildlife researchers have also worked with local Audubon and Pheasant Forever groups.

Extension Advisory Council members and local Extension volunteers remain as keys to 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 meetings with community collaborators and key leaders who were both targets for input and for identifying 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. The Extension web development group has developed a volunteer client management system for contacting individuals and groups of stakeholders regarding program participation and input and also met with staff who would like to adopt and use the system in their county locations.

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

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

Brief explanation.

Specific interactions of the Associate Dean for Research/Director of the AES with stakeholders included: [1] Participation in the June meeting of the Illinois Agricultural Legislative Roundtable sponsored by the Illinois Farm Bureau; [2] Meetings and a presentation to the Board of the Illinois Soybean Association; [3] Meeting with the Advisory Committee of the Dixon Springs Agricultural Center, the largest off-campus research and education center of the College of ACES; [4] Meeting with the Advisory Committee of the Dudley Smith Research Program [an endowed research program in sustainable agricultural production; members of the Advisory Committee include prominent leaders of the agricultural community in central Illinois]; [5] Participation in the annual Dudley Smith Field Day with approximately 60 producers; [6] Collaboration with the Illinois Corn Growers Association and the Illinois Council on Best Management Practices in preparation for submission of a grant proposal to the NRCS Regional Conservation Partnership Program; [7] A visit to the Illinois Department of Agriculture and meeting with the Director; [8] Participation in the annual Illinois Commodity Conference; [9] A significant amount of time invested in the cultivation of corporate partnerships in 2014 [major contacts and significant discussions occurred with Dow AgroSciences, ADM, General Electric, Monsanto, Kraft Foods, and Alltech]; [10] Participation in meetings of the NC Region AES Directors in April, July, and September; [11] Arranging and hosting a visit of the Executive Director of the NCRA to the Illinois AES; and [12] 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.

In DNS, the divsion meets with an established External Advisory committee annually. In Crop Sciences, input is collected through a State Advisory Committee as well as through frequent communication with commodity groups, industry, community colleges, and high schools. In NRES, methods utilized in 2014 included telephone meetings related to the Biomass Market Access Standards Group, work with public health agencies and mosquito abatement districts, contact with local wildlife preservation groups, and discussions with commercial entomology and crop protection/pest management professionals as well as agricultural biotechnology company representatives. In ABE, methods included direct interactions between faculty and stakeholders, invitations to provide input through the publication of departmental newsletters, invitations to professional, technical, and social events hosted by ABE, and through an established External Advisory Committee.

As mentioned previously, 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. Staff in a few units initiated more formal methods to seek input that included key informant interviews and invitations to attend meetings designed to seek input. Community and Economic Development Extension Educators assisted with survey distribution and analysis that yielded information about needs that Extension could address by developing educational responses. In addition, the majority of Extension programs included end-of-program 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 Action Plans
- To Set Priorities

Brief explanation.

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

In FSHN, External Advisory Committee input is used during strategic planning, which informs priorities for the department. In DNS, recommendations are received through a report from their EAC annually and the division reports back on their progress the following year. 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 is also used to evaluate current programs within teaching, research and Extension as well as providing a guideline for trends that impact course content for undergraduate and graduate students.

Extension staff members were once again encouraged to involve Extension Council members in reviewing, and if warranted, revising the three to five priorities to be reflected in a FY14 multi-county plan of work. Input through program evaluation responses has been used 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 programming 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.

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 associates, and colleagues from other Midwestern land-grant institutions to gain a better understanding of 'land-grant mission' research needs. There continues to be strong local support and interest in work conducted at the off-campus research and education centers, 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 that resulted in the compilation of an initial report entitled 'A Consensus Report of Illinois Agricultural Producer Leaders and University Agricultural Research Administration'. The report recommended that the Illinois agricultural sector should to develop a future-focused priority agricultural research agenda. A subsequent step in the process was to conduct a survey of producers in Illinois to identify farmer-centric areas of research needs to advance the agricultural enterprise. Research needs identified in this survey fell into five broad categories: [1] Improve [reduce] the environmental impact of agriculture in Illinois; [2] Advance crop genetics; [3] Improve nutrient management strategies; [4] Expand market opportunities for Illinois agricultural products; and [5] Development of new products from Illinois commodities.

The process of futuring Illinois agriculture has further evolved into a more statewide strategic planning exercise that incorporates both the Chicago Community Trust and many of our longstanding and emerging partners in charting future scenarios for development of the Illinois food and agriculture sectors. The Illinois AES and Extension are players in this process.

For NRES, the BMAS group determined that development of standards for agriculture is costly, and technically difficult, but is being driven by government policy. Standards are inevitable so academics need to transfer as much knowledge as possible to reduce costs. Findings from one research project will lead to collaboration with seed industry representatives during the 2015 field season. For ABE, it was learned that stakeholders continue to be very interested in research addressing the pressing societal issues in agriculture, food, energy and the environment. Stakeholders continued to express support for their partnership with ABE and recognition for faculty contributions in addressing the issues that are important to them as well as looking forward to continuing to work with the department's top-ranked undergraduate and graduate programs. Stakeholders of FSHN reported that consumer-driven research will be important in the future, particularly around issues of sustainability in the agricultural sector, that the integration of food, nutrition dietetics and hospitality management will be critical to the future, and that training in the food and nutrition sciences is important as many current pressing problems relate to the production of healthy foods and human health and nutrition outcomes. DNS stakeholders stressed the need to focus on issues relating to nutrition regulatory affairs, involvement with Cooperative Extension activities, and international opportunities.

Extension stakeholders who serve as Extension volunteers remain strong supporters for the 4-H Youth Development program and 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. Volunteers who completed a statewide volunteer survey in 2012 indicated that Extension does important work and recognizes that staff both support and appreciate the contributions of volunteers. 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 they are becoming more comfortable with it over time]. They are also interested in and willing to support efforts to increase public awareness of Extension's educational offerings as evident in the establishment of Publicity and Promotion Specialists positions in several Extension multi-county units.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
9728012	0	6940619	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	4920542	0	7073338	0
Actual Matching	4920542	0	7073338	0
Actual All Other	39507390	0	39549131	0
Total Actual Expended	49348474	0	53695807	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	4920542	0	3867262	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Agricultural And Biological Engineering

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management	20%		10%	
133	Pollution Prevention and Mitigation	5%		10%	
141	Air Resource Protection and Management	35%		10%	
401	Structures, Facilities, and General Purpose Farm Supplies	10%		20%	
402	Engineering Systems and Equipment	15%		15%	
403	Waste Disposal, Recycling, and Reuse	5%		10%	
404	Instrumentation and Control Systems	0%		15%	
405	Drainage and Irrigation Systems and Facilities	10%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.0	0.0
Actual Paid	0.0	0.0	3.2	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**
9841	0	442256	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
9841	0	442256	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
79015	0	1152255	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities in 2014 included an ongoing project with a focus on improving the efficiency of liquid agricultural chemical application systems [through the development of a real-time droplet size monitoring system for low-pressure field sprayers], the development of a novel handheld impedance analyzer system for use in animal health applications, continuing work to develop a framework and methodology for collecting information and evaluating field-based supply chain logistics, an effort to characterize the emissions from livestock buildings [with a focus on particulate matter emissions] and to develop integrated technologies to reduce emissions from livestock buildings [with a focus on biofilter technology], research findings indicating that drift reduction technologies can be successfully used to apply sprays containing both dicamba and glyphosate [the differences seen indicate pattern width/uniformity might be more of an issue than droplet size], work relating bioreactor performance to both air and soil temperature [the temperature of the water in the bioreactor is a function of both the air and soil temperatures which are not necessarily correlated], and a recent study 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.

Conference presentations included the South African Sugar Research Institute, John Deere Technology Innovation Center, South African Institute of Agricultural Engineers, American Society of Agricultural and Biological Engineers, Certified Livestock Manager Training Workshops, North Central Weed Science Society Annual Meeting, Water Environment Federation, and the International Congress of Pesticide Chemistry/American Chemical Society National Meeting.

Extension activities related to this planned program are interdisciplinary in nature and relate to other planned programs featured in this report [Sustainable Energy, Natural Resources and the Environment, and Animal Health and Production]. A great deal of effort was devoted to education focused on livestock manure management through eight statewide **Certified Livestock Manager Training** workshops that covered not only the basics of nutrient management, but also new technologies, current research and emerging 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 [**http://web.extension.illinois.edu/lfmm/manure.html**] registered more than 400,000 page views this past year and consists of several sections that included: [1] **Certified Livestock Management Training** and **Illinois Manure Management Plan** materials designed to help

livestock producers in developing manure management plans to more efficiently and safely use manure as a fertilizer [the website allows customizing the plan to meet a given producer's needs and facilitates any required annual updates]; [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** for individuals with less than 300 animal units; [4] **EZregs** for users who have established accounts to store their questions and Extension educator 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 of livestock manure, food scraps, and yard waste. Additional training was provided for custom manure haulers in Illinois, with certification and testing provided on a voluntary basis.

With respect to farm equipment education, a total of 15 **Operation S.A.F.E. Fly-In** seminars were conducted in Illinois and nine other states by an Extension pesticide safety education staff member to ensure that aerial applications of fungicides to corn are accurately applied and encompassed information related to spraying equipment. The three regional **Crop Management Conferences** included a presentation by an agricultural engineering Extension Specialist on calibrating sprayer quality requirements for pesticide applicators.

One of the Commercial Agriculture Extension Educators presented information and demonstrations of unmanned aerial vehicles [drones] and their potential use in crop scouting and management to 1,180 participants at 17 educational events this past year.

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 37,000 page views of the **Agriculture Safety and Health** website.

2. Brief description of the target audience

Members of the target audience included researchers, the agricultural chemical [herbicide and fertilizer] industry, chemical application equipment manufacturers, students and researchers in the areas of biosensors and nanotechnology applied to agriculture, agricultural engineers, environmental consultants, researchers in the livestock industry, animal scientists, livestock producers, agriculture consultants, livestock commodity group representatives, undergraduate students in agricultural and biological engineering, aerial applicators, commercial and private ground rig applicators, pesticide adjuvant manufacturers, farmers, crop scouts, turf grass applicators, pesticide registrants, drainage contractors, wastewater treatment facility staff, wastewater treatment equipment providers, regulators, environmental scientists, and environmental engineers. 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

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	716	1400	3276	0

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

Patent Applications Submitted

Year:	2014
Actual:	2

Patents listed

Issued Patents: 8,602,329 [Variable Orifice Nozzle] and 8,712,144 [System and Method for Detecting and Analyzing Features in an Agricultural Field].

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	21	21

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2014	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Number Of Subsurface Bioreactor Acres In Illinois

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Implementation Of Global Engineering Solutions Using Agricultural Machinery

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	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. 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 be able to implement global engineering solutions concerning agricultural machinery.

What has been done
During visits to China, South Africa and Italy, the PI was able to strengthen contacts with university institutions and with industry. A visit to South Africa and particularly the South African Sugar Research Institute [SASRI] was valuable in obtaining a fresh perspective about global engineering relative to agricultural practices at both the large and small scale. Potential research

collaborations related to data analytics are currently being explored with linkages to both SASRI and the University of KwaZulu-Natal.

Results
Two graduate students completed their theses addressing topics concerning the mapping and analysis of agricultural machinery operations. These projects were undertaken in collaboration with the John Deere Technology Innovation Center. In addition, the PI has discussed with colleagues the establishment of a laboratory focusing on data analytics for precision agriculture. The PI has also connected with companies that provide tools for agricultural information management and these are currently being installed and commissioned. These tools will be used for research associated with this project and for teaching.

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 #3

1. Outcome Measures

Improved Understanding Of The Environmental Impact Of Anthropogenic Nanoparticles On Photosynthetic Cyanobacteria

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One of the salient features of biological, agricultural and environmental applications of nanotechnology is that the nanoscale devices and systems are of the same size-scale as biomolecules. While the size similarity offers unique and powerful routes to directly manipulating biomolecules, the increased application of nanotechnology raises concerns about potential unintended interactions and consequences between nanoparticles and living systems. In our research program we focus on the environmental impact of anthropogenic nanoparticles on an

important group of bacteria, viz. photosynthetic cyanobacteria. These organisms convert solar energy to simple sugars and are primary producers in most aquatic ecosystems. We will develop novel analytical capabilities as well as experimental methodologies to quantify the risk associated with various nanoparticles on the growth and photosynthetic capabilities of cyanobacteria. The results of our work will be published not only through scientific publications and professional meetings, but also through the web, where we will develop tools to engage broader citizen participation for addressing concerns and questions pertaining to nanotechnology in the environment.

What has been done
Activities included the development of devices and systems incorporating microfabrication and nanotechnology, the development of a novel handheld impedance analyzer system for use in animal health applications, the development of a framework for economic, environmental and health risk assessment for nanotechnologies applied to food, agriculture and biological systems, and the development of mathematical models to understand ecological and evolutionary interactions in ecosystems subjected to nano[bio]technological intervention.

Results
Our group produced education and outreach materials on nanofabrication, sensing, systems integration and application risk assessment as well as mathematical models to illustrate dynamic systems properties in ecosystems perturbed with nano[bio]technological agents.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems

Outcome #4

1. Outcome Measures

Utilizing Biofiltration To Mitigate Amonia Emissions From Livestock Buildings

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Biofiltration is recognized as an effective technology to mitigate ammonia emissions from livestock buildings. Biofilters are bioreactors that can absorb ammonia and then oxidize it into nitrite and nitrate-using microorganisms. Woodchips and composts are often used as packing materials, thus making it an affordable method. This study focuses on improving the basic biofilter engineering designs [media selection and airflow resistance measurement], ammonia removal efficiency, and the effect of moisture on nitrous oxide generation. We conducted studies of various biofilter media, especially airflow characteristics linking particle size distribution, moisture content, condensation, and other factors. Physical and chemical properties and airflow resistances of eleven commonly-used biofilter media, including ten organic and one inorganic, were characterized. The density, porosity, particle size distribution, pH, total C, total N, and organic matter content of each material were analyzed using standard methods. The airflow resistance properties were tested on a large chamber. Based on the observations of moisture, bed thickness, and compaction effects on air flow resistance, an empirical equation was developed and can be used as an initial database for future biofilter designs.

What has been done

Ammonia removal of biofilters was studied in relation to moisture content and pH condition of target organic media. A baseline test was carried out to examine ammonia removal efficiency and nitrification kinetics at extreme conditions. The results suggested that nitrogen compound management is critical in achieving stable and high ammonia removal efficiency. Moisture is believed to be the most important factor in determining biofilter performance. It affects both ammonia mitigation and nitrous oxide generation. It was found that ammonia removal efficiency was improved when media moisture content was increased from 35% to 55%, but further increasing moisture content did not enhance ammonia mitigation but did increase nitrous oxide generation. Nitrous oxide generation from biofilters was also researched, and was related to organic media moisture content, pH condition, and microbial communities. In-depth understanding of the ammonia removal process, as related to moisture content and pH condition of organic media, was obtained. Due to the research, we can better predict ammonia removal based on media moisture content, pH condition, and ammonia loading history.

Results

Based on the results of moisture effects on biofilter performance, it is critical to manage the moisture content in the biofilter media. A moisture sensor was developed to control the moisture content in biofilter media in order to achieve high ammonia removal efficiency and low nitrous oxide generation in this project. We have an improved algorithm for the biofilter design process based on media airflow characteristics, particle sizing, and moisture content control.

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
403	Waste Disposal, Recycling, and Reuse
404	Instrumentation and Control Systems

Outcome #5

1. Outcome Measures

Developing Novel Processes That Are Cost-Effective In 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
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This project focuses on the removal of emerging contaminants [such as pharmaceuticals, steroids, surfactants, and plasticizers] that have been detected in wastewater discharges from various human and livestock sources. According to the Union of Concerned Scientists 70% of total annual antibiotics used in the U.S. [11,200 tons] are used for non-therapeutic purposes with cattle and swine, and a significant fraction [up to 75%] is excreted in an unaltered state. When released into the environment, these bioactive chemicals can exert selective pressures on microbial communities and cause them to develop antibiotic resistance as a defense mechanism. Antimicrobial drug resistance has become a major concern with an estimated economic impact of $4 to $5 billion. A significant number of studies have been done on the removal of pharmaceuticals and antibiotic resistance in drinking water and wastewater, and while some removal of pharmaceuticals has been observed in conventional wastewater treatment processes, most are not effectively designed to remove micropollutants. Thus, there is a critical need to better understand the fate, transport, and transformation of these 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 recent work 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 that have deleterious biological effects. Specifically, we showed that the aqueous organic mixture produced by HTL exhibited mammalian cell cytotoxicity with a LC-50 at a dilution of 7.5% and also showed inhibitory effects on anerobic bacteria and algae. Subsequently, we showed that biological treatment with algal bioreactors can effectively capture/remove a variety of organic contaminants and reduced mamallian cytotoxicity by 30%. Integrating adsorbents into bioreactors treating HTL wastewaters can improve the performance. 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 the net energy production for integrated systems providing both bioenergy production and wastewater treatment.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Optimization Of Sprayer Performance With A Focus On Drift Reduction

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In order to optimize sprayer performance both efficacy and drift need to be considered. Many applicators, particularly aerial, are looking to reduce their application volumes to increase their productivity. In addition, many of the pesticides currently used in crop protection are contact or locally systemic products. These products require increased coverage in order to be effective. Lower spray application volumes and less systemic pesticides both require the use of smaller droplet sizes in order to maintain efficacy. Even systemic products have experienced efficacy issues in recent years, likely because of poor coverage and deposition associated with the use of large drift-resistant droplets. Due to glyphosate resistant weeds, dicamba and 2,4-D resistant crops are expected to be commercially available within the next several years. These two herbicides will likely require a smaller droplet size than glyphosate in order to be effective. The need for a smaller droplet spectrum to provide effective coverage will increase the risk of these products drifting off target. Benefits of low volume aerial applications include increased productivity and timelier applications.

What has been done

The final year of drift reduction nozzle and adjuvant testing for dicamba-glyphosate applications was completed. As with last year, the research was conducted on a population of glyphosate resistant waterhemp. In addition to the nozzles and adjuvants, this year's study included the use of a pulse width modulation system. Results indicate that drift reduction technologies can be successfully used to apply sprays containing both dicamba and glyphosate. The differences seen indicate pattern width/uniformity might be more of an issue than droplet size. Another study of aerial fungicide applications to corn was conducted, and soybeans were added as an additional crop.

Results

Data confirms previous studies that show that the use of an oil-based adjuvant can help improve the efficacy of the applications. Also completed was a study to determine the effects of cutting off nozzles at the ends of the booms on agricultural aircraft. Two variables were measured: downwind drift deposit and total swath width. A system using a laser and radar was developed to record the speed and height of aircraft for research projects. It uses bluetooth technology to transmit data to a tablet computer. This technology will also be used for spray pattern testing clinics.

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 #7

1. Outcome Measures

Developing, Updating, And Using A Manure Management Plan

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	151

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Improper manure management has environmental consequences. 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, certification and testing programs were conducted for custom manure haulers. Operators who haul and apply manure to cropland for hire are not regulated in Illinois, but through collaboration with other Great Lakes states a voluntary training and certification program is provided that helps these individuals 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 8 sites across the state. This state program requires livestock and poultry producers to attend training and become certified once every 3 years. The curriculum includes key information on best management practices, nutrient management information, and updates on regulations and associated information. [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's] for producers that are actively using conservation practices and implementing the latest best management practices.

Results
[1] The Illinois Manure Management Planner website received 14,147 accesses, with 77 new accounts created and 74 plans updated and/or modified. [2] Twenty-six 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 26 individuals completed and passed the Level 2 examination for custom applicator certification. [3] One hundred eighty-one [181] individuals attended the Certified Livestock Manager Training programs. According to the survey data, 82% of attendees responded that they currently had manure management plans. Of these respondents, 46% updated and used their plan annually.

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

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 can be assumed that of the 9,164 participants in this year's training, 6,020 [65.7%] improved calibration procedures [frequency, accuracy, and measurement], 4,930 [53.8%] improved equipment maintenance [inspecting, cleaning, and replacing worn nozzles], and 4,838 [52.8%] improved changing of the type, size, or materials of the nozzles used as a result of attending the training.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Agricultural And Consumer Economics

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management	0%		5%	
602	Business Management, Finance, and Taxation	15%		10%	
603	Market Economics	0%		15%	
604	Marketing and Distribution Practices	10%		10%	
605	Natural Resource and Environmental Economics	0%		10%	
606	International Trade and Development Economics	0%		10%	
607	Consumer Economics	50%		15%	
610	Domestic Policy Analysis	0%		15%	
801	Individual and Family Resource Management	25%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.0	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**
98411	0	562011	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
98411	0	562011	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
790147	0	3426703	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities in 2014 included completion of a major project that compared household finance between U.S. households and Chinese households with special attention to the impact of mandatory saving for housing, a study with the objective of analyzing the allocative efficiency, productivity, and output of the U.S. agricultural sector over the last 30 years using farm-level data, research focused on community-support agriculture and liability for biotechnology, issues of genetic technology and food security, agro-environmental issues, and on food and FDA regulations from an international law perspective, ongoing progress toward understanding farm programs and providing communication, education, and outreach to farmers about programs in the farm bill [for conservation, progress has been made towards understanding a specific new program called the Regional Conservation Partnership Program and some educational efforts have begun through web-based articles and discussions included in meeting presentations], the development of new features in MarketMaker that will allow researchers to better study the business interactions of produce growers, research findings suggesting that the impact of Dodd-Frank on agricultural producers, and on agribusiness entities that deal directly with producers, may be much smaller than previously estimated, work with the intent of measuring the impact on economic outcomes of policy changes and new technologies in the food and agricultural system [outcomes measured are factors of central importance and include poverty rates, producer incomes, consumer welfare, economic growth, and environmental quality], an analysis of the Demographic and Health Services [DHS] data for Malawi and Mozambique to assess the effect of Malawi's fertilizer subsidy program on child health outcomes, and research focusing on examining the riskiness of energy crop production for farmers and the impact of farmer risk and time preferences on their willingness to grow energy crops.

Conference presentations included the American Economics Association, American Council for Consumer Interests, Eastern Economic Association, Urban Affairs Association, American Real Estate and Urban Economics Association, Conference on Empirical Legal Studies, Association for Education in Journalism and Mass Communication, Agricultural and Applied Economics Association, Northeast Agricultural and Resource Economics Association, 19th Congress of the International Academy of Comparative Law, Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, Food Distribution Research Society, National Value Added Agriculture Conference, International Crops Research Institute for the Semi-Arid Tropics, National Agricultural Credit Committee, Chicago Federal Reserve Agricultural Conference, and the Purdue University Top Farm Crop Workshop.

Extension specialists conducted the annual **Illinois Tax Schools** held in 30 locations in the state and five regional **Illinois Farm Economics Summits.** The summit presentations addressed farm profitability outlook and management challenges from several perspectives, including the outlook for prices, farm

income prospects and crop rotation decisions, trends in farmland prices and rents, renewable fuels policy and crop markets, the new farm bill, and health reform. In addition, four **FAST** [**Farm Analysis Solution Tools**] training workshops dispersed throughout the state included a one-day hands-on experience using Crop Insurance Decisions and Balance Sheet as well as other risk management tools. Understanding the risk factors affecting farm financial strength was 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 10-15 college student interns each semester in providing financial educational outreach to college students through Facebook, tweets, YouTube, an e-newsletter with 1,200 subscribers, and a six-session webinar series entitled **Get $avvy: Grow Your Green Stuff** focused on helping college students to manage their finances [and that also provided a recorded option that received 531 clicks]. Work continued on revising and updating **All My Money**, a train-the-trainer curriculum for working with limited resource audiences. Other outreach included the **Plan Well, Retire Well** blog and e-newsletters and **America Saves** conducted during America Saves week that involved 373 participants in a friendly competition format that challenged them to set a savings goal. **Master Money Mentors,** a volunteer program that matched 51 trained volunteers' with 67 mentees who have sought help with basic money management, was also initiated this year in two counties [discussed in the evaluation section of this planned program].

Other program delivery addressed financial security in an electronic world, estate planning, long-term care financing, health insurance, credit scores, and investments. Staff and volunteers in 45 counties also 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 future income and expenses [discussed in more detail in the evaluation section of this planned program].

2. Brief description of the target audience

Members of the target audience included researchers in consumer economics, household finance, and behavioral finance, policymakers, academics in the agricultural economics and food and nutrition circles, producers, food manufacturers, restaurants, practicing lawyers and academic lawyers in the U.S. and abroad, government regulatory agencies, farmers, processors and retail distributers of agricultural products, private firms with agricultural interests, Extension professionals, the crop insurance industry [agents and companies], the farm credit/banking industry, USDA officials, landowners, community groups, producer organizations, schools in the state of Illinois, graduate and undergraduate students, leaders in agricultural finance and members of institutions involved in providing credit to agricultural interests, farm managers, financial managers in the agricultural investment community, agricultural lenders, academic economists, and agricultural production students. 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 Extension staff members are members of the Financial Security for All Community of Practice.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	13875	14238	3942	0

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

Patent Applications Submitted

Year: 2014

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	33	33

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2014	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Page File Requests Made To Farmdoc

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	11400000

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 is 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 2014 well over 11 million page requests and over 2.5 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 a few 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
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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	320908

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The main goal of this program is to disseminate soybean production research results on a varietal basis to soybean producers, academic researchers, and the agricultural industry. The VIPS database and website is unique in that it makes public information on production performance of soybean varieties planted throughout the state. The information is updated at harvest each year giving users details on yield, disease, and insect and pest resistance as well as key quality results such as protein and oil quantities and even amino acid profiles. This information is valuable to researchers as well as to consumers. For soybean producers, it is a tool that allows them to make a more informed decision on what varieties to plant next season.

The research done for the Varietal Information Program for Soybeans [VIPS] website provides a widely-accessible tool for soybean producers, researchers, and industry members to access current information about the performance of a wide selection of soybean varieties produced in Illinois. The VIPS website has investigated communication technologies and information modes for soybean producers, researchers, and industry members to access critical information about varietal performance in different regions. VIPS has also served as a rapid access tool for users to evaluate seed choices for their locations and conditions. Evaluation of the usage and

effectiveness of the VIPS tool is provided annually by soybean producers, researchers, and industry members.

What has been done
A newly designed VIPS website, www.vipsoybeans.org, was developed and refined. New reports were added and updated. The key to this redesign was incorporating information from discussions with users to make the interface easier and more approachable for the busy soybean producer. A mobile phone application for VIPS was also created as a result of discussions with soybean farmers and others in the agricultural industry on how they best access information. Having this new mobile portal allows users quicker access to the site regardless of their access to a computer. Now growers can visit VIPS throughout the year whether they are home or in the field.

Increased emphasis was placed on highlighting the importance of quality traits in the soybean crop and the role varietal selection plays in achieving critical quality targets, especially for our export customers. Results of testing done on samples for protein and oil levels and even more information on the amino acid profiles found in the soybean samples are included. Tying all of this to value is also important and incorporating and updating the EPV [estimated processor value] figure in VIPS is another newer addition to the program.

Additional work and refinement to the VIPS redesign was accomplished making the website even easier to utilize and more visually appealing. Continued communication and promotional efforts connect the VIPS tool to soybean producers and industry representatives through communication pieces, presentations, and displays at industry meetings. Highlights of the soybean quality information located in the VIPS database were a focus of many communication and outreach efforts.

Results
The VIPS program has evolved to become more user friendly and more versatile through the website renovation and the new addition of the VIPS App. The program has been demonstrated at a number of industry meetings to showcase the redesign and the usability of the updated reports. A number of presentations were also developed and delivered to soybean producers as well as consumers from Illinois and around the world. As a result of the VIPS site, soybean producers have a unique one-stop tool that provides updated information on soybean variety yield, disease and insect resistance, value, and quality traits. In an environment where growers have to make challenging decisions on what varieties to invest in, they need the best information available on how these varieties have performed to help them in their decision making process. Thousands of users visit the VIPS website each year, not just from Illinois, but from around the world to learn more about the options in soybean varieties and to access information on soybean diseases, insects, pests, and weeds. This is truly a valuable on-stop location for anyone interested in soy production and quality.

Protein and oil data were also added to the VIPS database, allowing users to correlate varieties with their protein and oil content. We saw an increased interest in farmers visiting these data indicators.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
603	Market Economics

604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics

Outcome #3

1. Outcome Measures

Number Making Decisions To Reduce Risk In Agriculture Production

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Percentage Increase In Post-Farm Gate Business Registrations For MarketMaker

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Exploring Government's Influence 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
2014	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 government's 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.

What has been done
During this reporting period, we finished a major project that compares household finance between U.S. households and Chinese households, with special attention to the impact of mandatory saving for housing. Unlike credit expansion through the banking sector in Western economies, many Asian economies promote homeownership through savings and loan programs called housing provident funds [HPFs]. We also examined whether and how HPFs affect homeownership in China. We found that since discounted loans became available in 1998, households with double enrollments in the program increased their homeownership by 38 percentage points, and those with single enrollment increased by 14 percentage points.

Results
The findings suggest that HPF programs could be an effective policy tool for national governments to promote housing consumption. We compared and contrasted the homeownership promotion policies in China and the United States and found that the HPF in China, a self-sufficient savings and loan program, provides strong incentives to save for housing by mandating monthly pre-tax payroll deductions and matching employer contributions. In addition, it provides favorable financing options with low interest rates and low down payment requirements. The credit risk for HPF loans is relatively low given that HPF loans are employment-based and depend on previous deposits made by borrowers. All these features make the HPF an appealing alternative to mortgage credit expansion through lax lending standards as used in the U.S. in the period leading up to the Great Recession.

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 #6

1. Outcome Measures

Impact Of Payday Loan Regulation On Reductions In Crime Rates

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2014 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Household financial behaviors may have unexpected side effects on society. For instance, inappropriate use of credit may lead to financial distress that motivates crime behaviors. Research was conducted to study whether payday loan regulation can reduce crime in neighborhoods where payday loans used to be prevalent.

What has been done
Using the passage of the Illinois Payday Loan Reform Act, which restricted the loan amount, fees, terms, and number of concurrent loans, we found reduced property crimes in Chicago following the regulation yet no change in crimes without direct financial motivations. The property crime reduction was the most salient in median-income neighborhoods.

Results
The findings suggest that payday loan restrictions have alleviated the financial distress for payday loan consumers, especially those who had alternatives to payday loans. To further understand the financial decision making process for households and individuals, we also conducted research to investigate the fundamental factors contributing to individual differences in financial management behaviors. Drawing evidence from a sample of young adults surveyed by the National Longitudinal Survey of Adolescent Health, we have found that non-cognitive abilities such as personality traits affect individual's financial management behaviors.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

Impact On Economic Outcomes Of Policy Changes And New Technologies

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Work under this project is intended to measure the impact on economic outcomes of policy changes and new technologies in the food and agricultural system. Outcomes to be measured are factors of central importance to broad groups of people and include poverty rates, producer incomes, consumer welfare, economic growth, and environmental quality. Responding to the increasingly international nature of the food economy, the research considers policy and technology in the U.S. and abroad as changes abroad affect producers and consumers in the U.S., and also because the welfare of people in developing regions abroad is of both strategic and humanitarian interest to the people of the United States.

What has been done
Work in this project has been initiated along multiple intersecting tracks. To date, the bulk of the accomplishments have involved the collection of data and initiation of field experiments to measure impacts as well as the generation of new knowledge. Concerning impacts of agricultural technology, project members have established field sites in five countries where they will collect field-level data from precision farming operations in order to better determine economically-optimal fertilizer application rates. Various changes in production technology may be related to environmental issues including deforestation and bee colony collapse, both of which have feedbacks to producers and require collective action to address.

Results
Our work to date has developed models for understanding the role of collective action in addressing these issues and gathering data to better understand the dynamics involved. On the theme of animal agriculture, researchers have gathered and analyzed data on livestock development in Zambia and its effects on consumers and producers in that country. We have also continued to analyze trade and import refusals in seafood, fish, and other animal products as an important issue for both consumers and producers in the U.S. Much of the work on impacts of technology and animal agriculture intersects with work on food security and poverty. Thus, our group has developed and tested methods for measuring food security and changes in vulnerability to malnutrition and has documented the impacts of policy changes in China, technology in multiple settings, and growth in animal agriculture in Zambia on these food security measures.

4. Associated Knowledge Areas

KA Code	Knowledge Area
603	Market Economics
604	Marketing and Distribution Practices
606	International Trade and Development Economics
607	Consumer Economics
610	Domestic Policy Analysis

801 Individual and Family Resource Management

Outcome #8

1. Outcome Measures

Exploring The Decisions Facing Investors In Second Generation Biofuel Production

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Our research on investment in second generation biofuel [cellulosic ethanol] production capacity in the U.S. has focused on the decision facing potential investors. The decision to invest in building a cellulosic ethanol facility involves a number of risks and uncertainty which provide incentives to delay the investment decision until a later date, despite required blending or use levels outlined by federal biofuel policy in the U.S. These uncertainties include those associated with: [1] The emerging technologies used to produce cellulosic biofuels; [2] The underdeveloped markets for biomass feedstocks; and [3] Policy uncertainty which can directly affect the value of cellulosic biofuel.

What has been done
We have developed a real options model to analyze the investment decision in the face of these uncertainties. Our findings confirm and support the lack of investment activity in the industry given current conditions, and suggest that without additional policy support or a major technological breakthrough leading to cost reductions, investment will continue to be delayed for a number of years. In terms of policy analysis, existing policies such as loan guarantee programs are shown to be relatively ineffective in encouraging investment activity.

Results
While government support for research could speed investment if a technological breakthrough is achieved, it also has the effect of delaying investment until that breakthrough is achieved. Rather than external government policy, we have found that production cost reductions driven by 'learning effects' which are internal to a firm have the biggest effect in terms of increasing the speed of investment decisions.

4. Associated Knowledge Areas

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

Outcome #9

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
2014	1183

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 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 initiated this year. Fifty-one [51] volunteers were recruited to serve as Money Mentors and received 18 hours of in-person training. Following the mentor training the volunteers completed a program improvement evaluation which has been used to adjust the training and to identify perceptions of what mentors learned regarding money management and assisting others to do so. The program's impact on mentors knowledge and confidence follows [it should be noted that a revision of the mentee evaluation plan and tools is in process and results will be gathered after mentees' completion of the program and included in the 2015 Annual Report].

Annually Extension field staff members provide Welcome to the Real World training and curriculum materials for teachers and a simulation for their middle and high school students that allows them to explore careers and money management [balancing income and expenses] in

adult life. The simulation allows students to start with a monthly income and visit various booths to spend their income on items typically found in a family budget such as housing, utilities, food, transportation, insurance, and child care. Youth then complete an evaluation following the simulation.

Results

Using a 4-part scale with 1=Strongly disagree and 4=Strongly agree, 45 Money Mentors completed an evaluation that included questions regarding knowledge change and increased confidence in working with mentees. With respect to knowledge gained, 34 of the 45 mentors [3.76 average group score] indicated they strongly agreed that they had increased their confidence in their ability to gather necessary financial information from a participant during meetings. Twenty-nine of the 45 [3.62 average group score] strongly agreed that they increased their ability to read credit reports with a participant and calculate a budget/spending plan, surplus or deficit. Twenty-eight of the 45 [3.62 average group score] strongly agreed that they increased confidence in their ability to listen and understand someone's financial concerns. Additional results can be found in the evaluation section of this planned program.

At the end of the Welcome to the Real World simulation, evaluation forms were completed and collected from 1,703 youth participants located across Illinois. The evaluation was designed to identify increased knowledge of financial management. The evaluation asked students to evaluate five money management skills choosing between 'Learned how to do' or 'Already knew how to do'. Of the 1,693 youth respondents, 1,138 [67.2%] indicated that they learned at least one of the five skills with the largest number reporting learning how to balance income and expenses.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Money Mentors Evaluation

At the completion of the newly implemented **Money Mentors** 18 hour training, 45 volunteer mentors completed a program evaluation designed to assess what they learned regarding money management and assisting others to do so. The following statements are listed in the order of group average scores.

I have confidence in my ability to listen and understand someone's financial concerns [3.76 group average score].

I have confidence in my ability to gather necessary financial information from a participant during our meetings [3.62 group average score].

I have confidence in my ability to read credit reports with a participant [3.62 group average score].

I have confidence in my ability to calculate a budget/spending plan, surplus or deficit [3.62 group average score].

I have confidence in my ability to mentor a client with developing and implementing a personal savings plan [3.58 group average score].

The program training prepared me for determining someone's financial concerns [3.58 group average score].

The program training increased my understanding of debt reduction strategies [3.58 group average score].

The program training prepared me for engaging program participants about tracking expenses [3.58 group average score].

I have confidence in my ability to construct SMART goals with a participant [3.51 group average score].

I have confidence in assisting a participant to pay down their debt [3.52 group average score].

I have confidence in my ability to manage a client meeting in a timely manner [3.49 average group score].

I have confidence in my ability to assist a client with taking control of their money [3.49 average group score].

The program trained me to discuss and establish SMART goals with families and individuals [3.49 average group score].

I have confidence in my ability to communicate with participants who are in financial distress [3.42 average group score].

I have confidence to be a Money Mentor Volunteer [3.42 average group score].

I have adequate resources as a Money Mentor to help county residents [3.40 average group score].

The program training adequately prepared me to help someone fill out a money management calendar [3.31 average group score].

The program training prepared my understanding of how to refer participants to local resources [3.04 average group score].

With respect to program improvement suggestions, a decision was made not to include a requirement to complete a related website. Other suggestions included various viewpoints on scheduling the training and several regarding more role playing and practice exercises. A wide range of additional topics was also suggested by the volunteers with several mentioning more information on community resources.

Welcome to the Real World Evaluation

At the end of the **Welcome to the Real World** simulation, evaluation forms were completed and collected from 1,703 of the 4,375 youth participants located across Illinois. The evaluation was designed to identify increased knowledge of financial management. The evaluation asked students to evaluate five money management skills choosing between 'Learned how to do' or 'Already knew how to do'. Of the 1,693 youth respondents, 1,138 [67.2%] indicated that they learned at least one of the following five skills.

857 [50.6%] reported learning how to balance income and expenses.

735 [43.4%] learned how to open a savings account.

644 [38.0%] gained skill in keeping track of savings.

637 [37.6%] learned how to balance a checkbook.

315 [18.6%] 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', 819 [52%] of the 1,572 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. The level 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.

665 of 819 [81.2%] indicated increasing their awareness or knowledge of the relationship between education and money.

586 of 819 [71.6%] of the students indicating increasing their awareness or knowledge of the relationship of a job and money.

384 of 819 [46.9%] of the students indicated increasing their awareness or knowledge of the importance of getting more education after high school.

Key Items of Evaluation

Money Mentors

Money Mentors agreed or strongly agreed that they gained confidence in their ability to help mentees who seek help with basic money management, especially regarding: [1] Listening and understanding someone's financial concerns; [2] Gathering financial information from the mentees during a meeting; [3] Reading a credit report with a mentee; [4] Calculating a budget/spending plan, surplus or deficit; and [5] Mentoring a client with developing and implementing a personal savings plan.

Welcome to the Real World

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	10%		15%	
305	Animal Physiological Processes	0%		10%	
307	Animal Management Systems	20%		10%	
311	Animal Diseases	5%		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: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.0	0.0
Actual Paid	0.0	0.0	10.3	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**
24603	0	1131374	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
24603	0	1131374	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
197537	0	9587312	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities in 2014 included results suggesting that microneme secretion is a target that could be exploited for development of new drugs for the treatment of not only cryptosporidiosis but also other serious apicomplexan diseases such as toxoplasmosis, an exploration of how epithelial immunity may affect fly attractiveness in heifers, work to identify a minimally-invasive, easy-to-perform, and efficient means of providing pain management to piglets undergoing painful agricultural practices such as castration and tail docking, work demonstrating that an in vitro embryo production [IVP] technology can be utilized across two distant country borders, research with the goal of improving the quality of stover so it can be used as a forage replacement for feedlot cattle without impacting performance, a study with the goal of improving fertility when using frozen semen [resulting in increased use of cryopreserved boar semen for improving genetic merit and reducing potential for disease transmission], an effort to determine the effects of overfeeding energy on gene expression in mesenteric [MAT], omental [OAT], and subcutaneous [SAT] adipose tissue [AT] from nonpregnant and nonlactating Holstein cows, an exploration of the role of the first milk [colostrum] on the interaction between a balanced microbial population in the intestinal lumen and activation of the intestinal immune system in the neonatal animal [our aim was to make a positive impact on the management of newborn animals in terms of nutrition, prevention of infectious disease, and welfare], and studies to develop an average in vivo MRI-based atlas specific for the 4-week-old piglet and probabilistic tissue classification maps.

Activities also included a close examination of individual dietary macronutrients and other components known to affect microbial-derived fermentative metabolites and/or barrier function in growing pigs, the development of several diagnostic tools [dynamic light scattering and surface-enhanced Raman spectroscopy] that have the potential to reduce poultry morbidity and mortality as a result of early detection of avian influenza viruses, the finding that oral immunization may be the most efficacious PEDV immunization modality at this time, especially with regard to the production of milk antiviral antibody levels, work to educate poultry producers about the feeding of spray-dried bovine plasma protein on laying hen performance when exposed to high environmental temperatures, an effort to better understand the nutritional, metabolic, genetic, and endocrinological differences among animals [this will aid in the determination of why certain animals are more feed efficient than others and allow producers to manage beef cattle production systems in a manner that minimizes feed consumption relative to output], an analysis of gene expression in the anterior pituitary of two strains of silver foxes with different levels of stress reactivity and identification of significant differences in expression of genes involved in the regulation of HPG between the two strains [these finding provide a novel insight into the molecular mechanisms involved in the regulation of behavior and reproduction], the development of results demonstrating that ingestion of a hypercaloric, high-fat diet had significant effects on gut morphology and function in Ossabaw gilts, work to identify the factors and signaling pathways that are involved in the

cross-talk between the oocyte and the ovarian granulosa cells, research to improve our understanding of the impact that bacterial strain has on the inflammatory response to Lipopolysaccharide in horses, significant progress in research efforts aimed at defining the mechanism[s] by which porcine reproductive and respiratory virus [PRRSV] is able to inhibit the host interferon [IFN]-alpha response, and a project with the goal of developing needed reagents that could be used to evaluate equine sera for their immunoglobulin response to vaccination with a newly created modified live Streptococcus equi subsp. equi vaccine.

Conference presentations included the American Society of Animal Science, International Veterinary Emergency and Critical Care Society, Dudley Smith Summer Field Day, Farm Progress Show, Charolais Association, Orr Beef Research Center Field Day, Beef Quality Assurance Trainings, Driftless Area Beef Conference, Heart of America Grazing Conference, Beef Sire Selection and Management Seminar, Illinois Performance Tested Bull Sale, Jo Daviess County Beef Producer Meeting, Southern Illinois Cow Calf Conference, Illinois Cattle Feeders Meeting, Pike County Beef Association Meeting, Illinois Forage Institute, Midwest Animal Science Meeting, American Dairy Science Association, Canadian Society of Animal Science, Research Workers in Animal Disease, Beef Improvement Federation, Genes, Brain and Behavior Meeting, Association for Behavior Analysis, Society for Molecular Biology and Evolution, Symposium on Gut Health in Production of Food Animals, Illinois Dairy Summit, Four State Dairy Nutrition and Management Conference, and the 13th National Veterinary Scholars Symposium.

Two key programmatic thrusts characterize Extension livestock production outreach: increasing reproductive efficiency and reducing livestock production input costs. Two Extension educators located in research stations provided leadership for a number of programs that focused on beef production, such as statewide **Beef Quality Assurance** certifications, **Sire Selection and Management seminars**, the **Illinois Performance Tested Bull Sale** and **Illinois Beef Exposition**, the **Illinois Cattle Feeders meeting**, the **Illinois Forage Institute**, and the **Driftless Area Beef Conference** with the latter attended by participants from four states [Illinois, Iowa, Minnesota and Wisconsin]. Other local and regional programs included pasture walks, research farm field days, and regional **Cow/Calf Seminars**. Educational workshops for sheep and goat producers were offered in the southern and northeastern part of the state. Three **Dairy Summit meetings** were held throughout the state for dairy producers and included presentations on feeding strategies for 2014, transitioning with efficiency and calf management. 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. **Certified Livestock Manager Training Workshops** targeted at manure management are examples of programs that were delivered by Extension staff to audiences at campus and off-campus sites.

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 include the state **Dairy Quiz Bowl**, regional and state **Horse Bowl/Hippology** and speech contests. The Extension faculty specialist in poultry taught teachers how to use the curriculum and incubators for the 4-H chick incubation and embryology project in 191 classrooms that included 12,161 youth during the 2013-14 school year [see 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 and swine covering topics related to care and administration of medicine for livestock. It is worth noting that 4-H members raising dogs and rabbits are now expected to complete the training and quiz.

2. Brief description of the target audience

Members of the target audience included academic, medical, veterinary, industrial and professional

scientists and clinicians, entomologists, veterinary scientists and large animal veterinarians, feed companies, livestock producers, farmers, research scientists, reproduction companies, Extension agents, animal scientists, swine veterinarians and members of the swine production industry, poultry producers and researchers, breed associations, beef cow-calf producers, national and international dairy goat farmers, dairy nutritionists, and research scientists working on viral diseases of swine. 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, community leaders, and youth.

3. How was eXtension used?

Five Extension staff members 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

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	488	5013	16001	0

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

Patent Applications Submitted

Year:	2014
Actual:	1

Patents listed
TF 11130-US [Soybean-Based Porcine Reproductive and Respiratory Syndrome Virus Vaccine And Methods for Making and Using the Same].

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	40	40

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2014	12

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Increased Knowledge Of Livestock Care And Management

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	4155

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 management] that enhance producers profitability while providing quality meat products for consumption. Illinois has a number of areas where land is more conducive to grazing animals than row crop production. These areas are primarily located in southern and western Illinois. Other areas and production units are challenged when grain prices are high and producers must adjust production management accordingly. Humane care of animals is a concern as is a safe food supply.

What has been done
Illinois has historically offered a number of Extension-sponsored beef production programs held annually to address issues facing beef producers and to share the latest research being carried out at the University of Illinois. In anticipation that moderating grain prices will likely allow profits to again return to cattle feeding, 38 cattlemen and farmers attended the annual Illinois Cattle Feeders Meeting held at a community college in northern Illinois in March of 2014. The one-day program featured five university and industry experts who shared information on strategies to maximize profits in cattle feeding. At the end of the program an evaluation was distributed and returned by 35 attendees. A summary of their responses follows.

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 combines 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

All thirty-five [92% of the 38 attendees] who completed the evaluation of the Illinois Cattle Feeders' Meeting indicated that their knowledge regarding feeding cattle increased and also felt that the content of this conference met their expectations. On a scale of 1-4 [four being 'A Lot' as high], respondents rated the topics that were covered at the meeting. Approximately two-thirds of the 35 producers checked that either they learned 'Quite a bit' or 'A lot' regarding: [1] The value of cattle manure to the grain farmer; [2] State and federal policy affecting beef production; [3] Improved livestock feeding facilities; and [4] Differences in cattle performance and manure value when looking at cattle fed out in lots, indoors, and in improved cattle feeding facilities. Nearly two-thirds described changes they planned to make in feeding, improving or adding new facilities, or in managing manure.

With respect to the required livestock ethics training, online module training records indicate that 4,120 youth were successfully certified in 2013-14.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Treating Forages Prior To Feeding To Improve Feeding Value

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Defining The Early Mechanisms Of Apicomplexa-Host Interactions

Not Reporting on this Outcome Measure

Outcome #4

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
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The most recent estimate of the economic impact of porcine reproductive and respiratory syndrome [PRRS] to the pork industry is $650 million dollars per year. Although not representative of the whole industry, the available data indicates that for the last four years the annual cumulative incidence of new PRRS infections in sow farms during the PRRS season is approximately 40-50%. None of the intervention strategies that have been tried to control PRRS outbreaks are adequate to deal with this costly disease. A likely reason for this is that the PRRS virus possesses unique properties that allow it to evade the immune system. A major feature exhibited by PRRS virus is the lack of stimulation of interferon [IFN]-alpha production. Thus, the aim of this project was to determine the mechanism behind the failure of PRRS virus to stimulate the production of IFN-alpha of porcine alveolar macrophages.

What has been done
We examined the ability of several wild-type PRRS virus isolates to stimulate porcine alveolar macrophages to secrete IFN-alpha. The host cell used in this study consisted of the porcine alveolar macrophage cell line ZMAC. The ZMAC cells are readily infected by PRRS virus and are fully functional with regard to the type I IFN signaling pathway, as evidenced by the fact that they produce large amounts of IFN-alpha in response to their stimulation with synthetic double stranded RNA, namely polyinosine-polycytidylic acid [polyI:C]. PolyI:C is a well known toll-like receptor 3 [TLR3] agonist that stimulates IFN-alpha production in myeloid and non-myeloid cells. While all of the wild-type PRRS virus tested failed to stimulate IFN-alpha production, a laboratory strain mutant termed 1198 exhibited the ability to stimulate copious amounts of IFN-alpha. Using a comparative approach, our experiments were focused on understanding the molecular basis of the IFN-alpha-stimulatory phenotype of 1198 strain and the lack of stimulation by the wild-type PRRS virus strains as well as two other laboratory strain that are nearly isogenic to 1198.

Results
In these studies the 1198 strain proved to further distinguish itself from all other PRRS virus strains in that, unlike all other strains tested, it stimulated the phosphorylation of IRF3 and induced type I IFN gene transcription. Extensive analyses revealed wild-type PRRS virus exhibits a novel mechanism of immune evasion that is missing in the 1198 strain. Using the PRRS virus strains that are nearly isogenic to the 1198 strain, we were able to determine that the mechanism of immune evasion was attributable to a unique mutation in the non-structural protein 2 [NSP2]. The role of the NSP2 mutation in the IFN-alpha stimulatory phenotype was confirmed by a revertant mutant of the 1198 strain, mutant 1198B [which had lost a unique amino acid change in NSP2].

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

The Development Of Tools To Investigate Developmental Origins Of Behavioral Problems In Pigs

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Environmental insults during sensitive periods can affect brain development and function resulting in animals that are less resilient to stress. However, the ability to investigate how insults affect brain development and function in pigs has been limited by access to tools for assessing brain structure and composition in vivo. For example, magnetic resonance imaging [MRI] can be a powerful tool to study neurodevelopment in piglets, but most MRI resources have been produced for adult humans.

What has been done
In studies completed this year we developed an average in vivo MRI-based atlas specific for the 4-week-old piglet. In addition, we developed probabilistic tissue classification maps. These tools can be used with brain mapping software packages [such as SPM and FSL] to aid in voxel-based morphometry and image analysis techniques. The atlas enables efficient study of neurodevelopment in piglets. Because piglets are a highly tractable translational animal with brain growth and development similar to humans, this tool is also of interest to the biomedical community.

Results

In follow up studies to assess the effects of early life infection on brain development, piglets were inoculated with PRRSV on postnatal day [PD] 7 and magnetic resonance imaging [MRI] was used to assess brain macrostructure [voxel-based morphometry], microstructure [diffusion tensor imaging] and neurochemistry [MR-spectroscopy] at PD 29 or 30. PRRSV piglets exhibited signs of infection throughout the post-inoculation period and had elevated plasma levels of TNF alpha at the end of the study. PRRSV infection increased the volume of several components of the ventricular system including the cerebral aqueduct, fourth ventricle, and the lateral ventricles. Group comparisons between control and PRRSV piglets defined 8 areas where PRRSV piglets had less gray matter volume, 5 areas where PRRSV piglets had less white matter volume, and 4 relatively small areas where PRRSV piglets had more white matter. Of particular interest was a bilateral reduction in gray and white matter in the primary visual cortex. PRRSV piglets tended to have reduced fractional anisotropy in the corpus callosum. Additionally, N-acetylaspartate, creatine, and myo-inositol were decreased in the hippocampus of PRRSV piglets suggesting disrupted neuronal and glial health and energy imbalances. These findings show in a gyrencephalic species that early-life infection can affect brain growth and development.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Our laboratory has characterized a subset of long-chain polyunsaturated fatty acids [L-PUFFA], isolated from bovine colostrum, which block in vitro Cryptosporidium parvum and Toxoplasma gondii host cell infectivity as well as both Toxoplasma gondii and Plasmodium gallinaceum infectivity in vivo. Our current studies addressing the mechanism of L-PUFA-mediated inhibition of infectivity have led to the hypothesis that L-PUFA block a conserved apicomplexan microneme secretion pathway that regulates parasite motility.

What has been done
Our results as well as others suggest microneme secretion is a target that could be exploited for development of new drugs for the treatment of not only cryptosporidiosis but also other serious apicomplexan diseases such as toxoplasmosis. To probe this hypothesis we have leveraged NC-1202 funding by partnering with Dr. David Sibley, Washington University School of Medicine, on an NIH grant entitled Designing Selective Inhibitors of Calcium-Dependent Kinases in Parasites. The goal of the University of Illinois portion of this project is to evaluate small molecule inhibitors of parasite-specific kinases belonging to the calcium-dependent protein kinase [CDPK] family. CDPKs are plant-like protein kinases that are not found in animal cells, yet they are expanded in apicomplexan parasites. Recent studies using molecular genetic and chemical biology approaches reveal that CDPK1 controls microneme secretion and that inhibition of this kinase leads to profound defects in parasite motility, invasion, and egress from host cells.

Results
The NC-1202 crypto project described above allowed us to leverage multistate funds to successfully compete for an NIH award. Subsequently, we also acquired funding in collaboration with Dr. Steven Beverley at the Washington University School of Medicine to examine the role of a recently-discovered symbiont RNA virus [Cryspovirus], found in all mammalian Cryptosporidium isolates, in the pathogenesis of cryptosporidiosis. One-year pilot funding for this project was obtained from the Midwest Region Center of Excellence for Biodefense and Emerging Infectious Disease Research. Using rt-qPCR, we have screened a relatively large number of proprietary CPDK1 inhibtors and CpV antivirals for their ability to inhibit either or both the growth [or host cell invasion] of Cryptosporidium and CpV replication. The results indicate a relatively small number of putative drugs are capable of blocking growth of Cryptosporidium or CpV replication; however, the drugs selected for additional study appear selective, non-toxic in vitro and able to block cryptosporidium growth in vitro at low to sub-micromolar concentrations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
305	Animal Physiological Processes
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #7

1. Outcome Measures

Demonstrating The Ability To Apply In Vitro Embryo Production [IVP] Technology Across Two Distant Country Borders

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
It has been previously demonstrated that Panama is applying the biotechnology of in vitro embryo production [IVP] into their bovine reproduction management systems. This present work demonstrates the ability to apply the IVP technology across two distant country borders. We have demonstrated that a country [Dominican Republic, DR] that does not have a bovine IVP lab can take advantage of fresh bovine IVP embryos for transfer using distant IVP facilities in another country [Panama, approximately 1,500 km away]. The objective of this study was to demonstrate that a model system for large-scale commercial in vitro bovine embryo production for beef and dairy producers that do not have IVP technology in their home country could be developed producing comparable results.

What has been done
Since the same laboratory provides IVP services to both countries, a special sanitary protocol was developed in order to legalize the exchange of biological materials [oocytes/embryos]. The data obtained in the Dominican Republic was compared to Panamanian client data because identical conditions were utilized for IVP. Cattle production systems were similar as Brahman [a Zebu type of cattle] is the most popular breed in both countries. Oocytes were collected from 10 different herds in Panama and 4 different herds in the DR. The oocytes were transported in a oocyte transporter in both instances. However, oocytes from the DR were transported in InVitro Brasil maturation medium from 12-18 hours and in Panama from 6-12 hours before they were placed in a standard CO2 incubator. In both cases the oocytes were matured for 24 hours before fertilization with conventionally frozen Brahman semen in InVitro Brasil fertilization medium followed by culture up to 7 days in InVitro Brasil embryo culture medium. The embryos were transferred on day 7, either in Panama or the DR. They were transported by car in Panama and via airplane back to the DR. A comparison of oocyte number and quality, cleavage, embryo production and pregnancy rate was made using the same in vitro production system for Brahman donors from September 2012 until May 2013. The difference between sites in the relative number of viable oocytes, relative number of cleaved oocytes among viable oocytes, relative number of embryos produced among cleaved oocytes and relative number of embryos produced among viable oocytes was tested using Fisher's exact test. Pregnancy rate was analyzed with X2.

Results
We realize that these results represent field data, however we believe the present work is a significant step in demonstrating the potential for wide commercial-scale dissemination of the IVP

technology between distant countries. The number of embryos produced in Panama was slightly but significantly higher than those produced in the DR but this is likely due to the larger number of donors and oocytes from the Panama herds. However, the pregnancy rate was higher in the DR likely due to the health status of the DR recipients. These data illustrate that in vitro embryo production using Brahman donors could be used as a tool to improve and spread superior genetics. Furthermore, this technique can serve as a model for other Central American and Caribbean countries under similar management systems.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #8

1. Outcome Measures

Determining The Effects Of Overfeeding Energy On Gene Expression In Adipose Tissue From Nonpregnant And Nonlactating Holstein Cows

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Our objective was to determine the effects of overfeeding energy on gene expression in mesenteric [MAT], omental [OAT], and subcutaneous [SAT] adipose tissue [AT] from nonpregnant and nonlactating Holstein cows.

What has been done
Eighteen cows were randomly assigned to either a low energy [LE, net energy for lactation NE[L] = 1.35 Mcal/kg of dry matter [DM]] or high energy [HE, NE[L] = 1.62 Mcal/kg of DM] diets for 8 weeks. Cows were then euthanized and subsamples of MAT, OAT, and SAT were harvested for transcript profiling via quantitative PCR of 34 genes involved in lipogenesis, triacylglycerol [TAG] synthesis, lipolysis, lactate signaling, transcription regulation, and inflammation. The interaction of dietary energy and AT depot was only significant for LPL, which indicated a consistent response

among the 3 sites. The expression of key genes related to de novo fatty acid synthesis [FASN] and desaturation [SCD] was upregulated by HE compared with LE. Other genes associated with those processes, such as ACLY, ACACA, ELOVL6, FABP4, GPAM, and LPIN1, were numerically upregulated by HE. The expression of lipolytic [PNPLA2 and ABHD5] genes was upregulated and the antilypolytic lactate receptor HCAR1 was downregulated with HE compared with LE. The putative transcription regulator THRSP was upregulated and the transcription regulator PPARG tended to be upregulated by HE, whereas SREBF1 was downregulated. Among adipocytokines, HE tended to upregulate the expression of CCL2, whereas IL6R was downregulated.

Results

Overall, results indicated that overfeeding energy may increase AT mass at least in part by stimulating transcription of the network encompassing key genes associated with de novo synthesis. In response to energy overfeeding, the expression of PPARG rather than SREBF1 was closely associated with most adipogenic or lipogenic genes. However, the transcriptional activity of these regulators needs to be verified to confirm their role in the regulation of adipogenesis or lipogenesis in bovine AT. Overfeeding energy also may predispose cows to greater lipolytic potential by stimulating expression of TAG hydrolysis genes while inhibiting signaling via hydroxycarboxylic acid receptor [HCAR1], which is a novel antilipolytic regulator. Our results do not support an overt inflammatory response in adipose tissues in response to an 8-week energy overfeeding.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

Reducing The Economic And Public Health Impacts Of Enteric Disease In Cattle

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Enteric disease represents an important source of economic loss to the cattle industry and raises significant public health concerns regarding antimicrobial use. The alteration of gut physiology and homeostasis relies on the modification of the complex interaction of host, microbial, and environmental factors.

What has been done
In this study we wanted to explore the role of the first milk [colostrum] on the interaction between a balanced microbial population in the intestinal lumen and activation of the intestinal immune system in the neonatal animal. Our aim was to make a positive impact on the management of newborn animals in terms of nutrition, prevention of infectious disease, and welfare. Previous studies exploring the impact of colostrum on the health of young animals have focused on its influence on systemic immunity.

Results
The results of this study show that colostrum plays a significant role in determining the number and type of bacteria that become established in the calf intestine. As we explore the management factors that may influence how this takes place, we anticipate being able to apply this work directly to young stock rearing systems. In view of the universal importance of colostrum on disease prevention, this work is likely to have universal benefits to animal health and production, and is likely to attract the interest of nutritional and pharmaceutical companies with a stake in young stock disease management.

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

Outcome #10

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Identification of the molecular sources of individual variation in response to the changing environment will provide a foundation for developing effective methods for the assessment of stress-related behaviors and the potential improvement of livestock through selection. Anterior pituitary is one of the key regulators of the hypothalamic-pituitary-adrenal [HPA] axis, a major neuroendocrine system involved in adaptation to stress, and the hypothalamic-pituitary-gonadal [HPG] axis, the system which is involved in regulation of reproduction and development. In the current project we analyzed gene expression in the anterior pituitary of two strains of silver foxes with different levels of stress reactivity and identified significant differences in expression of genes involved in regulation of HPG between the two strains. These finding provide a novel insight into the molecular mechanisms involved in the regulation of behavior and reproduction.

What has been done

Differential expression of genes between tame and aggressive fox strains was assessed using the DESeq2 v. 1.6.2 program. For each gene in the input data, DESeq2 returns the log2 fold change of that gene's expression levels compared between the two groups [here, tame and aggressive foxes], the base mean expression levels in read counts, and the p value to indicate significance. A total of 339 genes were differentially expressed between the two fox strains at p=0.05 with no adjustment for multiple comparisons. Using DESeq2, the list of differentially expressed genes was identified.

Results

Differential expression of several genes associated with the HPG system was identified. EGR1 [early growth response protein 1] showed lower expression in tame foxes [p = 0.003; a log2 fold change of -1.025]. EGR1 is a DNA-binding transcription factor which mediates regulation of follicle-stimulating hormone [FSH] and luteinizing hormone [LH] by the pulse frequency of gonadotropin-releasing hormone [GnRH] release. EGR1 expression is downregulated by the protein output of NAB2, which also showed differential expression between the tame and aggressive foxes [p = 9.833e-05]. As expected, NAB2 levels were higher in tame foxes [a log2 fold change of 1.2]. We also found differential regulation of the ACVR2A gene [p = 0.017, -0.564 log2 fold change; lower expression in tame foxes]. This gene codes for activin receptor type 2A, which binds activin A, activin B, and inhibin A. Activin is responsible for FSH biosynthesis and secretion, while inhibin inhibits FSH biosynthesis and secretion. The PER1 gene, which is involved in biological rhythms and regulation of the timing of the reproductive cycle, also showed differential expression between the tame and aggressive strains [p = 0.016, -0.806 log2 fold change; lower in tame]. These findings strongly indicate a link between selection for behavior and reproduction.

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 #11

1. Outcome Measures

Identifying The Factors And Signaling Pathways That Are Involved In The Cross-Talk Between The Oocyte And The Ovarian Granulosa Cells

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The overall goal is to identify the factors and signaling pathways that are involved in the cross-talk between the oocyte and the ovarian granulosa cells. We employed microarray-based gene expression profiling to identify genes that are expressed in the ovary prior to ovulation. We used the well-characterized rodent superovulation model in which oocytes are released from the follicle in a controlled time-dependent manner. We hypothesized that this unbiased approach will allow us to identify factors and signaling molecules that are involved in cell-cell communication between oocytes and ovarian granulosa cells immediately prior to ovulation.

What has been done
The microarray analysis uncovered approximately three hundred genes whose expression was significantly altered in the ovaries at a time that shortly precedes follicular rupture. Among these genes, we focused our studies on signaling molecules that might be potentially involved in oocyte-granulosa cell communication. We initially focused our studies on the role of endothelin 2 [ET-2], a potent vasoactive molecule, in ovarian function. The endothelin family of ligands is composed of three structurally-related isoforms: endothelin-1 [ET-1], endothelin-2 [ET-2], and endothelin-3 [ET-3]. While the temporal expressions of ET-1 or ET-3 do not change significantly during the ovulatory period, ET-2 is robustly induced in the ovarian follicles prior to follicular rupture.

To address the role of ET-2 in ovulation, we employed antagonists of endothelin receptors [AETRs]. We used AETR-A [BQ-123], a specific inhibitor of ETR-A, AETR-B [BQ-788], a specific inhibitor of ETR-B, and AETR-AB [bosentan], which inhibits both subtypes, ETR-A and ETR-B. In

superovulation experiments, each inhibitor was administered intra-peritoneally at 8 hours after hCG priming. Since the progesterone receptor is known to be critical for follicular rupture, in a subset of animals we also administered ulipristal acetate [UPA], a progesterone receptor modulator. The impact of these drugs on ovulation was assessed by counting the number of released oocytes at 18 hours following hCG injection. Whereas administration of UPA or AETR-A led to a statistically significant reduction [approximately 20%, $p<0.05$] in the number of released oocytes compared to the vehicle treated control group, similar treatment with AETR-B or AETR-AB resulted in a more severe decline in the rate of ovulation. We observed approximately 75-80% inhibition in oocyte release when either of these drugs was given only 4 hours before the time of ovulation. Endothelin receptor-dependent signaling, therefore, appeared to play a critical role in ovulation.

Results
We also performed a histological analysis of the ovaries of mice treated with AETR at 8 hours after hCG injection. Ovarian sections of vehicle-treated control mice showed numerous corpora lutea, indicating successful ovulation. In contrast, ovarian sections from AETR-AB-treated mice showed many unruptured follicles and only a few corpora lutea. These results indicated that the blockade of ETR effectively suppressed ovulation by inhibiting follicular rupture.

4. Associated Knowledge Areas

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

Outcome #12

1. Outcome Measures

Increasing Postpartum Reproductive Performance In Dairy Cows

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The 6 to 8 week period centered on parturition, known as the transition or periparturient period, is critical to the welfare and profitability of individual cows. Fertility of high-producing cows is compromised by difficult transitions. Deficiencies in either nutritional or non-nutritional management increase risk for periparturient metabolic disorders and infectious diseases, which decrease subsequent fertility.

What has been done

A primary factor impeding fertility is the extent of negative energy balance [NEB] early postpartum, which may inhibit timing of first ovulation, return to cyclicity, and oocyte quality. In particular, pronounced NEB during the first 10 days to 2 weeks [the time of greatest occurrence of health problems] is critical for later reproductive efficiency. Avoiding over-conditioning and preventing cows from over-consuming energy relative to their requirements in late gestation results in higher dry matter intake [DMI] and less NEB after calving. A pooled statistical analysis of previous studies in our group showed that days to pregnancy are decreased [by 10 days] by controlling energy intake to near requirements of cows before calving compared with allowing cows to over-consume energy.

Results

To control energy intake, total mixed rations [TMR] must be well balanced for metabolizable protein, minerals, and vitamins yet limit total DM consumed, and cows must uniformly consume the TMR without sorting. Dietary management to maintain blood calcium and rumen health around and after calving is also important. Opportunities may exist to further improve energy status in fresh cows. Recent research to manipulate the glucogenic to lipogenic balance and the essential fatty acid content of tissues is intriguing. High-producing cows that adapt successfully to lactation can have high reproductive efficiency, and nutritional management of the transition period both pre- and post-calving must facilitate that adaptation.

4. Associated Knowledge Areas

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

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

At the end of the **Illinois Cattle Feeders** state meeting in Northern Illinois an evaluation was distributed and returned by 35 of the 28 attendees. Participants were asked to rate their level of learning for each topic by selecting from four choices: 'Nothing new', 'A little bit', 'Quite a bit', and 'A lot'. All 35 of those who answered the question indicated that their knowledge increased 'Quite a bit' or 'A lot' with respect to at least one topic. Ratings for the meeting topics follow and are listed in order of the number of individuals who checked either 'Quite a bit' or 'A lot'.

23 of 34 [68%] learned quite a bit or a lot about the value of cattle manure to the grain farmer.

23 of 35 [66%] learned quite a bit or a lot about state and federal policy affecting beef production.

22 of 35 [63%] learned quite a bit or a lot about improved livestock feeding facilities [question and answer session].

21 of 33 [64%] learned quite a bit or a lot about differences in cattle performance and manure value when looking at cattle fed out in lots, indoors, and in improved cattle feeding facilities.

18 of 32 [56%] learned quite a bit or a lot about management strategies to improve manure issues on the farm.

11 of 32 [34%] learned quite a bit or a lot about evaluation of different protein sources in corn silage based rations.

Nearly two-thirds [23 of 32] of the cattlemen described changes they planned to make. Nine listed planned changes in feeding [new rations or alternate sources]. Eight referenced improvements to existing facilities or adding new facilities [buildings, tube shelters, sprinkler systems, concrete lots]. Five planned to take action with respect to manure management [handling, utilization, and exploring new options]. Other changes mentioned included looking into wind breaks, EQUIP funding, contemplating expansion, and more thorough close-out analysis.

Key Items of Evaluation

All 35 participants in the **Illinois Cattle Feeders' Meeting** 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 value of cattle manure to the grain farmer, state and federal policies affecting beef production, and improved livestock feeding facilities. Nearly half of the cattlemen plan to apply what they learned with respect to manure handling, facilities, and feeding cattle.

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	10%		0%	
608	Community Resource Planning and Development	35%		35%	
802	Human Development and Family Well-Being	5%		25%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	10%		10%	
805	Community Institutions 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: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.0	0.0
Actual Paid	0.0	0.0	0.7	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
797128	0	124009	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
797128	0	124009	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
6400197	0	835622	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities in 2014 included a study that contributes 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], ongoing work under a project with the goal of 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, an examination of how low-income African American families cope with food insecurity, work demonstrating that rural lesbian and bisexual mothers with low incomes are not readily identifiable as sexual minorities in rural communities [many have a salient sexual minority identity while being either single or in heterosexual relationships; this methodological finding can inform future efforts to study diversity among lesbian and bisexual families], an examination of how racial socialization influences early emotional and behavioral development in African American families [the study emphasizes the role social support plays in fostering successful early educational and labor market trajectories among second-generation immigrant youth in the U.S.], research that questions whether maternal stress and depression mediate the relationship between maternal work hours and early child development, and an effort to identify the types of challenges that leaders encounter and the strategies experienced leaders used to address these challenges.

Conference presentations included the Ecological Society of America, Illinois-Indiana Sea Grant, Lincoln Park-Milwaukee Estuary Outreach Advisory Group, West/East Lakes Joint Meeting of the Association of American Geographers, 21st Annual Critical Geography Conference, National Great Rivers Research and Education Center Intern Symposium, Work and Family Researchers Network Conference, Society of Longitudinal and Life Course Studies, and the Ohio Youth-Led Prevention Network.

Extension activities include a wide variety of methods and focus on community participatory planning, organizational development, community economic development, and community leadership development and education.

Participatory community planning education in 2014 included continuing work to assist communities in developing, implementing, and/or updating 16 action plans, often assisting with needs assessment surveys, public meetings, goal formation, and implementation monitoring that successfully involved diverse participants and stakeholders. Various processes were used to work on municipal, county, and regional issues and projects related to managing disasters, downtown/main street development, transportation, and economic development. Three of the planning processes provided an opportunity for a graduate student to

experience and assist with the processes through the **Community Matters** program, a partnership between University of Illinois Extension and the University of Illinois Department of Urban and Regional Planning aimed at addressing local issues and designing a plan that fits locally-defined objectives.

Extension Educators engaged in a myriad of programs related to economic development. A number of Educators used the updated curriculum **On the Front Line for Customer Service** to educate employees of businesses, agencies and government entities, and students on customer service best practices. **Age Matters** was expanded this past year to a four-part module program addressing generational values and historical information that helps build participants' skills in working with consumers, employees and volunteers. The **Social Media for Businesses** curriculum was uploaded to the web as an online version to give small business owners the flexibility they need to access the information. Staff members have also provided assistance in helping individuals plan for starting or sustaining small businesses. **Buy Local: A Sustainable Communities Initiative** continues to be delivered via presentations to elected officials, community leaders, and residents and through a two-day classroom experience involving an interactive 'shopping simulation' that reached 625 youth this past year.

Building Entrepreneurial Communities continued to be a focus associated with economic development and workforce preparation. In addition, Extension Educators were actively involved in community groups focused on supporting and recognizing entrepreneurial activities**.** One example of such activities is the **Entrepreneurial Support Network of West Central Illinois.** Several counties have formed and supported youth activities that include 4-H youth group projects, two week-long camps, and presentations on designing entrepreneurial businesses. The **Living the Dream** program is being developed and piloted and focuses on fostering youth creativity and entrepreneurship.

Extension Educators have also been actively involved in interdisciplinary efforts focused on supporting youth workforce development. Working with their 4-H Youth Development colleagues they have facilitated opportunities to bring community colleges, schools, and business leaders together to identify and address youth workforce issues, sponsor youth career 'expos', conduct career-related camps, and provide presentations to high school workforce preparation classes. This past summer Extension Educators in Community and Economic Development led a team of Educators including 4-H Youth Development Educators to engage youth in a statewide grant-funded study to determine the economic impact of county fairs.

Community leadership development programming included continued support for five youth or adult **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 continued to be delivered, led by leadership teams of student and adult advisory planning groups. Leadership programming for public officials and leaders included the **Illinois Budget Policy Toolbox** statewide webinars that addressed Illinois' fiscal situation and solutions presented by faculty members from the Institute of Government and Public Affairs.

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], professionals working with mothers in the process of divorce [including family court judges, family law attorneys, parent educators, and health care providers], low-income residents receiving urban gardening assistance, low-income and minority communities experiencing environmental remediation in nearby rivers, community-based organizations and institutions, families, policymakers, researchers who study adolescence and youth programs, practitioners who run youth programs, and intermediary organizations that teach and support these practitioners. Community leaders, business leaders, agencies and organizations, and local government officials involved in community and economic development are key Extension target audiences that are

large in scope. Other target audiences include residents interested in starting small businesses and youth.

3. How was eXtension used?

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

V(E). Planned Program (Outputs)

1. Standard output measures

2014	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: 2014

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	4	4

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2014	1

Output #2

Output Measure

- Number Of Community Plans Developed, Adopted, Or Adjusted Through Community Resident

Engagement

Year	Actual
2014	16

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Number Of Individuals Reporting New Leadership Roles and Opportunities Taken

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

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 help in identifying strategies to engage residents in managing the rapidly-changing social and economic landscape.

What has been done
Several Community and Economic Development Extension Educators used a variety of processes to assist community leaders and residents in developing, implementing, and/or updating 16 action plans using a variety of processes to take charge regarding the future of their municipality, county, or region.

Results
Educational assistance was provided to nine municipalities that included the following actions: [1] Initiating a new comprehensive planning process that involved surveying residents and holding community meetings that focused on downtown/main street areas. In two locations, Extension's Community Matters program included faculty and students from the University of Illinois Department of Urban and Regional Planning who through their academic degree capstone project gained experience in supporting these community planning processes. [2] Assistance was also

provided for residents to develop action plans related to specific municipal projects for establishing local food gardens and a parks plan. [3] Progress on implementing another city's strategic plan encompassed the creation of a historic preservation district and ordinances, establishment of an Economic Development Commission, development of a Tax Increment Finance [TIF] District and securing two grants [$86,000 total] to create a virtual incubator and a community website.

With respect to the four county-wide planning processes, two counties engaged residents in the development of a strategic plan, and an additional two counties addressed the required annual progress review toward meeting county Hazzard Mitigation plan goals. Both of these Hazard Mitigation plans were in their final stages and one will initiate a new planning process order to seek funding to complete the unfinished goals.

Three regional planning processes included two focused on transportation planning [one in Southwestern Illinois and one in the West Central area with the latter using the Community Matters student involvement format] and a third associated with the USDA Rural Development Stronger Economies Together [SET] which focuses on developing a regional economic development plan that builds on unique assets and regional strengths [this process was initiated in a region encompassing 11 counties in Southeaster Illinois]. To date, 68 community leaders and residents have been involved.

4. Associated Knowledge Areas

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

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Number Of Community/Organization Programs/Activities Initiated

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number Of Jobs Created By New Businesses

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Examining How Low-Income African-American Families Cope With Food Insecurity

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Based on qualitative data collected on child health and well-being, we examined how low-income African-American families coped with food insecurity. This research allowed us to explore the experiences of and processes for managing food insecurity, thereby expanding on quantitative measures of food insecurity that focus only on the existence and severity of food insecurity. In response to gaps in the literature, we also examined the ways that households configured these strategies.

What has been done
The experience of food insecurity was common in our sample. The majority of households experienced periods of food insecurity and food security. Food management strategies fell within food-based, network-based, and institution-based categories. Participants used multiple strategies within and across all three categories. We distinguished between core and supplementary strategies and detailed how caregivers combined these two types of strategies in diverse ways.

Results
Our findings theoretically nuance discussions of food insecurity by introducing the concept of resilience. We detail the specific strategies used in response to the adversity of food insecurity, as well as their effects. With few exceptions, most studies downplay caregivers' active stance and the psychological benefits of some food management strategies. Caregivers expressed pride in their coping efforts, particularly food-based strategies that required planning and decision making skills. Our data suggest that caregivers' management activities promoted feelings of efficacy and control, positive self-esteem, and hopefulness. Even in households that used crisis-oriented strategies, reliance on supportive kin for instrumental aid and expressions of emotional support may have buffered households from a greater sense of despair in the absence of this assistance.

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 and Social Services
806	Youth Development

Outcome #8

1. Outcome Measures

Identifying The Types Of Challenges That Leaders Encounter And The Strategies Experienced Leaders Used To Address Them

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2014 0

3c. Qualitative Outcome or Impact Statement

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

What has been done
We completed data collection with 26 leaders of 14 programs for middle school-aged youth. This included four 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 in the Pathways sample [who led programs for high school-aged youth]. The two samples of programs come from the same three regional locations and have a similar range of content [leadership, arts, and STEM]. The two samples are also similar in ethnicity and serve approximately the same ethnic and SES mix. These additional leader interviews double 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
Adolescents' Development of New Skills for Prospective Cognition: Learning to Anticipate, Plan and Think Strategically. We published an article that describes adolescents' development of skills for strategic thinking and for anticipating possible scenarios in a plan and formulating flexible plans that take these into account. 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 leaders provide support that facilitate youth learning to anticipate the particularities of the contexts and people involved in reaching a goal and learning general 'meta' concepts and strategies that apply across situations, such as formulating plans that take uncertainties into account.

Why Youth's Trust in Program Leaders Matters. We sought to understand the processes through which youth's 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 youth's confidence in leaders' guidance in program activities; [2] Increased youth's motivation in these activities; [3] Increased youth's use of leaders for mentoring on personal issues; and [4] Provided a useful model of a well-functioning relationship.

The Art of Restraint: How Program Leaders Use their Authority to Support Youth's Agency. In the youth development field, it is often assumed that a strong inverse relationship exists between

adult leaders' exercise of authority and youth's 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 youth's agency and skills for agency.

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 and Social Services
806	Youth Development

Outcome #9

1. Outcome Measures

Knowledge Gained Regarding Buying Locally

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	625

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Revenue is declining in many rural communities and is affected by many factors related to overall state and national challenges, as well as local challenges to sustain economies, such as the loss of businesses which in turn affect unemployment rates and out-population migration.

What has been done
In an effort to assist local residents, community leaders, and elected officials in understanding the importance of 'buying local' in sustaining both their local economies and Southern Illinois as a whole, a University of Illinois Extension Community and Economic Development Educator

completed a Retail MarketPlace Profile Study of the sixteen-county Southern Illinois region in the fall of 2012 using data obtained from ESRI Business Analyst to compare an analysis of consumer spending and business revenues resulting in a retail gap. The analysis indicated that a $272 million net leakage for Southern Illinois existed in contrast to retail surpluses in the sections of neighbor states bordering Illinois. Accompanying the leakage are corresponding losses in sales tax revenues, retail sector jobs associated with those sales, and the multiplier effect lost which supports further retail sales in the market area.

The educator has continued to share this information by: [1] Making presentations [13] to community groups to disseminate the study results; [2] Making personal visits with key community groups, leaders, and elected officials; and [3] Conducting two-day school classroom shopping simulations that reached approximately 625 youth. The Buy Local: Sustainable Communities Initiative program helps elected officials, community leaders, local residents and youth audiences in understanding the importance of buying local to the sustainability of local economies by helping program participants recognize how buying patterns impact their household, their community, their county and their state.

Results

As a result of a presentation, an Extension Educator was invited to address a county Women in Business organization that committed to officially undertake a local first campaign in the county. After developing marketing materials the organization officially launched their Keep It In The County - Think, Shop, and Buy Locally Fir$t campaign. With additional information, thoughts, and ideas from the educator, the organization members have made numerous presentations to other organizations and local governments in the county seeking support for the campaign. Success in increasing sales revenue has yet to be determined.

With respect to the Buy Local two-day school programs, posters made by the students on the second day provided visual evidence that the 625 youth learned through the 'shopping simulation' and discussion about the importance of recycling their monies in their home community.

4. Associated Knowledge Areas

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

Outcome #10

1. Outcome Measures

Number Of Those Gaining Knowledge Regarding Customer Service

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	67

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Consumers are smarter and more discerning than ever and are demanding great service. Skills in meeting the demands of customers are important for employees of private and public entities to ensure their employment, the health of their organization, and a thriving community.

What has been done
Programming to increase knowledge of customer service primarily focused on workforce development and retention has been a part of Extension's educational programming for many years. University of Illinois Extension Community and Economic Development [CED] Educators with the assistance of a part-time recent Department of Urban and Regional Planning graduate completed a comprehensive update of the ten-module program. The modules address: [1] The value of customer service; [2] Generational and cultural differences in customers' needs and wants; [3] Creating positive first impressions; [4] Elements of communication, verbal language, and body language; [5] Telephone and online service techniques; [6] Dealing with unhappy customers; and [7] Keeping customers happy. The format includes opportunities for practicing skills, discussions, and the creation of a personal development plan.

This revised On the Front Line for Customer Service curriculum was used by five CED Extension Educators in settings that included retail and public entity employees [restaurants, hospital and library staff, and community leaders]. An end-of-program evaluation was completed in four locations this past year by 67 respondents.

Results
On the Front Line program participants were asked to rate the usefulness of the information presented using a scale of 1-5 [1= Not at all useful, 2=Slightly useful, 3=Somewhat useful, 4= Moderately useful, 5=Extremely useful]. Fifty-nine [92.5%] of the respondents circled 'Extremely useful' or 'Moderately useful', and 4 [6%] circled 'Somewhat useful'. Only one indicated that the information was 'Slightly useful' and no one indicated 'Not at all useful'. The overall group average for usefulness of the information was 4.4.

The program participants were also asked to rate the amount of knowledge gained from attending the program using another 1-5 scale [1= None, 2=A little, 3=Some, 4= A good deal, 5=Very much]. Forty-nine [77%] circled 'Very much' or 'A good deal', and 13 [20%] circled 'Some'. Only two indicated their amount of knowledge only increased 'A little' and no one circled 'None'. The overall group average was 4.1

When asked what changes they plan to make, participants most frequently mentioned that they planned to consider needs and wants of others and making adjustments for personalities and age/generations. Others planned to focus on their own attitudes [such as staying positive, being kind, being courteous, and respecting others]. Several mentioned smiling more and improving communication. Some mentioned plans to acknowledge customers [a suggestion box, asking for feedback/sharing it, and keeping a file of complaints and complements]. Setting standards and policies were actions mentioned by managers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
805	Community Institutions and Social Services

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

On the Front Line for Customer Service program participants were asked to rate the usefulness of the information presented using a scale of 1-5 [1= Not at all useful, 2=Slightly useful, 3=Somewhat useful, 4= Moderately useful, and 5=Extremely useful]. Fifty-nine [88%] of the respondents circled 'Extremely useful' or 'Moderately useful', and 4 [6%] circled 'Somewhat useful'. Only one indicated that the information was 'slightly useful' and no one indicated that it was 'not at all useful'. The overall group average for usefulness of the information was 4.4.

The program participants were also asked to rate the amount of knowledge gained from attending the program using another 1-5 scale [1= None, 2=A little, 3=Some, 4= A good deal, and 5=Very much]. Forty-nine [73%] circled 'Very much' or 'A good deal', and 13 [19%] circled 'Some'. Only two indicated their amount of knowledge only increased 'A little' and no one circled 'None'. The overall group average was 4.1

When asked what changes they plan to make, participants most frequently mentioned that they planned to consider the needs and wants of others and make adjustments for personalities and age/generational differences. Others planned to focus on their own attitudes - staying positive, being kind, being courteous, and respecting others. Several mentioned smiling more and improving communication. Some mentioned plans to acknowledge customers - a suggestion box, asking for feedback/sharing it, and keeping a

file of complaints and complements. Setting standards and policies were actions mentioned by managers.

It is worth noting that increasing levels of future participation in this program are anticipated.

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
101	Appraisal of Soil Resources	2%		0%	
111	Conservation and Efficient Use of Water	10%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		10%	
205	Plant Management Systems	10%		0%	
216	Integrated Pest Management Systems	5%		0%	
501	New and Improved Food Processing Technologies	0%		10%	
502	New and Improved Food Products	0%		15%	
503	Quality Maintenance in Storing and Marketing Food Products	10%		5%	
603	Market Economics	3%		5%	
701	Nutrient Composition of Food	0%		5%	
702	Requirements and Function of Nutrients and Other Food Components	0%		5%	
703	Nutrition Education and Behavior	0%		10%	
704	Nutrition and Hunger in the Population	10%		10%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	20%		10%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	20%		10%	
806	Youth Development	10%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890

Plan	0.0	0.0	7.0	0.0
Actual Paid	0.0	0.0	5.7	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
654432	0	619860	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
654432	0	619860	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
5254483	0	1853116	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities in 2014 included research to determine if various commercially-available salts influence the rate of oxidation in fresh pork, a project that will develop and employ effective methods for the investigation of potent odorants [aroma-active compounds] in foods, food ingredients and various other complex materials, research that will address the following four questions: [1] What are the material conditions that reduce or reproduce household food insecurity?; [2] What are specific interventions that affect transitions into and out of household food insecurity?; [3] What are the spatial differences in food insecurity prevalence?; and [4] What is the anticipated impact of specific policy interventions?, a study with the overall goal of developing and field testing effective fortification technologies that are low-cost, easy to use, and that do not change feeding habits of populations in developing countries [in the Central American region iron deficiency anemia is a major health concern], a study conducted to determine the optimum conditions for combined treatments of ultrasound and mild heat to improve the microbiological safety of alfalfa seeds while maintaining satisfactory germination rates, an effort to model the effect of incorporating hydrolyzed protein into a formulation on the resulting sensory and physical characteristics of a high-protein snack system, and outreach programs designed 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.

Activities also included a study focused on leveraging the properties of legume protein nano-aggregates to disperse and stabilize fat soluble compounds such as lutein and vitamin D [besides enhanced dispersion, legume protein nanoparticles could add functionality to these vitamins by protecting them from the environment and offering enhanced bioaccesibility and bioavailability], research to improve the safety of Hispanic-style fresh cheeses, the development of a written protocol to reduce the incidence of cork spots and bitter pit in apple fruits, and the generation of high-quality draft genome sequences and genome maps for two Et strains which may promote the identification of virulence factors as well as determinants of host specificity [this is the first report of genome sequences for Et strains].

Conference presentations included the Center for Advanced Research in Drying, Institute of Food Technologists, American Society of Agricultural and Biological Engineering, First Workshop of the Molecular Basis of Fire Blight, XVI International Congress of Molecular Plant Microbe Interactions,

International Congress for Plant Pathology, XIII Weurman Flavour Research Symposium, Brookings Institution, Illinois Specialty Crops, Agritourism, and Organics Conference, and the Illinois Horseradish Growers Association.

Extension's food safety training for employees of establishments and volunteers that prepare or serve food to the public was delivered to nearly 300 individuals primarily through the following four programs: [1] The Illinois Department of Public Health five-hour **Refresher Course for Food Handlers** designed for food service sanitation managers who must maintain their certification every three years; [2] Food handling safety for food bank managers and staff members; [3] **Serve it Safely**, a food class for volunteers who serve food at fundraisers, community organizations, and family events; and [4] A two-hour workshop titled **From Garden Gates to Dinner Plates** that was attended by individuals who were interested in information about the Illinois Cottage Food Operation Law regarding low-risk foods that can be prepared in private homes and sold at Illinois Farmers Markets. New online and supplemental programs entitled **Yes, You Can--Preserve Food Safely** were conducted in a few locations in the summer. 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.

During this past year, six **Enhancing Specialty Food Safety** programs were offered to 130 specialty growers in Illinois and addressed safe food production and handling in order 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** [five regional-based meetings] that featured eight faculty presentations on the latest research concerning crop production, pest management, economics, and the interactions among them were attended by 779 producers and agricultural consultants. The multi-state **AGMasters Conference**, a two-day multidisciplinary conference, was attended by 169 who participated in one general session and 12 specialized sessions. **Regional Crop Management Conferences** were held in four locations in 2014 and were attended by 374 registrants. The primary audience was 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 the campus and at all the other University farms located throughout Illinois to showcase the results of research plots to producers.

The **Pest Management and Crop Development Bulletin** is an online series of articles [67 this past year] primarily posted throughout the crop-growing season [early April to mid-August] and additional times in the off-season to report on the current agricultural conditions based on pest management information provided by entomologists, agronomists, and plant pathologists. The 3,807 plant samples diagnosed by the **University of Illinois Plant Clinic** in 2014 were comprised of 771 client submitted plant samples, 1,300 phytosanitary inspection samples and 1,736 client-submitted soybean cyst nematode and corn nematode soil samples. Of this total 84% involved field crops and 35% involved fruit and vegetable crops. Pesticide safety education was conducted using presentations at numerous locations that resulted in 9,164 commercial pesticide applicator certifications and 1,318 private pesticide applicator certifications.

Statewide Extension conferences related to produce production included several multi-state conferences: the **Southern and Southwestern Tree Fruit Schools**, **Stateline Fruit and Vegetable Conference**, and the **Southern Illinois Commercial Vegetable School.** Additional Illinois state or regional conferences focused specifically on growing horseradish, small fruits, and strawberries. Extension also provided leadership for the **Specialty, Agritourism and Organic Conference** and distributed 20 issues of **Fruit and Vegetable News** approximately bi-weekly. Aspiring farmers and 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 began collected weekly fruit and vegetable prices from 11 farmers markets and posted them on a website created and shared by Kentucky Extension staff to help farmers [especially new farmers] to decide how to price their products. For a second 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 was offered to help people who have only a few acres learn ways that they can put them to use. One hundred ninety individuals [190] attended one of the four programs. In addition, a series of 13 weekly one-hour webinars directed at small farm owners or operators was offered in the winter of 2014 for 453 Illinois residents and 188 residents of 37 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 conducted 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** and **EFNEP** 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. Nearly 561,000 teaching contacts were made through the **SNAP-Ed** program and 48,148 teaching contacts were made through **EFNEP** this past year.

2. Brief description of the target audience

Members of the target audience included farmers and the fresh produce industry, food industry professionals who work with extruded snack and cereal products, Illinois horseradish growers and scientists as well as dieticians interested in phytonutrient research in horseradish, U.S. food producers, processors, ingredient manufacturers, and flavor companies, researchers in the fields of economics, public health, and nutrition, policy makers charged with improving the well-being of low-income Americans, program administrators overseeing food assistance programs, scientists at peer institutions, officials from USAID, food industry scientists, the international food and nutrition scientific community, members of the general public who have an interest in the delivery of nutrients and nanoencapsulation, supply chain personnel, farmers' market managers, and the U.S. dairy industry. Extension targeted youth, certified food handlers, and volunteers who serve food to the public, producers of food distributed through local systems, producers of commercial fruit and vegetable crops, producers of feedstuffs for livestock, certified crop advisers, and limited resource audiences that are food stamp eligible.

3. How was eXtension used?

Eight Extension staff members 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

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	88123	291668	32291	0

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

Patent Applications Submitted

Year:	2014
Actual:	6

Patents listed

TF 10182-US [Enhanced Fermentation of Cellodextrins and B-D-Glucose], TF 11160-US [Enhanced Cellodextrin Metabolism], TF 12192-US [Biosynthesis of Oligosaccharides], TF 13036-US [Stabilized Compositions and Methods of Manufacture], and TF 13045-PRO [Methods and Compositions for Utilizing Mixed Cellulosic Polysaccharides and Derivatives Thereof]. Issued Patents: 8,748,140 [Xylose-Fermenting Microorganism].

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	24	24

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2014	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Number Increasing Knowledge Of New Corn And Soybean Crop Management Techniques

Not Reporting on this Outcome Measure

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
2014	5625

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Over 1.9 million Illinois residents are considered food insecure, which means that 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. Those individuals must rely on charities to feed themselves and their families.

What has been done
University of Illinois Extension's Illinois 4-H program members with funding support from a local donor and the Illinois 4-H Foundation are working with the campus-based Illini Fighting Hunger group to expand efforts across the state to empower youth to end hunger in their communities. 4-H members planted community gardens, stocked food pantries, prepared community meals, provided weekend backpack meals, and promoted farmers markets.

Results
In 2014, the lives off 3,316 families in need were positively impacted through the Illinois 4-H Feeding & Growing Our Communities outreach program. Approximately 1,225 4-H youth and adult volunteers donated 8,300 hours of service to improve the lives of the 4,906 youth and 2,684 adults in those families. These volunteers included 193 4-H Teen Teachers who reached an additional 1,801 youth in 1,400 different families from 30 counties. This past summer 4-H

partnered with the Illini Fight Hunger campus initiative and packaged nearly 63,000 meals of soy-fortified rice casserole mix using soy textured protein from Illinois farms for distribution to families in need. In addition, more than 5,625 pounds of produce worth $10,621 was donated to local food pantries and other centers serving families in need. 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
2014	82

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. In 1999, the Food Service Sanitation Code required Illinois-certified food service sanitation managers to attend food safety training for a minimum of five hours or to complete a re-certification exam to be eligible for re-certification to serve food every five years. The required hours of training have recently been increased to eight [8] hours.

What has been done

Due to changes this year in food safety certification by the Illinois Department of Public Health, only five certification workshops on food safety [5-hour Refresher Course] were conducted this past year by an Extension Educator with nutrition and wellness assigned responsibility. Fifty [50] individuals involved in serving food to the public participated in these programs. In addition, 102 food bank managers and staff members who are involved in distributing food to those in need participated in the program [the program was adjusted to address their unique food handing safety challenges]. Also, more than 60 participated in the Serve it Safely program for volunteers, and 79 participated in the From Cottage Gates to Dinner Plates program focused on food safety related to Farmers' Market regulations.

A pre- and post-test consisting of eight multiple choice items focused on 2008 changes in the updates to the Illinois Food Sanitation Service code was distributed and collected from those in the certification course to measure knowledge change. Additional information and pre-test/post-test items were shared with food bank staff, volunteers, and those interested in selling items at farmers' markets. A follow-up assessment was collected from the Serve It Safely participants. A pre-post evaluation was also administered to those participating in From Cottage Gates to Dinner Plates.

Results

Impact on knowledge of food safety measured by pre- and post-tests scores from participants in the 5-Hour Refresher Course revealed increases in one or more of the eight food safety practices by all but one of 50 participants [98%]. Seventy of the 102 food bank staff members were able to answer at least one post-test question correctly that they were unable to answer correctly on the pre-test. Specific to maintaining proper temperatures of food, 36 [72%] of the Refresher Course participants learned the temperature range [danger zone] when food is most susceptible to the growth of bacteria that cause foodborne illnesses, and 35 [70%] indicated learning that ready-to-eat potentially hazardous foods can be stored in the refrigerator for no more than seven days.

Seventy percent of the respondents to the Serve It Safely programs indicated that they had changed their food handling procedures [most often their hand washing procedure and using a thermometer to check food temperatures]. For From Garden Gates to Dinner Plates 70 of the 79 participants [89%] indicated gaining knowledge of what food is permitted to be made for sale by a Cottage Food operation, labeling requirements, or were able to correctly identify a 'potentially dangerous hazardous food' after the program ended.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
806	Youth Development

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The overall goal is to develop and field test effective fortification technologies that are low-cost, easy to use, and that do not change feeding habits of populations in developing countries. In the Central American region iron deficiency anemia [IDA] is major health concern. Most populations in this region consume tortillas. Thus, fortification of nixtamalized corn for tortillas at the point of wet grinding could be an effective strategy against IDA in rural Central America. This alternative fortification strategy could be incorporated into local products used in emergency relief efforts by USAID. In this branch of the project we continued the development and characterization of an in situ fortification technology for nixtamalized corn tortillas.

What has been done

High Temperature Extrusion Process With External Fluid Delivery System for Creation of Fortified Pellets: An optimized extruded pellet containing high amounts of iron [either NaFeEDTA or ferrous bisglycinate] and made of corn and brown rice [1:1 w/w] was established. A S2 Welly puffing extruder with a single screw, barrel diameter of 41.2 mm, and a circular die hole of 3.1 mm at a rate of 65.6 g/minute was used. The initial temperature was 115 degrees C and increased to a working temperature of 153 degrees C. Fluid delivery of iron sources was achieved using a peristaltic pump at a flow rate of 2 mL/minute. Iron solutions of NaFeEDTA [92.3 mg/mL] or ferrous bisglycinate [137.5 mg/mL] were pumped into the feeding end of the extruder. A single blade cutter set at 450 rpm attached at the end of the die was used to shape pellets into spheres. The content of iron in pellets was 1±0.08, 300±10, and 660±10 mg/kg for control, NaFeEDTA, and ferrous bisglycinate respectively. Moisture content of pellets was below 10%. These pellets were used to directly fortify nixtamalized corn kernels [wet] right before grinding with a pilot scale Burr mill.

Incorporation of Fortified Pellets Into Wet Nixtamalized Corn Kernels and Dispersion of Iron in Corn Masa: A nixtamalization and mixing process was established previously but not optimized to obtain clear incorporation of iron. This was due to the addition of iron oxide from the Burr mill. Thus, after several trials using 5 pound batches, a baseline was collected and used for correction of added iron. A protocol for cleaning the equipment was also developed leading to low contamination of nixtamalized corn masa. The incorporation of pellets into nixtamalized corn kernels was evaluated using a kitchen aid to avoid the contamination process and to contrast its variability with the grinding process using the Burr mill. Whole yellow corn [9 kg] was mixed with 1% lime solution at a ratio of 1:3 w/w [maize:lime solution] and cooked in a kettle at 115 degrees C for 120 minutes. Nixtamalized corn was steeped in the kettle for 12 hours reaching final room temperature [24 degrees C]. The alkaline fluid containing the hulls and dissolved starch was decanted and discarded. Nixtamalized corn was removed from the kettle and washed for 10 minutes with DI water and allowed to rest for 5 minutes. Two fortification levels, either 1:20 or 1:40 w/w [pellet:corn kernels], were systematically mixed for 30 seconds in a bucket containing the corn [5 pounds] before grinding. Grinding of materials was accomplished after a single pass through a pilot scale Burr mill [6 inch plate diameter, 5 hp motor] set at 400 rpm. This lasted less than 5 minutes per batch. Corn masa was directly collected into 7.5 L resealable plastic bags as it left the grinder. Samples were not kneaded or mixed. Each bag was placed horizontally and divided into three collection sections [first, middle and last], representing ground material coming out of the mill. Three sub-samples from each collected section were prepared for further analysis. In order to determine how cultural practices can affect the redistribution of iron within the food matrix, remaining nixtamalized fortified masa samples were kneaded for 5 minutes as is customary in Central America. Sample points were collected similarly as described before. Iron content in samples varied across batches, but not across iron types. The variability [RSD%] within batches for both levels was higher than that between batches, ranging from 3 to 21% for ferrous bisglycinate masa and 7 to 19% for NaFeEDTA masa. Both iron dispersed similarly in unkneaded masa samples. Despite the somewhat uneven iron dispersion in masa, after a 5 minute kneading of samples this variability was reduced to less than 10% across all batches and iron formulations.

Results

These results showed a significant change in knowledge. We were able to establish and characterize a high temperature extrusion process for the formation of extruded products containing two commercial and highly bioavailable chelated iron formulations. Also, we were able to show that incorporation of iron fortified pellets into several batches of nixtamalized corn resulted in uniform dispersion of iron in corn masa after a short and customary kneading process. These results support the ability to fortify nixtamalized corn at the point of wet milling without

modifying consumption behavior.

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
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

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
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The key to ensuring sprout safety is to have clean seeds. Although seed sprouts are considered a health food by consumers because they are low in fat and calories and high in fiber and antioxidants, the consumption of raw sprouts has been linked to E. coli O157:H7 outbreaks. Unfortunately, the FDA-recommended calcium hypochlorite wash is unable to achieve a 5-log reduction in the pathogen populations on seeds. Thus, many studies have sought new means to secure sprout safety.

What has been done
A study was conducted to determine the optimum conditions for combined treatments of ultrasound and mild heat to improve the microbiological safety of alfalfa seeds while maintaining satisfactory germination rates. Alfalfa seeds [100 g] were inoculated with E. coli O157:H7 87:23.

The inoculated samples [10 g each] were treated with conditions obtained from the Response Surface Methodology [RSM] with three independent variables: temperature [55, 60 and 65 degrees C], ultrasound power level [20, 40 and 60%], and time [1, 3 and 5 minutes]. Twenty combinations of these three variables were performed. The effects were evaluated by counting the E. coli populations on TSAN plates. The germination rates were determined by counting the germinated seeds after 72 hours [24 in the dark and 48 under light]. The correlations between the trial conditions and the microbial count reduction and germination rate were modeled with an RSM polynomial equation.

Results

The determination coefficient [R2] was 97.6% and 96.4% for log reduction and germination, respectively, and the levels of significance were p <0.0001. The effects of temperature and treatment time were significant, while that of sonication power was less so. The optimum conditions to achieve a 5-log reduction of the E. coli population and 90% germination were determined from the overlaid contour plots.

4. Associated Knowledge Areas

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

Outcome #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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	92

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In recent times, the safety of fresh produce has become a growing concern to consumers and the horticultural industry. Contamination of produce by microorganisms that cause foodborne illness outbreaks results in significant associated health costs. In addition, these outbreaks have financial consequences for a given producer as well as other producers in the same industry who incur losses when the public refuses to buy any product associated with a given foodborne illness outbreak. Since the Food and Drug Administration introduced new rules to regulate production and handling practices for fresh produce, it is imperative that stakeholders in the food industry become proactive regarding both Good Agricultural Practices [GAPs] and Good Handling Practices [GHPs].

What has been done

In response, six one-day and two online multi-session Extension educational programs were conducted in Illinois in the winter and early spring of 2014 to address safe food production and handling in order to ensure that fresh produce is free from contamination by microorganisms that cause foodborne illness. Specific topics addressed in these programs included water usage and water testing, worker health and hygiene, facilities and equipment sanitation, manure handling and field application, and record-keeping. More than one hundred thirty individuals participated in the training sessions representing specialty crop producers and others interested in food safety practices.

Results

An end-of-meeting evaluation form was distributed and collected from 130 of the participants. A second evaluation was also mailed in September of 2014 to all attendees in the eight programs who provided an address [119] to identify any of 34 different practice changes resulting from their participation that were implemented during the growing season. Twenty-six evaluations were returned [21.8%]. It should be noted that the low response rate is likely due to mailing the evaluations during the busy growing season in order to meet a grant funding deadline.

Sixteen of the 26 respondents [62%] identified practice changes implemented. Eight [31%] of the respondents indicated implementing practice changes related to water usage for washing and cooling fresh produce and testing water quality. Eight [31%] also indicated implementing practice changes related to facilities and equipment sanitation, cleaning harvesting bins/aids each day, and sanitizing trucks and other transportation vehicles before loading. Seven [27%] of the respondents indicated implementing practice changes related to worker health and hygiene [such as training their workers about hand washing, posting hand washing signs, and stocking hand washing supplies]. Six [23%] implemented changes in their record-keeping and five [19%] made changes in manure handling and field application. With respect to their involvement in an audit of their operation regarding risk management practices, only two indicated they conducted a self-audit. However, nine [35%] created a written food safety plan for their food production enterprise. In addition, 21 of 26 of the respondents [81%] indicated that they planned to implement at least one additional practice change.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and

Naturally Occurring Toxins

Outcome #10

1. Outcome Measures

Commercialization Of High Protein Extruded Snacks

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	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 the findings from this study, we will be able to determine the relationship between the degree of hydrolysis of the proteins in the formulation and the physical and sensory characteristics of the resulting high protein snack product, which 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
Twenty formulations were developed with a total protein content of 28, 33, 38 and 43% [w/w] comprised of ratios of whey to soy protein of 100:0, 75:25, 50:50, 25:75 and 0:100 [4 × 5 factorial design]. Formulations above 33% total protein were developed to meet the Food and Drug Administration's requirements for a high-protein food claim, for which there is little research done in this type of application. Instrumental analyses were used to characterize the physical properties of samples. Descriptive analysis was conducted on the samples with 12 trained panelists in order to quantitatively profile the sensory characteristics. Findings showed that both protein level and protein type had a significant effect on models predicting attributes generated during descriptive analysis, rated on a 16-point scale. In terms of appearance, increasing protein level resulted in lower predicted values for models predicting puffed, porous and uniformity attributes. Attributes for sample aroma were mainly affected by protein type. Increasing whey protein resulted in higher

values in models predicting dog food and buttery aromas, meaning samples higher in soy protein were stronger in aroma attributes of roasted soy and toasted corn.

Results

For basic taste attributes, increasing protein level had minimal effect. Varying protein type significantly affected models predicting basic taste attributes, with increasing whey protein predominantly increasing the value for the model predicting sweetness. For aroma-by-mouth attributes, varying protein level and protein type had a significant effect on the models. Increasing protein level resulted in lower predicted values for toasted corn aroma-by-mouth, likely due to decreasing amounts of corn meal in the formulation. Protein type also had an effect, with increasing whey protein level resulting in increased values for models predicting cheese, dried creamer, and buttery aromas-by-mouth. For texture attributes, the degree of sample expansion had a significant impact on texture characteristics. Increasing protein level inhibited expansion, resulting in higher values for the model predicting crunchiness, defined as the amount of force required to chew during the 1st through 3rd chews, and lower values for the model predicting crispiness, defined as the amount of airiness felt during the 1st through 3rd chews.

Increasing whey protein content also inhibited expansion, similarly affecting crunchiness and crispiness models but to a higher degree. As protein level and percent whey increased, predicted values for the model for grittiness decreased. Instrumental testing showed that water hydration capacity decreased with soy protein addition, which may correlate to the particles not dissolving during chew down in these samples.

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
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #11

1. Outcome Measures

Delivering Adequate Nutrition To At-Risk Populations

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Delivering adequate nutrition to at-risk populations and facilitating access to functional foods have become a new priority for the food industry. Dispersion of lipid soluble bioactives such as lutein and vitamin D in aqueous food systems, however, continues to be a significant challenge for the industry. Although strategies exist to add these compounds into aqueous systems, it is not without problems. For example, incorporation of new ingredients often leads to food deterioration and rapid spoilage, changes in rheology, less than optimal sensory characteristics, modified preparation and consumption habits, and interactions with other food components, thereby reducing the intended beneficial effect.

What has been done
This study aims at leveraging the properties of legume protein nano-aggregates to disperse and stabilize fat soluble compounds such as lutein and vitamin D. Besides enhanced dispersion, legume protein nanoparticles could add functionality to these vitamins by protecting them from the environment and offering enhanced bioaccesibility and bioavailability. These functions could translate into more suitable applications for the food industry, where the nanoparticles are created from generally recognized safe materials.

Results
These results showed a significant change in knowledge. The authors were able to create stable legume protein nanoemulsions amenable to dispersing two chemically-different bioactives [such as vitamin D and lutein]. The legume protein nanoemulsions have enhanced functionality as soluble proteins that allow for emulsification of oil and non-polar molecules protecting them from UVC light, freeze drying, and simulated in vitro digestion conditions.

4. Associated Knowledge Areas

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

Outcome #12

1. Outcome Measures

Improving The Safety Of Hispanic-Style Fresh Cheeses

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Most styles of cheese are not commonly associated with foodborne pathogens. The majority of the risk associated with cheeses in general is due to outbreaks of Listeria monocytogenes in Hispanic-style fresh cheeses such as queso fresco. Such non-cultured, unripened cheeses have high moisture content, low salt content, and near neutral pH, so proper refrigeration is required to maintain shelf life. However, L. monocytogenes can proliferate at refrigeration temperatures, leaving few hurdles for its inhibition.

What has been done
Listeriosis outbreaks from illicitly-produced queso fresco make headlines and emphasize the growing market for these products, but many manufacturers hesitate to capitalize on such demand due to liability concerns. Strategies are needed to help prevent Listeria outbreaks and allow for safer expansion of the market for Hispanic-style fresh cheeses. Outbreaks continue to occur, despite pasteurization of raw ingredients, due to listerial contamination during manufacturing processes. What research is available on Listeria control measures in fresh cheeses has confirmed survival and growth of L. monocytogenes during manufacturing as well as during storage under refrigeration. Considering post-manufacture processes such as high-pressure or additional heat treatment can unacceptably alter the delicate cheese structure, there are no effective measures available to eliminate post-pasteurization contamination. This suggests direct incorporation of antimicrobial compounds into fresh cheeses may be necessary for Listeria control.

Results
Objective 1: Develop a Laboratory-Scale Method to Produce a Model Hispanic-Style Fresh Cheese. A laboratory-scale method that would enable the production of a Hispanic-style cheese in a biosafety cabinet is critical for the safe evaluation of potential antimicrobials. We have developed a model to do this and have submitted the results for publication. Our model cheese

has similar composition as cheese made on a traditional scale [fat, protein, water].

Objective 2: In Vitro Screening of Antimicrobials [Bacteriocins, Organic Acids, Spice Extracts and Novel Ingredients] for Activity Against Listeria Monocytogenes. We have made significant progress with this objective. We have tested several commercially-available products for antilisterial activity and found that nisin and ferrulic acid had the most promise from our initial screening. We will continue screening for more effective antimicrobials.

Objective 3. Evaluation of Selected Antimicrobials in Our Hispanic-Style Fresh Cheese Model. Nisin [a bacteriocin produced by Lactococcus lactis and widely used by the food industry] was able to decrease the listerial population briefly but the population quickly recovered. Ferrulic acid [which is present in many plants] was bacteriostatic against L. monocytogenes in our model. Another key observation was that the activity of the various antimicrobials we tested were far different in our model cheese than they were in simple broth experiments [Objective 2]. This confirmed that it is critical to evaluate these antimicrobials in the cheese matrix.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
704	Nutrition and Hunger in the Population
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #13

1. Outcome Measures

Managing Bacterial Wilt In Cucurbits

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Bacterial wilt disease of cucurbits, caused by Erwinia tracheiphila, is a serious bacterial disease resulting in crop losses of up to 80%. The pathogen is transmitted by cucumber beetles. An effective strategy of controlling the disease is to manage insect vectors. However, applying pesticides, which are toxic to bees during flowering and fruit, can lead to decreased pollination, low fruit qualities, and environmental and health concerns. Therefore, alternative management measures should be sought to solve these problems, especially for home gardening and organic production. On the other hand, little research has been done on the pathogen side. No genetic information of the pathogen is currently available. Therefore, there is a critical need to obtain the genetic information of the pathogen, which could lead to a better understanding of how the pathogen causes disease and how to best seek alternative control measures. Moreover, there is also a critical need for disseminating the knowledge about bacterial wilt disease to the general public, especially for home gardening and organic production.

What has been done

The draft genome sequences for two strains of Erwinia tracheiphila were obtained with both shotgun and pair-end libraries. A total of 620 million bases represent about 60 fold coverage of the genome at approximately 4.8 Mb. Initial assembly yielded about 42 scaffolds with about 400 contigs. An OpMap for both genomes based on restriction enzyme digestion was generated, and all the contigs and scaffolds were aligned to the map. In addition, the number of plasmids in the two strains of E. tracheiphila and the contigs that belong to the plasmids based on gene content were determined. Genome sequences of the two strains were also compared, and 37 and 40 gaps were closed, respectively. Several hundred primers were designed for gap closing.

Furthermore, bacterial populations within the insect vectors of E. tracheiphila were determined. Six major bacterial species belong to six different genera within Enterobacteriaceae, which includes most of the currently known microbes that are of concern to food safety on fresh produce. The next step for this project is to determine the microbiota of insects and to submit the genome sequences to NCBI.

Results

We have generated high-quality draft genome sequences and genome maps for two Et strains, which may promote the identification of virulence factors as well as determinants of host specificity. This is the first report of genome sequences for Et strains. The outcomes of this project not only provide new and much-needed knowledge to the research community, but also benefit cucurbit growers in the U.S. Moreover, understanding the bacterial population within insect vectors will provide information for the potential source of microbial contamination for fresh produce, which is of great concern for fresh produce safety.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
216	Integrated Pest 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 #14

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
2014	192

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 and in conjunction with neighboring states. These include vegetable, fruit, 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. This past year a formal evaluation was collected from participants at the end of the Southern Illinois Vegetable School and the two Southern Illinois Tree Fruit Schools.

In addition, as part of a three-year NIFA grant, Year 2 activities of the Preparing a New Generation of Illinois Fruit and Vegetable Farmers included classes with hands-on and in-field experiences in English at three locations in the state held on one Saturday per month. Seventy-seven participants [new farmers, aspiring farmers and educators] completed this program. In addition, 15 participants completed the Spanish-language programs also held at three site locations. Seven participants used incubator plots to gain hands-on farming skills, and 34 educators [Extension and others] attended one or more sessions during the year. The teaching curriculum [30 Power Point presentations and associated online references] were revised and

made available as YouTube videos online for viewing prior to classes to allow for more in-depth discussions. An evaluation questionnaire was collected at the end of the year.

Results

The approximately 250 attendees at fruit and vegetable 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 but one of the 21 vegetable producers who responded checked at least one topic as a 4 or 5, while 12 checked a 5 rating for at least one session topic. All but two of the 48 fruit producers who responded checked at least one topic as a 4 or 5, while 27 checked a 5 rating for at least one session topic.

All those who completed the Preparing a New Generation of Illinois Fruit and Vegetable Farmers evaluation indicated experiencing a change in knowledge, abilities, skills, and /or farming. Eighty-six percent [86%] plan to start farming, 90% of those who plan to start or are currently farming plan to increase the scale of their farming operations, 5% decided not to start farming or to discontinue their initial efforts, and 59% changed their attitudes about how to operate a successful small farm business. All participants indicated the program met most or all of their expectations. In addition, 55% adopted plans or practices to increase their production efficiency, and similarly 43% plan to increase environmental sustainability. Additional results are posted in the Evaluation section of this planned program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
216	Integrated Pest Management Systems
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

Outcome #15

1. Outcome Measures

Increased Knowledge Of Small Farm Production Options

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	73

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Owners of small acreages are in need of 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 developed Putting Small Acres to Work, a one-day program that addressed a variety of topics that was offered to help people who have a few acres learn ways that they can put them to use. One hundred ninety [190] individuals attended one of three workshops held at various locations in the state. An end-of-workshop evaluation form was distributed and collected from 73 of the participants at three of the six workshops.

Results
Respondents to the Putting Small Acres to Work end-of-program evaluation were asked to identify the degree to which their knowledge, confidence and abilities were changed regarding putting their small acres to work. Using a scale from one to five [1=No change; 5=Greatly improved], the average score for 69 who responded was above a 3.5 for all the items. Responses to specific evaluation items were: [1] Ability to effectively find and access resources to support their small acreage systems [4.29 average group score; 58 of 68 [85.3%] choosing a rating of 4 or 5]; [2] Ability to develop goals for their property [3.99 average group score; 47 of 67 [70.1%] choosing a rating of 4 or 5]; and [3] Knowledge of concepts and principles of managing small acreage [3.90 average group score; 43 of 67 [64.2%] 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

Food Service Safety

5-Hour Refresher Course

University of Illinois Extension Nutrition and Wellness Educators conducted three **Food Service Sanitation Management Certification** courses in 2013-2014. Fifty individuals involved in serving food to the public participated in the programs as a requirement to maintain their food service certification by the Illinois Department of Public Health. In order to identify changes in their knowledge of food safety, participants were asked multiple-choice questions at the beginning and at the end of the five-hour course. The questions were designed to address critical practices and recent regulation updates to reduce the risk of bacterial contamination that can cause foodborne illnesses. In addition, 102 food bank managers and staff members who were involved in distributing food to those in need participated in the program that was adjusted to address their unique food handing safety challenges and completed a multi-choice pre- and post-test set of questions that addressed the content of that training.

All but one of the participants demonstrated an increase in knowledge to prevent food contamination by correctly answering at least one question correctly at the end of the course that they had incorrectly answered before the course began. Twenty-five [50%] were able to correctly answer 3 to 6 additional questions correctly at the end of the training. In addition, more than half of the participants who had answered each question incorrectly before the program answered it correctly at the end for the following items:

36 [72%] learned the temperature range [danger zone] when food is most susceptible to the growth of bacteria that can cause food borne illnesses.

35 [70%] learned that ready-to-eat potentially hazardous foods can be stored in the refrigerator for no more than seven days.

29 [58%] gained knowledge about how to correctly label prepared foods that are stored in the refrigerator or coolers.

With respect to food bank staff responses to nineteen pre-post-test questions, 70 increased their knowledge of temperatures for serving and storing foods.

28 [28%] gained knowledge about the temperature zone [41 degrees Fahrenheit to 135 degrees Fahrenheit] when food is most susceptible to the growth of bacteria that cause food borne illnesses.

20 [20%] learned that when evaluating perishable food for safety, the most important characteristic is temperature.

19 [19%] learned that food and food contact equipment should be stored at least six inches off the floor and away from the walls.

18 [18%] learned that leaving potentially hazardous food in the temperature danger zone for more than two hours can grow disease-causing microorganisms that can make someone sick.

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', and 'Does not apply'. Also offered as responses were 'Plan to do" and 'Don't plan to do'.

Practice Changes Adopted

Two-thirds of the 26 participants from thirteen counties who responded indicated that they had changed their food handling procedures. Eighteen of 26 participants [69%] adopted one or more of the practices to safely serve food at events. Practices changed by nearly a third of the evaluation respondents included washing their hands for at least 20 seconds using soap and warm water and using a thermometer to check temperatures of foods. Other practices adopted included using a separate hand-washing sink, using slow cookers only to hold hot foods hot and not to reheat foods, labeling items clearly when storing prepared food, preparing all foods on site [rather than at home], making their own sanitizing solution, and eliminating use of home canned food in their operation. In response to two other questions, 88% indicated feeling more confident in preparing foods to serve to the public, and all but one reported being more aware of basic food safety principles, which when followed, can help reduce the risk of food borne illness.

Cottage Food Law Food Safety

University of Illinois Extension Nutrition and Wellness Educators conducted two-hour workshops to address the **Illinois Cottage Food Operation Law** regarding low-risk foods prepared at home and sold at Illinois farmers' markets. In order to identify changes in knowledge of food safety, the participants were asked to answer five multiple-choice questions at the beginning and at the end of the two-hour course. The questions were designed to address critical practices and recent regulation updates to reduce the risk of bacterial contamination in food products sold at farmers markets that can cause foodborne illnesses. A total of 79 completed the questions both before and after the workshops.

Seventy of the 79 [89%] who responded to the questions demonstrated an increase in knowledge to prevent food contamination by answering one of the questions correctly at the end of the workshop that they had incorrectly answered before the workshop began.

46 [58%] participants learned what foods are permitted to be made for sale by a Cottage Food Operation.

38 [48%] were able to correctly identify what safety practices were and were not required by the law.

26 [33%] were able to indicate what information must be on the food package to conform to the labeling requirements of the law.

12 [15%] learned the legal definition of a Cottage Food Operation.

11 [14%] were able to correctly identify a 'potentially hazardous food' after the program.

Good Agricultural Practices [GAPs] Training Evaluation

An end-of-meeting evaluation form consisting of seven questions was distributed and collected from 130 of the participants in six one-day and two online multi-session **Enhancing Specialty Food Safety** programs. An evaluation was also mailed in September of 2014 to all attendees in the eight programs who provided an address [119] to identify any of 34 practice changes resulting from their participation that were implemented during the growing season. A stamped return envelope was provided to each and a second reminder letter and evaluation copy was sent out two weeks after the original mailing. Respondents to the follow-up survey included a total of 16 of 26 attendees [specialty crop producers and other individuals interested in food safety practices]. It should be noted that the low response rate is likely due to mailing the evaluation during the busy growing season in order to meet a grant funding deadline.

Knowledge Changes

A key question asked respondents to assess the knowledge level gained on specific topics that were covered in the conference using a scale from one to five [1=None/already knew; 5=A great deal]. The average score for the 130 respondents was a high three or above for all topics. The areas of greatest learning were:

Preparing for a GAPs audit [4.58 average group score; 92 of 129 [71%] checked 'A great deal'].

Keeping records [4.30 average group score; 73 of 130 [56%] checked 'A great deal'].

Minimizing risks during postharvest handling [4.10 average score; 56 of 130 [43%] rated this 'A great deal'].

Manure handling and application [4.09 average score; 60 of 127 [47%] checked 'A great deal'].

Minimizing risks during food production [4.08 average score; 55 of 128 [43%] rated this 'A great deal'].

Practice Changes Implemented

Five questions encompassed 34 potential practice changes that were addressed in the programs. The focus areas of the five questions included: [1] Water usage and water quality testing; [2] Worker hygiene and health; [3] Facilities and equipment sanitation; [4] Manure handling and application; and [5] Recordkeeping. Respondents were presented with five options for each practice that included 'Did prior', 'Done as a result', 'Plan to do', 'Don't plan to do', and 'Does not apply'.

A large number of the practices were checked 'Does not apply'. Most [60-80] of the respondents checked this response in relation to testing well and surface water, recording application of surface water, and purchasing compost. Nearly one-half of the respondents did not have employees and had no need to implement changes related to worker health

and hygiene.

However, 16 of the 26 respondents [62%] identified practice changes that they had implemented.

Eight [31%] of the respondents indicated implementing practice changes related to water usage and water quality.

Eight [31%] of the respondents indicated implementing practice changes related to facilities and equipment sanitation.

Seven [27%] of the respondents indicated implementing practice changes related to worker health and hygiene.

Five [19%] of the respondents reported making changes in manure handling and field application.

Six [23%] of the respondents indicated implementing practice changes related to record keeping.

Specific practices most frequently marked as changes by **five or more** respondents included: Prior to harvest, clean and sanitize all storage facilities [7 respondents]; Clean and sanitize trucks and other transportation vehicles before loading [7]; Monitor the level of chlorine in sanitizing solutions [7]; Monitor chlorine and other disinfectants in water used to wash produce [6]; Monitor produce wash water temperature to ensure it is not less that 10 degrees Fahrenheit cooler than produce [5]; Monitor the cooling bath temperature to ensure it is not less than 10 degrees Fahrenheit cooler than produce [5]; Cover clean storage bins when not in use [5]; Clean harvesting bins/aids daily [5]; Remove field soil from the outside of harvesting container/bins prior to moving them into packing areas [5]; Wash, rinse, and sanitize the packing area, equipment, and floor at the end of each day [5]; and Evaluate fertilizer sources for GAPs safety [5].

An additional nineteen [19] practices have been implemented by at least one respondent. In addition, 21 of 26 [81%] indicated that they planned to implement at least one additional practice change. All but two of 34 practices were checked as 'Plan to do' by at least one and as many as nine respondents.

Fresh Fruit and Vegetable Production Evaluation

The attendees [267] at the two **Southern Illinois Commercial Tree Fruit schools** and the **Southern Illinois Commercial Vegetable school** 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. Sixty-nine responded.

Fruit and Vegetable Program Knowledge Gained

All but two of the 48 who responded checked at least one topic as a 4 or 5, while 27 checked a 5 rating for at least one session topic at the Southern Illinois Fruit School. All topics were rated 4 or 5 by 50% or more of those who responded. The list of topics that follows are those that were rated 4 or 5 in order of the percentage of those who circled that rating regarding knowledge gained.

Management of Blossom Blight and Brown Rot in Peaches--rated 4 or 5 by 37 of 45 individuals who responded [82%].

Disease Management in Peaches, Scab and Bacterial Spot--rated 4 or 5 by 37 of 47 individuals [79%].

Peach Insect Disease--rated 4 or 5 by 30 of 45 individuals [67%].

All but one of the 21 commercial vegetable growers who completed the evaluation checked at least one topic as a 4 or 5, while 12 [57%] checked a 5 rating for at least one session topic. All topics were rated 4 or 5 by more than half of those who responded. The list of topics rated the highest by percentage are as follows:

Vegetable Insect Update--rated 4 or 5 by all 11 individuals who responded [100%].

Disease Management in Cucurbit Production--rated 4 or 5 by 11 of 13 individuals who responded [85%].

Blossom End Rot: A Major Physiological Disorder of Tomato--rated 4 or 5 by 17 of 21 individuals who responded [81%].

Utilizing Cover Crops in Vegetable Production systems--rated 4 or 5 by 12 of 17 individuals who responded [71%].

Practices Implemented by Individuals Who Attended the 2014 Southern Illinois Fruit Schools and 2014 Southern Illinois Vegetable School

Attendees at the **2014 Southern Illinois Fruit Schools** were asked to indicate practices that they implemented as a result of what they learned at last year's schools. Eighteen individuals responded to this question, representing 37% of those who completed the evaluation. Twelve of the 18 [67%] controlled a fruit pest using herbicide/fungicide recommendations shared by a presenter; 11 [61%] improved their record keeping; 10 [56%] planted a new variety of peaches or apples; 9 [50%] implemented fertilizer adjustment; 8 [44%] investigated or planted new rootstock or cultivars; 7 [39%] ordered trees earlier; and 2 [11%] developed a GAP plan.

Attendees at the 2014 **Southern Illinois Vegetable School** were asked to indicate which of six practices they have implemented as a result of what they learned at last year's school. Only five individuals responded to the question with four [80%] indicated that they grew new varieties; three [60%] improved field monitoring/scouting insects and disease; two [40%] improved or increased soil sampling and testing, two [40%] diversified items taken to market; and one [20%] controlled a vegetable pest using herbicide/fungicide recommendations shared by a presenter.

Preparing a New Generation of Illinois Fruit and Vegetable Farmers

Participants [126] in this three-year program completed a questionnaire following the final class of this year's program. These participants included 77 English-speaking new or aspiring farmers and educators and 15 Spanish-speaking Hispanic participants.

Participant responses to questionnaires indicated that as a result of this program: [1] 100%

experienced a change in knowledge, abilities, skills, and/or farming intentions; [2] 86% plan to start farming or are currently farming and plan to continue; [3] 90% of those currently farming plan to increase the scale of their farming operations; [4] 5% decided not to start farming or to discontinue their initial efforts; [5] 59% changed their attitudes about how to operate a successful small farm business; [6] 55% adopted plans or practices to increase their production efficiency; [7] 43% adopted plans or practices to increase their environmental sustainability; and [8] 82% plan to increase their participation in future educational programs for fruit and vegetable producers.

Participants were asked 'To what extent did this program meet your expectations?' All indicated that their expectations were met to some degree [Exceeded = 43%; Completely = 32%; Mostly = 25%].

Participants were asked 'How much did this program help you in developing your farming plans?' All indicated that they were helped somewhat or to a greater degree [A great deal = 68%; Just what I needed = 9%; Somewhat = 23%].

Participants were asked to indicate which of the following documents they had completed at the end of the course. The following percentages had developed a: Business plan = 57%; Production plan =47%; Marketing plan = 36%; or Financial plan = 43%.

Participants were asked to indicate if at the end of the course they knew how to access various resources. More than 80% had accessed: USDA programs and services [such as NRCS of FSA] = 95%; markets = 90%; business management support [such as SBDC] = 86%; production information [seed catalogs, newsletters, or production guides] = 97%; grower networks = 81%; and credit =86%.

Putting Small Acres to Work

An end-of-program evaluation was distributed to the 190 **Putting Small Acres to Work** participants and collected from 73 participants. Respondents to the **Putting Small Acres to Work** 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; 5=Greatly improved], the average score for 73 respondents was above a 3.5 for all the items.

Ability to effectively find and access resources to support their small acreage systems [4.29 average group score; 58 of 68 [85.3%] choosing a rating of 4 or 5].

Ability to develop goals for their property [3.99 average group score; 47 of 67 [70.1%] choosing a rating of 4 or 5].

Knowledge of concepts and principles of managing small acreage [3.90 average group score; 43 of 67 [64.2%] choosing a rating of 4 or 5].

Confidence in using small acreage management principles [3.76 average group score; 39 of 68 [57.4%] choosing a rating of 4 or 5].

Knowledge about land stewardship and resource management [3.72 average group score; 44 of 68 [64.7%] choosing a rating of 4 or 5].

Understanding about farming practices [3.66 average group score; 38 of 67 [56.7%] choosing a 4 or 5 rating].

Preparedness to start a farming enterprise [3.55 average group score; 33 of 65 [50.8%] choosing a rating of 4 or 5].

When asked if their personal objectives for attending this workshop were met, 64 respondents provided a rating using a five part scale [1=Not met, 3=Satisfactorily met and 5=Extremely met]. All except one of them [98.4%] chose a rating of 3 [Satisfactorily met] or above. Twenty-eight [43.8%] marked a rating of 5; 23 [35.9%] marked a rating of 4, and 11 [17.2%] 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, 74 [44.5%] responded. Twenty-nine [39%] of the 74 participants listed specific planned actions. Most often mentioned [14 responses] were planning actions including developing/writing a business or marketing plan and setting goals.

Key Items of Evaluation

Food Service Safety

The responses to questions before and after the **5-hour Refresher Course** food safety programs for individuals involved in retaining certification to serve food to the public indicated that 96% of the 28 participants gained knowledge in handling food safely. Most notably, 21 [75%] of the participants learned that ready-to-eat potentially hazardous foods can be stored in the refrigerator for no more than seven days. In addition, two-thirds of them learned the temperature range [danger zone] during which food is most susceptible to the growth of bacteria that cause foodborne illnesses and how to correctly label prepared foods that are stored in the refrigerator or in coolers. In addition, 22 food bank staff members [29%] gained knowledge regarding the temperature zone when food is most susceptible to the growth of bacteria that can cause foodborne illness and that appearance is the most important characteristic in evaluating perishable food.

Using the information collected in 2011 through a University of Illinois Extension random survey that indicated that the conservative number of meals participants reported serving daily was 100 and the annual number of food handlers trained this year, an estimated 2,700 additional meals per day are free of contaminants that can cause foodborne illnesses. Based on the March, 2010 study funded by the Pew Charitable Trust indicating that the average cost each time someone gets sick from food is $1,850, this shared knowledge clearly represents a substantial reduction in healthcare costs.

Nineteen [73%] of the 26 **Serve It Safely** participants who returned the follow-up evaluation adopted one or more of the practices to safely serve food at events. Twenty-three [89%] indicated feeling more confident in preparing foods to serve to the public, and all but one reported being more aware of basic food safety principles which, when followed, can help reduce the risk of food borne illness.

Nearly 90% of the **From Garden Gates to Dinner Plates** participants who provided information before and after the program demonstrated an increase in knowledge regarding the requirements of the Cottage Food Law and the foods that are permitted to be sold at farmer's markets.

Good Agricultural Practices [GAPs] Training Evaluation

More than 70% of the end-of-program evaluation responses indicated that they had learned a great deal about enhancing specialty food safety pertaining to preparing for an audit of implementation of safety practices and approximately one-half indicated learning a great deal about keeping appropriate records related to these practices. A follow-up evaluation evidenced food safety practice changes had been implemented by nearly two-thirds of the respondents, primarily with respect to water usage and facilities and equipment sanitation [such as cleaning procedures for trucks, storage, and harvesting bins]. Approximately one-third of the respondents created a written food safety plan for their food production enterprise that will reduce their risk of food contamination by microorganisms that cause foodborne illnesses. However, only two conducted a self-audit of their enterprise.

These actions will position the program participants to be in compliance with rules and policies that regulate production and handling practices of fresh produce. Extension training is bringing about practice changes to prevent the spread of food contamination, and thus, reducing the risk of consumer foodborne illnesses and their associated health costs. In addition, these safe practices substantially reduce the financial risk to a given producer as well as other producers in the same industry who incur losses when the public refuses to buy any product associated with a given foodborne illness outbreak.

Fresh Fruit and Vegetable Production Evaluation

Responses collected through the evaluation forms evidenced a high level of knowledge gained regarding all of the topics for the 2014 **Southern Illinois Commercial Tree Fruit School** and the **Southern Illinois Commercial Vegetable School.** All topics offered at the **Southern Illinois Fruit School** received a 4 or 5 rating from 50% to 82% of those who completed the evaluation. Likewise, approximately 40% of those completing the evaluation listed something they planned to do with information on implementing suggested practices and 18 indicated implementing specific practices that had been recommended at the 2013 conference. With one exception, 2014 **Southern Illinois Vegetable School** participants who completed an evaluation indicated that they learned new information about one or more topics covered by the presenters. Ten individuals shared plans for using the information and five indicated implementing specific practices that had been recommended at the 2013 conference.

Responses collected from participants in **Preparing a New Generation of Illinois Fruit and Vegetable Farmers** through a questionnaire evidenced that all experienced a change in knowledge, abilities, skills, and/or framing intentions. 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.

Small Acres Evaluation

Primarily motivated by the desire to seek information about options for using small acreage, 73 [all but one] of the **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 an increase in their ability to effectively find

and access resources to support their small acreage system and to develop goals for their property, as well as knowledge of concepts and principles of managing small acreage. Sixty-eight [42%] listed actions they planned to take with 14 referencing intentions to develop business and marketing plans and setting goals. Ten of the participants indicated plans to do more research, find a mentor, and make use of resources identified through the workshop.

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 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: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.0	0.0
Actual Paid	0.2	0.0	14.4	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**
802048	0	1644398	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
802048	0	1644398	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
6439704	0	3851206	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities in 2014 included a research program aimed at preventing the burden of adult obesity among women [rather than waiting until overweight or obesity has developed, this study is intended to identify the determinants of weight gain prevention and to apply principles of weight gain prevention strategies to food-based dietary guidance], the generation of information on how immigrant Latino parents raising adolescents in the U.S. navigate discontinuities between their culture of origin and the family's new environment [given the growth of the Latino population, particularly in rural settings, this project has the potential to inform research, policy and practice], the development of a choline-sensitive behavioral paradigm of learning and memory that provides clear evidence that sensitive periods exist during cognitive development, the creation of a measurement tool that identifies stay-at-home father families and their type [choice and non-choice] and measures the reasons leading these families to such paid-work and care arrangements, the characteristics of these families, and the well-being at the individual [each spouse and the children], couple, and family levels in both urban and rural areas, studies that contribute to the understanding of how dietary isoflaovones impact metastatic progression in an experimental model of breast cancer metastasis, continued development of the Fun with Sisters and Brothers suite of programs that are aimed at enhancing children's sibling relationship quality, a project with the goal of developing evaluation methods and criteria that support the identification of the highest quality nutrition education apps, work to complete Phase I and execute Phase II of the Multidimensional Cultural Identity Study [focusing on the presence of daily variations in and well-being implications of multiple cultural identities among non-metropolitan youth], and a study to determine the barriers and benefits as perceived by teachers in implementing an online nutrition and physical activity program for middle school students.

Activities also included laboratory studies to identify physiological and biological factors related to healthy family interactions during mealtimes and healthy outcomes in children, the development of education and training programs to promote in-home cooking and positive times during shared family mealtimes, the dissemination of materials through new social media [podcasts, twitter, Facebook] identifying positive and health-promoting aspects of shared family mealtimes, the development of new knowledge of the basic processes involved in harmonious parent-child relationships and how positive relationships with parents may provide children with building blocks for developing positive relationships with peers, work to illustrate the potential epigenetic mechanism from the exposure to soy genistein which contributes greatly to the regulation of a critical signaling pathway during colon carcinogenesis [the Wnt pathway], research to establish a human infant microbiome associated [HIMA] piglet model at the University of Illinois [a HIMA piglet model will enable hypothesis-driven research on host-microbe interactions and mechanisms of action by probiotics and other dietary components that will be more directly translatable to the human infant], work to strengthen interdisciplinary research initiatives dedicated

to child and family health and wellbeing [through expanded interdisciplinary collaborations in the bio-behavioral, nutrition, and physical activity research sciences the University of Illinois Family Resiliency Center will be able to extend its current research portfolio into more complex research designs], and an effort to improve our understanding of the role of maternal protein deficiency that may provide additional insight into the long-term health of mothers [new knowledge of the effects induced by maternal protein intake may enable the development of a nutritional intervention to ensure that nutrition during and after gestation is beneficial to adult health].

Conference presentations included the National Council on Family Relations, International Association for Relationship Research, Society for Research in Child Development, American Educational Research Association, La Coordinación para la Innovación y Aplicación de la Ciencia y la Tecnología [CIACYT] at the Universidad Autónoma de San Luis Potosí, International Leadership Association, Association of Leadership Educators, 6th International Congress on Food Science, Biotechnology, and Safety, Society for Research in Child Development Special Topic Meeting: New Conceptualizations in the Study of Parenting-At-Risk Children, Phytochemical Society of North America, Society for Research on Human Milk and Lactation, Experimental Biology 2014, Universidad Nacional Autonoma De Mexico [UNAM], Society for Research on Adolescence, Cambio de Colores Conference, Association for Asian American Studies, and the Institute of Food Technologists.

This past year saw increased delivery of an Extension program series on brain health that was offered to provide information on strategies and techniques for building a better memory, learning about how brain health is directly related to body health and how to maintain that health, and exploring and practicing several exercise strategies to challenge the brain. Each segment of the series [**Building a Better Memory for Everyday Life**, **FIT WITS**, and **Head Strong**] were also offered to meet the needs of various audiences.

Building Bridges Across Generation Gaps workshops were developed and delivered at 16 locations in the state to Illinois Municipal Retirement Fund retirees as well as to other local audiences. **Coming of Age: Explore Your Future**, another new four-part series, was developed for those who are considering retirement soon or are newly retired to help participants examine the social aspects of retirement to identify their strengths and interests and plan for the post retirement activities. Resources related to aging and retirement were also available through **Long-Term Care: Talking, Deciding, and 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 through **Plan Well, Retire Well**, a comprehensive website that includes blogs, e-news, and monthly news articles. **Share Your Life Story,** a multi-week life series, provided a therapeutic approach to life renewal. Additionally, Extension educators [nutrition & wellness, family life, and consumer economics] reached out to all counties statewide by offering similar 'healthy living' programs focused on older adults. For example, an interdisciplinary series of 79 programs titled **Learning is Timeless** continued to be delivered at the Urban Leadership Center in Chicago to help 1,120 participants develop skills in health [9 programs with 109 participants], family life [37 programs with 109 participant contacts], consumer and money management [7 programs with 100 participant contacts], and horticulture [12 programs with 198 participant contacts] to reduce stress and promote better mental and physical health. In addition, **Making a Meaningful Nursing Home Visit** was developed and delivered to multiple groups throughout Illinois. **Simplify Your Life: Clear the Clutter & Your Stress** workshops continue to be delivered.

This year a first-time webinar series attended by 117 participants was conducted based on **Your Young Child**, a research-based curriculum and set of customized brochures that help parents of infants and toddlers manage seven difficult stages and behaviors that are linked to child abuse and neglect. Early in 2014, Family Life Extension Educators engaged in a new partnership with Pennsylvania State University and the University of Nebraska at Lincoln through a U.S. Department of Defense grant to deliver the **Childcare and Youth Training and Technical Assistance Project** [**CYTTAP**] which reached 384

childcare providers. Extension Family Life educators also conducted multi-session programming on parenting and adult caregiving. **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 aged-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 every month from birth to 12 months, and then every two months until the child is five years old. **Parenting Again** topic-based discussion guides were available for grandparents raising grandchildren. The **Intentional Harmony: Managing Work and Life** curriculum and web-based self-study focusing on nurturing adult relationships continued to be offered.

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 444,620 youth who were taught healthy eating choices and 31,240 youth who were reached through **EFNEP** in 2014. 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 and by **EFNEP** staff in 3rd through 5th grade classrooms. Under the leadership of 4-H Youth Development staff members, the **Health Jam** program was conducted for 5th graders and offered support related to exercise, wellness, nutrition, and health careers information using an experiential learning approach. New interdisciplinary programming involving **4-H** in conjunction with **Supplemental Nutrition Assistance Program Education** [**SNAP-Ed**] engaged teens to teach primarily fifth-grade youth to make healthy food choicest though a new program titled **4-H Food Smart Families** that was conducted in after school programs and summer camps.

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 samples of healthy foods. **Diabetes Lifelines,** a bi-monthly web accessible newsletter provided information in both English and Spanish to clientele on a variety of diabetes-related topics [located at http://www.urbanext.uiuc.edu/diabetes; more than 56,000 English page views and more than 109,000 Spanish page views recorded for this past year along with 12,500 app connections]. Two additional websites, **Your Guide to Diet and Diabetes** and **Diabetes Recipes**, logged more than 341,000 English page views and more than 336,000 Spanish page views. The **Meals for a Healthy Heart** program is a two-part series focused on increasing participant awareness of the risk factor 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, the new **Putting Wellness to Work** worksite series was delivered in a lunch-and-learn format to help businesses and organizations meet employee wellness goals.

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 795 Cook County youth.

2. Brief description of the target audience

Members of the target audience included young adult and midlife women, nutrition and dietetics

professionals, breast cancer survivors, health care professionals, families with more than two children in the 4- to 12-year old age range, product developers who are interested in improving health benefits using microencapsulation technology, research scientists interested in early childhood obesity prevention, early childhood educators, parents of young children, Extension educators, nutrition Extension specialists, postdoctoral fellows in human development, family science, psychology and related social and behavioral sciences, research scientists in childhood obesity prevention and food insecurity, parents and educators of children between birth and eight years of age, eXtension educators in nutrition and family life, policy makers interested in child health and wellbeing, university students and the administrators and educators responsible for their growth and development as emerging leaders, professionals in food science and human nutrition, commodity groups, clinicians and practitioners who serve children and families, and scientists and practitioners interested in the regulation of intestinal digestive and absorptive function. Extension 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 members 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

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	29815	73927	26096	0

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	53	53

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2014	11

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	Identifying Chronic Stressors In The Lives Of Low-Income African-American Families
9	Utilizing A Family Resiliency Framework To Address Childhood Obesity
10	Development And Evaluation Of New Therapies For ER-Negative Breast Cancer
11	Number Of Youth That Increased Knowledge Of Bullying And Actions To Take In Dealing With A Bullying Situation
12	Number Of Families/Caregivers That Gained Knowledge About Eating Healthier Foods [Those Low in Fat and High in Fiber]
13	Number Of Individuals Improving Financial Capability And/Or Adopting Consumer Behavior Skills
14	Number Of Adults That Apply Skills As They Age In Maintaining Brain Fitness And Cognitive Health
15	Improved Understanding Of How Dietary Isoflaovones Impact Metastatic Progression
16	Continued Development Of The Fun With Sisters And Brothers Suite Of Programs
17	Encapsulation Of Bioactive Compounds Into Food Products

18	Toward An Improved Understanding Of The Health Benefits Of Peptides
19	Improving Our Understanding Of Social-Emotional Development Among Young Children From Rural And Suburban Communities
20	Increased Knowledge Of Healthy Lifestyle Choices And Consequences Of Actions With Respect To Healthy Lifestyle Choices
21	Knowledge Gained Regarding Strategies And Skills Needed By Childcare Providers To Enhance Child Development
22	Improved Emotional Health And Well-Being Through Actions Taken To Reduce Household Clutter And Accompanying Stress

Outcome #1

1. Outcome Measures

Number Of Research Projects Utilizing The Child Development Laboratory Research Database

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	22

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 [UIUC]. 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 and Community Development [HCD] 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

In addressing the three objectives outlined above, the project focuses on four overarching developmental themes related to the teaching, research, and outreach functions of faculty within HCD and from across campus. These themes are: [1] Examination of the impact of high-quality early childhood programming on child outcomes; [2] Examination of emerging social relationships within early childhood contexts for children with and without disabilities and/or developmental delays; [3] Examination of the developmental trajectories of language and cognitive development during the early childhood years; and [4] Examination of the child care context as a risk factor for early childhood obesity and inappropriate weight gain.

Results
A total of 22 research projects were conducted at the CDL during the current reporting period. Eighteen of the 22 studies accessed information from the CDL Research Database project as part of their data collection. These 22 projects represent a diverse array of disciplines [including Human Development and Family Studies, Advertising, Anthropology, Landscape Architecture, Art and Design, Nutritional Sciences, Communications, Community Health, and Music Education], and all focused on various aspects of children's growth and development [such as social/emotional development, cognitive functioning, and physical growth and health]. Ten of the projects were investigations conducted by graduate students working under the direction of a faculty advisor, while 12 of the projects were faculty-led investigations.

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 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
2014	67

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Heart disease ranks as the number one cause of death, and diabetes ranks as the seventh leading cause of death in Illinois according the Illinois Department of Public Health. In fact, more than 920,000 adults [8.9%] 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 2½-3 hour face-to face sessions designed for anyone interested in preventing or managing diabetes. During the series held in Illinois this year, 60 participants received information on 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. 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 at the end of the I on Diabetes sessions. Meals for a Healthy Heart is a two-part face-to face series that focuses on increasing participant awareness of the major risk factors of coronary heart disease using methods that are similar to the diabetes programs. Evaluations are distributed at the end of the program, and one and three months after the program has ended.

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', 46 of 60 participants [77%] 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', 48 of 60 participants [80%] 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', 48 of 60 participants [80%] 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 this planned program Evaluation of Results section.

All of the 19 who completed all or sections of the Meals for a Healthy Heart one-month follow up evaluation indicated taking at least one, and as many as six actions including 18 [95%] who read more food labels to help plan their meals, 15 [79%] who used less sodium to season food [a recommended practice to reduce the risk of heart disease], and 13 [68%] who took action to make a weekly meal plan.

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

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #4

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1232

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Obesity among children in the United States has become a national public health concern. Lack of proper nutrition and inadequate physical exercise are two of many interactive factors that lead to childhood obesity.

What has been done
University of Illinois Extension 4-H in conjunction with Supplemental Nutrition Assistance Program - Education [SNAP-Ed] Extension Educators engaged teens to teach primarily fifth-grade youth to make healthy food choices though a new program titled 4-H Food Smart Families that was

conducted in after school programs and summer camps. Additionally, the program was designed to encourage youth to share what they learned with their families. Both the teen teachers and the participants were asked to complete a post-program questionnaire that included questions related to food choice knowledge and actions taken by the youth and their families. The teen evaluation also included items related to positive youth development.

Results

The 4-H Food Smart Families questionnaires were completed after the experience by 1,441 youth and 84 teen teachers. With respect to frequency of healthy food actions taken, youth were asked to check 'Almost never', 'Some days', 'Most days', or 'Every day'. Results indicated that 87.3% of the youth eat breakfast, 84.2% engage in physical activity, 82.7% eat fruit, 62.6% choose healthy snacks, and 57.4% eat vegetables every day or most days. Three-fourths also indicated that they usually often wash their hands. The youth used a 4-part scale that revealed that as a result of their program participation, 70.4% 'Agreed' or 'Strongly agreed' that they learned skills for buying food on a budget with one-half having taught their family those skills. Nearly all [94.5%] learned cooking skills that were used by 83.3% to prepare food at home. Using this same agreement scale four-fifths of the youth 'Agreed' or 'Strongly agreed' that they encouraged their families to eat meals together, and that their families have purchased healthier foods, prepared healthier foods, and prepared meals together. The teen teachers' level of agreement with respect to these statements was slightly higher than for the youth. As a result of their participation, three-fourths of the teen teachers drink less soda and eat more whole grains, and more than 90% drink more water and eat more fruits and vegetables.

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
805	Community Institutions and Social Services
806	Youth Development

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**

Identifying Chronic Stressors In The Lives Of Low-Income African-American Families

Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

Utilizing A Family Resiliency Framework To Address Childhood Obesity

Not Reporting on this Outcome Measure

Outcome #10

1. **Outcome Measures**

Development And Evaluation Of New Therapies For ER-Negative Breast Cancer

Not Reporting on this Outcome Measure

Outcome #11

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
2014	46

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 retired educators developed a research-based prevention simulation and guided discussions for junior high and high school youth, supported by statistical research on bullying among teens in the U.S. The goals of the Breaking the Code [BTC] program 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 that 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 137 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 +46 [34% additional students checked this on the post-test [38 pre-test versus 84 post-test]; [2] Confront a bully +34 [25%] additional students checked this on the post-test [50 pre-test vs. 84 post-test]; [3] Help someone who is being bullied +30 [22%] additional students checked this on the post-test [57 pre-test vs. 87 post-test]; and [4] Want to help change a bullying situation +30 [22%] additional students checked this on the post-test [61 pre-test vs. 91 post-test]. Sample responses when asked what they will do differently follow: 'Thank you, you showed me that bystanders are the most powerful', 'I think that bullying should stop from what I've heard in Breaking the Code and at school', and 'It helps me stop bullying'.

4. Associated Knowledge Areas

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

Outcome #12

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 #13

1. Outcome Measures

Number Of Individuals Improving Financial Capability And/Or Adopting Consumer Behavior Skills

Not Reporting on this Outcome Measure

Outcome #14

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	84

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With 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
Drawing on research being done at the University of Illinois and other research institutions, a total of six three-part program series on brain health were conducted by the four Extension Educators, Family Life in both rural and metropolitan areas in Illinois this past year. The first session of the series addressed strategies and techniques for Building a Better Memory. In the second session [Fit Wits] participants learned about how brain health is directly related to body health and how to maintain that health. In the third session [Head Strong: Exercise Strategies to Enhance Memory and Thinking], participants explored and practiced several exercise strategies to challenge the brain. In addition, sessions were delivered as a stand-alone program that reached 492 individuals throughout the state. At the end of each session, participants provided written feedback on changes in knowledge, plans for using the knowledge they gained, and activities they tried at home.

Results
The following results were collected from the 84 participants in three of the series that were taught. Distribution and analysis of evaluations after the first three sessions of Brain Health revealed that all of the 84 participants learned something. Evaluation responses from those surveyed indicated that 100% of participants reported trying 'brain health' activities between each of the three sessions offered. Some of their activities included purposely recalling information from their long term memories like childhood friends' names, states, and sports teams. Seventy-two percent [72%] of the respondents reported specific strategies or activities they will continue on their own, some of which included practice focus and attention activities, make lists, try Sudoku, word games, creating things with their hands, and activities that help them pay attention.

4. Associated Knowledge Areas

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

Outcome #15

1. Outcome Measures

Improved Understanding Of How Dietary Isoflaovones Impact Metastatic Progression

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2014 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Breast cancer [BC] is the most common cancer affecting women in the United States. Metastatic BC [Stage IV] is the leading cause of death in BC patients. Cancer metastasis is a multi-step process in which cancer cells first proliferate at a primary site, invade the basement membrane and stroma of the primary organ, followed by injection into the circulatory system. Bone is one of the most common sites for metastasis in BC and micrometastasis in bone marrow was detected in 30% of patients with stage I, II, or III BC at the time of primary surgery and is a strong indicator of poor prognosis. The role dietary soy isoflavones play in BC with bone micrometastasis is unclear.

What has been done

In this study, we examined the effect of genistein, daidzein, [-]-equol or a mixture of soy isoflavones on BC with bone micrometastasis using a preclinical model of murine mammary cancer 4T1 cells engineered with luciferase. A small number [1,000] of 4T1 cells were injected into the tibia of female Balb/c mice to establish microtumors in bone. Soy isoflavones were supplemented in the diet at 750 mg/kg and provided to mice from 3 weeks before to 3 weeks after cell injection. Dietary soy isoflavones enhanced the growth of bone microtumors on day 8 after cell injection and stimulated metastatic tumor formation in lungs. This increase was due, in part, to the increase in Ki-67 protein expression in the metastatic tumor cells in lungs. In addition, we showed that soy isoflavones had limited influence on growth, motility or invasion of 4T1 cells in vitro at concentrations lower than 10 mM.

Results

We monitored the progression of 4T1 tumors by injecting 1,000 4T1 cells into the marrow cavity of the tibial bone. The cells were engineered with luciferase; therefore, the growth of micro-tumors in bone could be monitored using bioluminescent imaging [BLI] in real time. No bioluminescent signals were detected on day 2 [D2] after cell injection. Bioluminescent signals from tumors in bone were detectable on D6. The signals in the control group and the mixed isoflavone group continued to increase until the end of the study, while the signals in the genistein, daidzein and equol groups peaked on D16, and then reduced on D20. To examine the effect of soy isoflavones on metastatic tumor formation on the surface of lungs in mice, we counted the white tumor nodules formed by 4T1 cells on the lung surface. Mice in the control group had an average of 2 tumor nodules on their lungs, while mice in the dietary soy isoflavone-treated groups had a significant increase in tumor nodule count with an average of 6 tumor nodules on their lungs [$P<0.001$]. To examine microscopic metastasis inside lungs, sectioned lung tissues were stained with H&E. Tumor colonies in the sectioned lung tissue were counted and tumor area was measured. Mice in the control group had an average of 2 tumor colonies per lung section, while mice in the dietary soy isoflavone-treated groups had a significant increase in tumor colony count with an average of 7 [genistein], 6 [daidzein], 9 [[-]-equol] or 11 [mixed isoflavones] tumor colonies [$P<0.001$]. Tumor colonies in the mixed isoflavone and [-]-equol groups had a large average size when compared to the control group, while the genistein and daidzein groups did not. Although not all treatment groups showed a larger tumor colony size, the two variables, tumor count and tumor area, showed a significant correlation [Pearson's $r= 0.86$, $P<0.001$], indicating similar patterns when representing lung metastasis inside lung tissues.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle

Outcome #16

1. Outcome Measures

Continued Development Of The Fun With Sisters And Brothers Suite Of Programs

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Evidence is mounting that children who experience more positive relationships with a sibling are also more likely to enjoy better developmental outcomes. Conflicts among siblings are a prime source of dissatisfaction for most parents and children. Although a certain amount of conflict appears to be 'normal' for siblings, these disputes can be disruptive to family life due to both their frequency and qualitative characteristics. In addition to being the most common type of family strife, sibling conflicts may be quite aggressive and even violent. Intractable conflictual relations among young siblings have been shown to be predictive of later difficulties, such as antisocial and disturbed behaviors in adolescence. 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. 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 at a disadvantage.

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 middle childhood.

What has been done
Few techniques are currently available to help children achieve these goals. Siblings in middle childhood may be particularly disadvantaged if they have not had the opportunity to develop the

social and emotional competencies that set the stage for prosocial and supportive relationships. Therefore, the current investigation will extend a successful, evidence-based approach for strengthening prosocial sibling relationships by developing and testing a developmentally-appropriate curriculum for children in middle childhood, the Even More Fun with Sisters and Brothers program. This research will contribute to our understanding of the qualities of sibling relationships in middle childhood while providing a tool that is expected to help families.

Results
Curricular developments and evaluation informed the continued development of the Fun with Sisters and Brothers suite of programs that are aimed at enhancing children's sibling relationship quality. Theoretical understanding of the factors that promote prosocial sibling interactions was enhanced. An unexpected positive finding was that children's improvements in sibling relationship quality were also associated with gains in parents' abilities to manage the negative emotions that are often elicited when their children are engaged in conflict. Results indicated that parents gained in emotion regulation competencies, which enabled them to use more effective parenting strategies when responding to their children's conflicts.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
806	Youth Development

Outcome #17

1. Outcome Measures

Encapsulation Of Bioactive Compounds Into Food Products

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As part of the development of encapsulation technology, encapsulation of bioactive compounds is a very promising area [as well as the encapsulation of probiotics]. Bioactive compounds, such as

resveratrol, 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 help to stabilize the compounds during processing, storage, and digestion, and minimize negative sensory properties.

Resveratrol was used as a target bioactive compound encapsulation. The incorporation of resveratrol in general food products is limited by the instability of resveratrol under environmental conditions and within the digestive system due to the isomerization of trans-resveratrol [bioactive form] to cis-resveratrol [bio-inactive form]. The overall goal of this research is to stabilize the bioactive form of resveratrol through microencapsulation.

What has been done
The resveratrol was encapsulated in protein-based microcapsules using dairy proteins [whey protein concentrate and sodium caseinate]. 4.8% resveratrol was added to the protein solution with and without anhydrous milk fat [AMF] and homogenized. The homogenized solutions were spray dried to produce encapsulated resveratrol powders.

The resveratrol recovery from the capsules was ranged from 37% [whey protein concentrate based microcapsules] to 66% [sodium caseinate + AMF based microcapsules]. The limited recovery of resveratrol from the microcapsules was attributed to the binding between the protein and resveratrol, which was supported by fluorescence measurements.

The stabilities of the resveratrol encapsulated in the protein matrices were evaluated by UVA [ultraviolet A] light testing and a 3-stage in vitro digestion model. The 3-stage in vitro digestion model included oral phase [mouth], gastric phase [stomach], and intestinal phase [small intestine]. Sodium caseinate as the wall material for encapsulation enhanced UVA light stability of resveratrol and the stability through the simulated digestive system by increasing both digestive stability and bioaccessibility of resveratrol. The digestive stability of the resveratrol encapsulated in the sodium caseinate + AMF based microcapsule was 88% while the digestive stability of the unencapsulated resveratrol was only 47%. The addition of anhydrous milk fat in the formulation did not have a significant effect on the stability of resveratrol within the microcapsule.

Results
Stabilization of resveratrol was achieved through microencapsulation within a protein matrix using spray drying. In the food industry, spray drying is a common technique and the equipment is readily available to make the scale-up and production of execution of producing resveratrol microcapsules feasible. In addition, the relatively low cost of protein helps to minimize the cost of the encapsulation, thereby minimizing the additional cost of providing a stabilized form of resveratrol to the consumer.

The developed encapsulation system can be applied to other bioactive phenolic compounds such as quercetin for protection and controlled release. Future research can also compare the ability of other types of proteins, such as soy protein and pea protein, to stabilize resveratrol through encapsulation. It would also be interesting to add the resveratrol microcapsules to food products, such as chocolate and protein shakes, and evaluate consumer acceptance of these products. Consumer testing could also be completed on food products with added resveratrol, with and without the information regarding health benefits. In this way, the effect of the information about the resveratrol health claim on consumer acceptance of the product could be determined.

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

Toward An Improved Understanding Of The Health Benefits Of Peptides

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Bioactive properties and peptide profiles were evaluated in protein hydrolysates of raw and commercially precooked common beans. Five varieties [Black, Pinto, Red, Navy, and Great Northern] were selected for protein extraction, protein and peptide molecular mass profiles, and peptide sequences.

What has been done
Potential bioactivities of hydrolysates, including antioxidant capacity and inhibition of alpha-amylase, alpha-glucosidase, dipeptidyl peptidase-IV [DPP-IV], and angiotensin converting enzyme I [ACE] were analyzed after digestion with pepsin/pancreatin. Hydrolysates from Navy beans were the most potent inhibitors of DPP-IV with between precooked and raw [IC50 = 0.093 and 0.095 mg protein/mL, respectively] not being statistically significant. Alpha-Amylase inhibition was higher for raw Red, Navy, and Great Northern beans [36, 31, 27% relative to acarbose [ac]/mg protein, respectively]. Alpha-Glucosidase inhibition among all bean hydrolysates did not show significant differences; however, inhibition values were above 40% rel ac/mg protein. IC50 values for ACE were not significantly different among all bean hydrolysates [range 0.20-0.34 mg protein/mL], except for Red bean that presented higher IC50 values. Peptide molecular mass profile ranged from 500 to 3,000 Da.

Results
Eleven and seventeen peptide sequences were identified in raw and precooked beans, respectively. Peptide sequences YAGGS and YAAGS from raw Great northern and precooked Pinto showed similar amino acid sequences and the same potential ACE inhibition activity.

Processing did not affect the bioactive properties of released peptides from precooked beans. Commercially precooked beans could contribute to the intake of bioactive peptides and promote health.

4. Associated Knowledge Areas

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

Outcome #19

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
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The objectives of this research are: [1] To assess the extent to which early child-mother attachment security predicts theory-of-mind understanding; [2] To examine young children's theory-of-mind understanding as a predictor of children's subsequent peer competence; and [3] To test whether theory-of-mind understanding mediates associations between early child-mother attachment and later peer outcomes. In addressing these objectives, we will utilize data from three longitudinal studies of social-emotional development among young children from rural and suburban communities. The three studies were conducted at the University of Illinois and include: [1] The Children's Social Development Project-Phase 1 [supported by the PI's prior Hatch Grant]; [2] The Children's Social Development Project-Phase 2 [supported by an NSF grant to the PI]; and [3] The Toddler Transitions Project [supported by a seed grant from the Family Resiliency Center at the University of Illinois].

What has been done
Major accomplishments over the past funding year include: [1] Dissemination of findings via four publications in peer-reviewed top-tier scientific journals, with two additional manuscripts under review or revision for resubmission to top-tier journals; [2] Broad dissemination of findings via

newsletters and press releases; and [3] Training opportunities for both undergraduate and graduate students in observational research methodologies, advanced statistical techniques [multilevel modeling] and preparation of conference presentations and manuscripts for publication.

Results

The main findings disseminated over the past year address key study objectives to increase our knowledge of basic processes involved in harmonious parent-child relationships and how positive relationships with parents may provide children with building blocks for developing positive relationships with peers. In one set of papers utilizing data from the Toddler Transitions Project [TTP], our findings highlight key components of mothers' psychological adjustment, including their empathy for other people and physiological levels of stress when exposed to infant emotion vocalizations [crying], that promote mothers' availability and responsiveness to their toddler-aged children. In a second set of papers utilizing data from the Children's Social Development Project [CSDP], we have made novel contributions to our understanding of the beginnings of friendship formation very early in the life course at age three. The unique CSDP study design, in which newly-acquainted same-sex peers were observed over several play sessions across one month, permitted an assessment of how both children's characteristics [such as quality of the mother-child relationship and the child's temperament] predicted children's behavior toward each other and the quality of the children's interaction over time.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #20

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
2014	368

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Recent statistics confirm what parents, teachers and other concerned adults have suspected: 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 inauguration of this program in Illinois was conducted at 13 sites in Chicago and the greater Cook County area. Trained teens and staff provided ten or more hours of educational hands-on activities in school classrooms, summer youth programs, and after school programs. In addition to learning the facts about drugs and the consequences of taking them, the youth engaged in educational activities that encompassed building life skills such as showing concern for others, making healthy lifestyle choices, managing stress, and developing refusal skills. A total of 628 of the 795 youth participants completed the 10 hours of required training. Five hundred and seventy-eight [578] 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 increased agreement 'before' the program. Three hundred and sixty-eight youth [64%] increased their agreement with at least one of the statements when comparing post training ratings and pre-training ratings. One-fourth of the youth increased their agreement with the following statements: [1] Using drugs can ruin my relationship with my family and friends [knowledge of the consequences of actions] and [2] If a friend wanted to try drugs, I can talk them out of it [concern for others life skill]. Nearly one-fourth also increased their agreement with the statements: [3] People who use drugs sometimes see or hear things that are not really there; [4] Once you start smoking, it is hard to stop; and [5] When I feel stressed I am able to talk about it with people I trust. In response to the final set of four questions regarding program satisfaction and experience, 3.3 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

Outcome #21

1. Outcome Measures

Knowledge Gained Regarding Strategies And Skills Needed By Childcare Providers To Enhance Child Development

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	176

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As more women and mothers enter the workforce, child care has become an increasingly important public policy issue. These issues include the growing need for childcare, childcare affordability, and child care quality. Education on child development is critical to creating and sustaining quality child care.

What has been done
Early in 2014, Family Life Extension Educators engaged in a partnership with Pennsylvania State University and the University of Nebraska at Lincoln through a grant from the Department of Defense to deliver the Childcare and Youth Training and Technical Assistance Project [CYTTAP]. The goal of the CYTTAP program is to improve the quality and quantity of childcare for off-installation military families by providing training for childcare providers. The training was held across Illinois in eight locations and included topics from Rock Solid Foundations curricula [emotional literacy, responsive environments, friends and play skills] and Better Kid Care modules [math, sparking kids' curiosity, and emergency preparedness]. A total of 384 childcare providers participated in one or more of the training curriculum topical sessions. An end-of-program retrospective pre-post evaluation to identify changes was collected from participants. A follow-up evaluation was distributed to those for whom mail or email addresses were available; however, a low response rate occurred and precluded reporting those findings.

Results
End-of program evaluation surveys were collected from a total of 356 participants [129 from Rock Solid Foundations participants and 227 from Better Kid Care participants]. The evaluations included both questions related to program satisfaction and improvements and knowledge and confidence in implementing childcare practices and strategies. Two-thirds of the Rock Solid Foundations evaluation respondents [89 of 129] indicated they had increased their understanding and application of what they learned into their work in childcare settings. Using a 4-part scale with 1=None and 4=A lot, more than half of the respondents increased their level of understanding regarding: [1] Strategies to promote children's social and emotional development; [2] The importance of being intentional about supporting children's social emotional competency; [3] Strategies that can be used to build positive relationships with children; [4] Strategies that can be used to build social skills in young children; and [5] The impact of the environment on helping children expand their social skills. In addition, three-fifths [79 of 129] increased their likelihood to apply one or more practices or strategies they learned in the training. All but four of the 227 Kid Care Instructor module evaluation respondents indicated that they learned 'Much' or 'Very much' that applies in their work in childcare settings and nearly half [110] increased their confidence in

implementing the strategies discussed in the training.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #22

1. Outcome Measures

Improved Emotional Health And Well-Being Through Actions Taken To Reduce Household Clutter And Accompanying Stress

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	76

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Excess stress and conflict can be a detriment to achieving a healthy lifestyle. One of the stresses may be living in a cluttered environment. Taking action to organize one's life is one way to help to reduce that stressor.

What has been done
University of Illinois Extension Educators, Family Life continued to offer workshops for various adult audiences [community groups, child care providers] statewide titled Simplify Your Life: Clear the Clutter & Your Stress. The workshop reached 118 individuals. The objectives of the workshop included helping participants to: [1] Understand how clutter can cause stress; [2] Identify their own reasons for the build-up of clutter; [3] Learn the barriers and benefits of dealing with clutter; and [4] Learn techniques to clean-up their clutter. As a part of the program participants developed an action plan to get organized.

Follow-up evaluations were collected from participants to identify what steps were taken to complete participants' action plans.

Results

Follow-up evaluations for Simplify Your Life: Clear the Clutter & Your Stress indicated that 69 [85%] participants indicated that they now think differently about de-cluttering after attending the workshop and 64 [79%] had started or finished their plan to de-clutter. With respect to experiencing a sense of relief/reduction of stress due to progress made from de-cluttering, nearly all [94%] of the 81 who answered the question indicated 'Yes' [48%] or 'Somewhat' [44%]. These and other responses to the evaluation completed by the Simplify Your Life: Clear the Clutter & Your Stress participants evidenced the impact this particular family life program had on improving residents' emotional health and well-being.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle

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

Chronic Disease Management

In 2014, pre- and post-evaluations consisting of four sections of questions were collected from 60 participants at the beginning and again at the end of **I on Diabetes** programs conducted in ten 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 but two of the 60 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

Forty-six [46] of 60 participants [77%] 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', 33 [55%] reported they could now more easily prepare healthy foods, 30 of 60 participants [50%] who completed the

evaluations indicated they improved their ability to select healthier choices when dining out, and 28 [47%] indicated they could easily select foods that fit their meal plan. Twenty-two [22] of 60 [37%] increased agreement that healthy foods taste good. Only 16 of 60 [27%] of the participants 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'. Forty-eight [48] of 60 participants [80%] indicated that they improved their confidence in managing their diabetes. More than half of the 60 who answered these questions indicated an increased confidence in the following: Estimating the amount of food you should eat [39 or 65%]; Selecting foods that will reduce the risk for heart disease [37 or 62%]; Knowing which foods have carbohydrates [35 or 58%]; Preparing foods that fit into their meal plan [32 or 53%]; and Following a healthy diabetes meal plan [32 or 53%]. Only 21 [35%] 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', 48 of 60 participants [80%] reported increasing their frequency in taking at least one recommended action. More than forty percent of the participants revealed increasing the following practices: Setting goals to help manage their diabetes [32 or 53%]; Using food labels to plan their meals [28 or 47%]; Following a meal plan to help manage diabetes [27 or 45%]; and Keeping track of the amount of foods with carbohydrates they eat each day [26 or 43%].

Approximately one-third indicated increasing their frequency in taking the following actions: Trying to limit fat intake [22 or 37%]; Trying to be physically active [22 or 37%]; Reading food labels [21 or 35%]; Eating at least three regularly-spaced meals a day [20 or 33%]; and Trying to limit salt intake [19 or 32%].

In 2014, a one-month and a three-month evaluation was sent to 40 participants in the University of Illinois Extension's **Meals for a Healthy Heart** program. The program is a two-part face-to-face series that focuses on increasing participant awareness of the major risk factors of coronary heart disease. During the series participants received information on heart healthy foods, menu planning, healthy eating away from home, physical activity and weight management. All but one of the 19 participants who responded to an evaluation that was distributed one month after the program's completion indicated taking at least one, and as many as six, of the following actions: Read more food labels to help plan their meals [18--95%]; Used less sodium to season food [15--79%]; Increased physical activity [13--68%]; Made a weekly meal plan [12--63%]; Checked blood pressure more often [7--37%]; and Checked their cholesterol [6--32%].

After receiving a follow-up evaluation mailed three months after the program ended, eleven participants responded. Nine of the 11 participants made at least one and as many as four changes in the following eating habits since participating in the program: Read more labels [8 of 11 reported doing so]; Decreased salt/sodium intake [7 of 11 did--another plans to

do so]; Decreased intake of high fat foods [5 of 11 did]; Increased fiber intake [2 of 11 did]; Ate a variety of foods based on MyPlate food guidance system [2 of 11 did-one plans to do so]; and Changed to monounsaturated fats in food preparation [1 of 11 did]. Eight of the eleven respondents indicated that they had decreased the use of mono-unsaturated fat and seven indicated increasing their fiber intake before attending the program.

Three additional questions sought to elicit respondents' opinions about the following changes resulting from their participation in the program:

More confident in planning and preparing heart healthy meals -- ten checked 'yes' and one checked 'uncertain'.

Making more heart healthy food choices when eating away from home -- eight checked 'yes', two checked 'no', and one checked 'uncertain'.

More aware of the relationship between diet and chronic diseases [such as heart disease, diabetes, or stroke] -- ten checked 'yes', and one checked 'uncertain'.

Health Rocks!

Five hundred seventy-eight [578] of the 795 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. Three hundred and sixty-eight youth [64%] increased their agreement with at least one of the statements when comparing post training ratings and pre-training ratings. Note: This evaluation tool has been designed for use nationally.

Data regarding the increases between before and after the program follow in the order of highest to lowest number of youth who increased their level of agreement with each of the thirteen statements.

142 of 578 [25%] increased agreement that 'Using drugs can ruin my relationship with my family and friends'.

142 [25%] increased agreement that 'If a friend wanted to try drugs, I can talk them out of it'.

136 [24%] increased agreement that 'People who use drugs sometimes see or hear things that are not really there'.

129 [22%] increased agreement that 'Once you start smoking, it is hard to stop'.

124 [21%] increased agreement that 'When I feel stressed I am able to talk about it with people I trust'.

105 [18%] increased agreement that 'People who smoke can die from lung cancer'.

105 [18%] increased agreement that 'I need to think about how my choices will affect my future'.

103 [18%] increased agreement that 'I am able to say no if others offered me cigarettes'.

95 [16%] increased agreement that 'I don't have to drink or smoke even if some other young people do it'.

93 [16%] increased agreement that 'I would help other kids like me to stay away from alcohol or other drugs'.

92 [16%] increased agreement that 'It is important for me to stay focused on learning at school'.

85 [15%] Increased agreement that 'I have goals for myself'.

73 [13%] increased agreement that 'I feel good about myself'.

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'.

Key Items of Evaluation

Chronic Disease Management

All but two [97%] of the 60 participants who completed all or some of the sections of the evaluation indicated increasing their confidence, skills, or practices in managing their diabetes, especially with respect to selecting healthy food choices and following a healthier meal plan to manage their diabetes.

Using a four-part scale ranging from 'Strongly disagree' to 'Strongly agree', 46 of 60 participants [77%] 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'" 48 of 60 participants [80%] 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', 48 of 60 participants [80%] 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 participants' management of diabetes.

Responses from the participants in **Meals for a Healthy Heart** indicated that all but one participant took at least one, and as many as six recommended actions to reduce the risk of

heart disease: Eighteen [95%] took action to read more labels to help plan meals; Fifteen [79%] took action to reduce their use of sodium [a recommended action to reduce the risk of heart disease]; and Thirteen [68%] increased their physical activity.

Approximately one-half to three-fourths of the 11 three month evaluation respondents are maintaining changes such as reading food labels to select healthy food or decreasing intake in salt/sodium or high fat foods in order to reduce the risk of developing heart disease. In addition, more than two-thirds who responded to the questions feel more confident in planning and preparing heart healthy meals, making heart healthy choices when eating away from home, and increased their awareness of the relationship between diet and heart disease.

Health Rocks!

Three hundred and sixty-eight 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. Of note: 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.

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	15%		10%	
123	Management and Sustainability of Forest Resources	10%		10%	
132	Weather and Climate	15%		10%	
133	Pollution Prevention and Mitigation	10%		10%	
134	Outdoor Recreation	0%		10%	
135	Aquatic and Terrestrial Wildlife	5%		15%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		10%	
405	Drainage and Irrigation Systems and Facilities	5%		5%	
605	Natural Resource and Environmental Economics	0%		5%	
806	Youth Development	15%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.0	0.0
Actual Paid	0.0	0.0	7.0	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**
211582	0	1099255	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
211582	0	1099255	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1698819	0	3081099	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities in 2014 included ongoing wet atmospheric deposition monitoring at three sites in Illinois as part of a nationwide project [these results continue to be part of a national program that leads to a complete understanding of atmospheric inputs of nutrients, and is needed to develop appropriate polices], preliminary analysis of data that will provide information about short-term agronomic responses to urban soil management systems, an evaluation of the additional ecosystem services such as carbon sequestration, water infiltration, visual quality, and food production provided by community gardens and other urban agriculture systems, ongoing efforts to enhance the usefulness of existing online interactive keys to Empoasca and related typhlocybine leafhoppers, a study of the immune response of the gypsy moth, Lymantria dispar, to a microsporidian pathogen using proteomic analysis of midgut tissues during the first 72 hours of infection, continued monitoring of the success in establishing new soils in a brownfield that was formerly the U.S. Steel production facility in South Chicago, research focused on determining how landscape level cues [such as the amount of grassland within an area or the juxtaposition of grasslands] affect the occupancy and density of grassland birds, work demonstrating that there is a strong, clear link between habitat quality and physiological properties of resident stream fish [more specifically, the proportion of forest cover in a watershed was the best predictor of blood parameters representing free energy and resistance to oxidative stress, whereas wetland proportion was the best predictor of glucocorticoid function for fish], and research to estimate the value of grassland restoration and exploring how conservation planning could be improved by incorporating an understanding of leakage into its practice.

Activities also included a study designed to quantify the export of MeHg [and total Hg] from selected bioreactors over a full year and compare the flux to free-flowing tiles for a variety of bioreactor designs, operating conditions, and environmental settings, work to identify patterns in diversity [alpha- and beta-diversity] and composition of soil microbial communities associated with invasive and nuisance plant species across broad geographic areas and soil types, the development of models that will be extremely useful in determining which habitats need to be protected to promote connectivity within historical dispersal corridors [improving these corridors will help dispersal through natural migration and/or assisted migration], the development of new knowledge about how forest ecosystems respond to disturbances associated with pest-induced tree mortality, research with a long-term goal of developing sustainable ways to manage lepidopteran corn pests, and a project with the primary objective of predicting changes in soil organic carbon [SOC] and total soil nitrogen [TSN] stocks as a result of land use change from prairie to agricultural land if the mesic-frigid temperature line moved north in the U.S. and the formerly-frigid soils were cultivated.

Conference presentations included the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, American Chemical Society, Ecological Society of America, American Society for Microbiology, Freshwater Science, Entomological Society of America, Indiana Dunes National Lakeshore, Entomological Collections Network, St. Charles Twilight Field Tour, Illinois Mosquito and Vector Control Association, German Society for Protozoology, 47th Annual Meeting of the Society for Invertebrate Pathology, North Central Branch of the Entomological Society of America, American Society of Mining and Reclamation, Beijing International Symposium on Land Reclamation and Ecological Restoration, American Ornithological Union, Livingston County Farm Bureau Agronomy Day, and the NIREC Corn Rootworm Session.

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.

Seventeen self-study modules were made available online for Certified Crop Advisers [CCA's] to access 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 13 locations in the state with approximately 80 in attendance and included topics on cover crops, managing soils to reduce weather variation, using wetlands to reduce nutrient loading, vertical tillage equipment, and the effect of intentional Mississippi River levee breaks on adjacent cropland. In addition, four pond management workshops were conducted and attended by 150 individuals.

The **Illinois Master Naturalist** [ILMN] program completed a seventh year of statewide implementation. Using the twenty-chapter curriculum [that included one on weather and climate], training offered in eleven multi-county locations to certify new Master Naturalists was completed. Nearly 600 Master Naturalists are actively engaged in a wide variety of projects as environmental stewards. They invested a total of 46,850 hours, 4,529 of which reflected educational efforts and another 36,668 were devoted to natural resource stewardship delivered to a reported 1,782 adults and 1,702 youth. A web-based reporting site is used to collect information on all Master Naturalists' and Master Gardeners' training, volunteer hours, contacts, and projects.

In November of 2013 a tornado raced through three towns in West Central Illinois, destroying or damaging an estimated 1,000 homes. Extension responded by providing 100 financial toolkits to victims. Extension staff also served on the long term recovery committee and presented information on remediation of soils imbedded with dangerous small debris from the tornado, a safety concern for home owners, school yards, and park districts. Removal of all the affected soil and replacing it with clean top soil and fall reseeding or sod replacement was recommended.

A climatologist with the Illinois State Water Survey presented 'The Unusual Weather of 2013 and the Outlook for 2014' at the six **Corn and Soybean Classics** and 'Extreme Weather Events and Their Connection with Climate Change or Normal Viability' at the four regional **Crop Management Conferences**. Additional topics presented at the Crop Management Conferences related to natural resources included response to risks associated with excess precipitation, effects of cover crops and no-till on soil organic carbon sequestration, and advanced soil and water management. **Weather Observer Course** classes were held in two counties this year to provide information on the weather as well as training on the volunteer precipitation monitoring program that is a part of the national volunteer precipitation monitoring program. YouTube videos on 15 weather/climate topics were developed this past year as an additional educational effort to address climate and weather. Climate education was also a part of the Master Naturalist volunteer training.

Educational efforts carried out with respect to air quality addressed recent radon testing and reporting

requirements that impact day care facilities and new construction. Workshops were held in six counties in Northwest Illinois and were attended by approximately 130 individuals. The workshops were supported using grant dollars and through a partnership with the Illinois Department of Public Health with leadership provided by an Extension staff member. Other radon educational efforts this past year included two radon awareness billboards. These radon education efforts are also relevant to the Human Health and Human Development planned program area.

Extension campus and field staff continued to conduct six **First Detector** trainings delivered across the state this year that focused on increasing awareness of emerging and current oak problems in Illinois [Oak Splendor Beetle, Goldspotted Oak Borer, European Oak Borer, and Sudden Oak Death] to prevent the loss of shade trees that remove and sequester carbon from the atmosphere [also see the Plant Health, Systems, and Production planned program section]. The Extension pesticide training program reached 1,318 private [farmer] pesticide applicators and 9,164 commercial applicators this past year and provided them with information on the proper and safe use of pesticides that is vital in protecting public health and promoting environmental stewardship.

This past year a forestry field workshop, the first of its kind in several years and attended by 35 individuals, was conducted in West Central Illinois in March. The Extension Forester presented information for forest land owners on selling and marketing their timber and provided sustainable techniques on optimizing timber value. An outdoor afternoon session discussed timber grading, giving attendees information on what foresters/timber buyers look at in valuing timber. The majority of additional 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 woodland owner conferences, 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. **Ask A Forester** is a key feature of the Extension forestry website that received over 163,000 page views. Seven chainsaw safety and directional felling classes/trainings were conducted for 149 woodland owners and farmers. Iowa State University Extension and University of Illinois Extension again partnered to offer the **20th Tri-State Extension Forest Stewardship Conference** that included 21 session choices related to tree diseases and pests, pruning and grafting, forest management plans, planting techniques, and timber sale contracts and marketing. It was attended by over 500 woodland owners and tree enthusiasts from Illinois, Iowa, and Wisconsin.

The **Return of the Large Predator** program was developed this past year to focus on physiology, behavior, and habitat requirements of wolves, cougars, and black bears in response to their migration into Northern Illinois. Multiple presentations engaged over 130 individuals who were able to discuss wildlife values and different perspectives on wildlife.

Youth conservation days with hands-on activities were held in many locations in the state reaching 600 youth, 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 1,351 3rd through 5th graders [discussed in more detail in the Evaluation section of this planned program]. Through a new partnership with Cornell, Teen Teachers were trained in the **Nature Detectives** program and conducted summer program activities in two counties. **Nature Detectives** and **Habitat Connections** will be incorporated into the **I Think Green** curriculum in the coming year. The Cook County Extension Educators who focus on science, technology, engineering and math [STEM] as a priority issue also initiated **Inquiry Adventures,** an inquiry-based nature exploration project for youth. A total of 364 urban youth from ten different organizations 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.

2. Brief description of the target audience

Members of the target audience included gardeners/farmers growing fresh produce in an urban environment, community groups that support urban food production, Extension agents serving the urban audience, community-based organizations [Advocates of Urban Agriculture, Growing Power, Growing Home], urban planners [City of Chicago Department of Housing and Economic Development] and urban gardeners, professional insect taxonomists, Extension specialists, professional insect diagnosticians, students, amateur naturalists, insect ecologists, academic ecologists, land managers, restoration practitioners, government agency personnel involved in planning, implementing, and regulating wetland restoration programs, conservation groups, federal conservation agencies, city storm water managers, scientists and regulators working in the area of agricultural non-point pollution control, the scientific research and regulatory community working in the area of mercury pollution, researchers working in the areas of ecology, microbial ecology, invasion biology, restoration, weed science, and agroecology, aquatic scientists, students, conservation biologists at the state, regional, and national levels, Illinois and Corn Belt corn producers, Illinois crop consultants, seed technology/biotechnology professionals, policymakers, USDA Forest Service scientists, regional and state natural resource professionals who manage forest lands, and the general public who use these forests for recreation. Extension activities targeted pesticide applicators, forest landowners, public officials, representatives from land management agencies, residents interested in natural resource stewardship, home owners, child care facility employees, and youth.

3. How was eXtension used?

eXtension was not used in this program.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	27158	65968	54613	0

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	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
2014	9

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	Nontarget Effects Of Pesticides And Fertilizers On Aquatic Communites
6	Improvement Of Fertilizer Usage Recommendations To Increase Profitability And Reduce Environmental Impacts
7	Ongoing Monitoring Of Wet Atmospheric Deposition
8	Enhancing The Useability Of The Existing Online Interactive Keys To Empoasca And Related Typhlocybine Leafhoppers
9	Demonstrating The Usefulness Of Sub-Lethal, Physiological Metrics In Assessments Of Habitat Quality And Restoration Success
10	Investigating The Ability Of Plants To Alter The Structure Of Microbial Communities
11	Applying Statistical Tools To Aid In The Discovery Of Novel Plant-Microbe Interactions
12	The Development Of Sustainable Practices To Manage Lepidopteran Corn Pests
13	Developing Land Use And Agricultural Management Practices That Would Increase Soil Organic Carbon Sequestration
14	Number Of Pesticide Applicators Making Decisions To Avoid Harming 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
2014	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 through 5th grade youth in investigating how living things interact with each other and with their environment. This program includes three tracks: [1] Worms; [2] Butterflies; and [3] Insects. All three tracks are aligned to Illinois State Educational Goals and 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 1,351 youth this past year.

Results
In responding to a ten-question evaluation given to the youth participants at the end of each of the three tracks, 83% [370] reported that the activities helped them learn how butterflies, worms, or insects contributed to the environment, 80% [356] reported being more excited about helping to care for the environment, 77% [343] reported having more ideas about ways they could help care for the environment, and 71% [316] 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.

4. Associated Knowledge Areas

KA Code	Knowledge Area
134	Outdoor Recreation
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
2014	1294000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Acidic atmospheric deposition continues to be a serious environmental concern. Sulfur and

nitrogen oxides emitted from industrial and transportation sources, utilities, and metropolitan areas enter the atmosphere and are transformed into acidifying compounds. These pollutants are transported in the atmosphere and are removed, in part, as acidic wet deposition. Ecological impacts from this deposition include changes to lake and stream chemistry, reduced forest growth, reduced soil fertility, and increased weathering and corrosion of exposed structures. Aerosols resulting from the emissions reduce visibility and alter the radiative balance of the Earth's climate system. Epidemiological studies link adverse human health impacts with fine particles containing sulfate and nitrate. Deposition of atmospheric mercury has been identified as the major contributor of mercury to ecosystems, where toxic methyl mercury can accumulate in the food chain and have a measureable impact upon human and wildlife health. The goal of the NADP is to monitor the nation's precipitation for these constituents, report our findings to support scientific research, and to determine whether spatial and temporal trends in concentration and wet deposition are present.

What has been done

Since 1978, the National Atmospheric Deposition Program [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. The NRSP-3 provides a framework for cooperation among State Agricultural Experiment Stations, the U.S. Department of Agriculture, and other governmental and non-governmental organizations.

Results

During 2014, NADP data were cited in over 150 peer-reviewed journal articles and other scientific and policy publications. Data and map products from the NADP's five monitoring networks, namely the National Trends Network [NTN], Mercury Deposition Network [MDN], Atmospheric Mercury Monitoring Network [AMNet], Ammonia Monitoring Network [AMoN], and Atmospheric Integrated Research Monitoring Network [AIRMoN] were again downloaded over 28,000 times during the year. 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. All data are available free of charge at http://nadp.isws.illinois.edu.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Nontarget Effects Of Pesticides And Fertilizers On Aquatic Communites

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In the United States and throughout the world fertilizers and pesticides are used to improve crop production through nutrient enhancement and control of pest organisms. In general, fertilizers and pesticides are applied in terrestrial environments but they also reach water sources, including ditches, livestock watering ponds, and troughs used in agricultural practices. Some of these water sources are potential breeding sites for the immature stages [larvae] of mosquitoes. Little is known about how these nontarget effects of pesticides and fertilizers affect aquatic communities. Therefore there is a need to study these aquatic systems, especially when considering mosquitoes are transmitters of human diseases. We used a series of experiments to test how pesticides and nitrogen enhancement in the larval stages affect mosquito performance [adult life span] and susceptibility to infection with disease agents [viruses].

What has been done
Pesticides are widely used around the world to control undesired plants and animals including mosquitoes. The United States accounts for one-third of the total amount of pesticides used to control agricultural and public health pests around the world. In this reporting period, we generated data on non-target effects of agricultural use of pesticides on the ecology of vector mosquitoes.

Results
This data was disseminated to local public health agencies and Mosquito Abatement Districts [MADs] to assist in the development of policies on how to converge integrated pest management with integrated vector management to promote crop production while mitigating the risk of mosquito-borne diseases.

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
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife

605 Natural Resource and Environmental Economics

Outcome #6

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Ongoing Monitoring Of Wet Atmospheric Deposition

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A better understanding of the chemical inputs resulting from atmospheric deposition is critical to understanding nutrient cycling in both crop and forest systems. This can lead to improved nutrient utilization in these systems. The comprehensive monitoring system that Illinois takes part in is also an early warning system for excessive nutrient loadings through atmospheric deposition, and provides an indication of the recovery from acidification in many ecosystems.

What has been done
Wet atmospheric deposition continues to be monitored at three sites in Illinois as part of this nationwide project. Data include weekly collection of precipitation with pH and complete chemistry measured. A long-term record [35 years] is now available at some of these sites, allowing for a better understanding of long-term changes in chemistry.

Results
These results continue to be part of a national program that leads to a complete understanding of atmospheric inputs of nutrients, and is needed to develop appropriate polices. Results continue to

show a decline in both nitrate and sulfate deposition across the Midwestern and Eastern U.S. in response to Clean Air Act regulations. This is one of the few projects that can show a clear environmental outcome to a change in national policies.

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
135	Aquatic and Terrestrial Wildlife

Outcome #8

1. Outcome Measures

Enhancing The Useability Of The Existing Online Interactive Keys To Empoasca And Related Typhlocybine Leafhoppers

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	15000

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 a computer with Internet connection 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
To enhance the useability of the existing online interactive keys to Empoasca and related typhlocybine leafhoppers, a major effort was undertaken over the past year to obtain images illustrating diagnostic morphological characters included in the keys.

Results
Approximately 15,000 images were added to the database and linked to character states and species. This brings the total number of images to more than 40,000 for the 462 genera and more than 4,700 valid species now included in the database. To enhance performance, the leafhopper databases were migrated to a new web server.

4. Associated Knowledge Areas

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

Outcome #9

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
2014	0

3c. Qualitative Outcome or Impact Statement

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

What has been done
This work has demonstrated that there is a strong, clear link between habitat quality and physiological properties of resident stream fish. More specifically, the proportion of forest cover in a watershed was the best predictor of blood parameters representing free energy and resistance

to oxidative stress, whereas wetland proportion was the best predictor of glucocorticoid function for fish. Interestingly, anthropogenic land use categories, such as urban and agriculture, were not the best predictor for any blood parameters.

Results
Together, our results indicate that fish health is largely driven by natural features of a landscape rather than anthropogenic land uses. Furthermore, these findings suggest that physiological methods could supplement traditional population and community assessments to develop a more comprehensive understanding of ecosystem interactions and improve stream management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife

Outcome #10

1. Outcome Measures

Investigating The Ability Of Plants To Alter The Structure Of Microbial Communities

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Soil microbial diversity is strongly shaped by both local and regional factors [climate, soil type, and soil chemistry], but our broad comparison of natural and agricultural ecosystems has demonstrated that plants can significantly alter the structure of microbial communities. Our work has demonstrated that soil bacterial communities and soil fungal communities respond to the presence and density of invasive plants, including Lespedeza cuneata, Rhamnus cathartica, Microstegium vimineum, Elaeagnus umbellata, and Alliaria petiolata. We also demonstrated that encroachment of native shrubs [Cornus drumondii, Rhus spp., and Juniperus virginiana] alters grassland soil fungal community composition.

What has been done
Shrub encroachment threatens remnant hill prairie ecosystems in Illinois, Missouri, Minnesota, and Wisconsin. Fungal communities under shrub encroachment begin to resemble fungal communities found in forests, and this shift from 'grassland' to 'woodland' fungi play a role in the loss of hill prairie plant communities. We demonstrated that certain agricultural weeds [Ambrosia trifida and Helianthus annus] change soil microbial community composition in ways that affect the performance of these plants [this phenomenon is what plant ecologists call 'plant-soil feedback'].

Results
Our work has further demonstrated that the use of cover crops and green manures in agricultural systems can change microbial community composition with potential consequences for weed germination and seedling emergence. By investigating these phenomena across different spatial scales, we have been able to demonstrate that these specific plant-induced changes are robust in the face of large-scale geographic and environmental variability, and we have pioneered the use of statistical tools to help tease out the signal from the noise in these coupled plant-microbe datasets.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
123	Management and Sustainability of Forest Resources

Outcome #11

1. Outcome Measures

Applying Statistical Tools To Aid In The Discovery Of Novel Plant-Microbe Interactions

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One of the most challenging aspects of plant-microbe work is uncovering important species interactions from the vast species diversity of soil microorganisms. We have made significant advances in applying statistical tools to aid in the discovery of novel plant-microbe interactions

and identifying key microbial 'signals' from the background 'noise' of high-diversity datasets. We demonstrated that multivariate tools can be used to define an index of 'affinity' for microorganisms for particular plant species; that is, does the microorganism respond positively or negatively [or not at all] to the presence of a given plant species? We also showed how 'home and away' experiments can be used to assign an index of 'effect' to microorganisms; that is, does the microorganism have a positive or negative [or neutral] influence on the growth of a particular plant?

What has been done
We demonstrated that the agricultural weeds Ambrosia trifida and Helianthus annus can alter microbial communities in ways that are consistent with plant-microbe feedback loops, and by combining the 'affinity' and 'effect' indices of microorganisms that respond to these plants, we were able to identify key microbial players that accounted for over 70% of the variation in growth rates for these plants. In addition, we have been applying multivariate data analyses to characterize key microbial actors in early season weed seed germination and seedling growth. As a result of these analyses, we have discovered that a bacterial strain of Chryseobacterium, a strain of Xanthomonadaceae, a strain of Agrobacterium, and several strains of Pseudomonas all play large roles in suppressing the growth of weed seedlings. We have also identified several fungal species in the classes Sodariomycetes and Agaricomycetes with similar weed-suppressive roles.

Results
These microorganisms respond positively to the addition of red clover green manures, which indicates that cover crop management can influence soil bacterial communities, which can then interact with weed seedlings to reduce weed pressure on crop plants. We also applied classical inoculation experiments to show that invasive Lespedeza cuneata derives a greater benefit from bacteria in the genus Bradyrhizobium than from other closely related nitrogen-fixing Rhizobia; this association between non-native plants and Bradyrhizobium has been noted previously for other invasive species, and it may be a general pattern in plant-microbe interactions for non-native legumes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #12

1. Outcome Measures

The Development Of Sustainable Practices To Manage Lepidopteran Corn Pests

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The impacts of exotic insects and pathogens on forest ecosystems are increasingly recognized, yet the factors influencing the magnitude of effects remain poorly understood. Eastern hemlock [Tsuga Canadensis] exerts strong control on nitrogen [N] dynamics, and its loss due to infestation by the hemlock woolly adelgid [Adelges tsugae] is expected to decrease N retention in impacted stands. We evaluated the potential for site variation in N availability to influence the magnitude of effects of hemlock decline on N dynamics in mixed hardwood stands. Contrary to expectations, we found that hemlock decline increased ecosystem N retention by stimulating N uptake and growth by healthy vegetation within mixed forests. Our findings contribute new knowledge about how forest ecosystems respond to disturbances associated with pest-induced tree mortality. Our findings suggest that tree mortality may contribute to decoupling the relationship between N deposition and ecosystem N flux.

What has been done

We measured N pools and fluxes at three elevations [low, mid, and high] subjected to increasing atmospheric N deposition where hemlock was declining or absent [as reference] in western North Carolina. Nitrogen pools and fluxes varied substantially with elevation and increasing N availability. Total forest floor and mineral soil N increased [$p<.0001$, $p=0.0017$, resp.] and forest floor and soil carbon [C] to N ratio decreased with elevation [$p<.0001$, $p=0.0123$, resp.], suggesting that these high elevation pools are accumulating available N. Contrary to expectations, subsurface leaching of inorganic N was minimal overall [<1 kg ha-1 9 mo.-1], and was not higher in stands with hemlock mortality. Mean subsurface flux was 0.16 ± 0.04 [SE] [kg N ha-1 100 d-1] in reference and 0.17 ± 0.05 [kg N ha-1 100 d-1] in declining hemlock stands. Moreover, although subsurface N flux increased with N availability in reference stands, there was no relationship between N availability and flux in stands experiencing hemlock decline. Higher foliar N and observed increases in the growth of hardwood species in high elevation stands suggest that hemlock decline has stimulated N uptake and growth by healthy vegetation within this mixed forest.

Results

We also measured phosphorus [P] pools and fluxes. While total soil P was similar across the study area, phosphorus fractionation revealed distinct differences in the distribution of soil P fractions as elevation and N availability increased. Soils from high elevation plots where N availability was greatest had 139% larger organic P pools and 55% smaller residual and refractory P pools than soils from low elevation plots with less N availability, suggesting that increased N availability has driven the depletion of recalcitrant P pools by stimulating biotic demand and sequestration. These differences in P distribution among fractions influenced how tree mortality affected P dynamics. At high elevations, plots containing declining hemlocks had significantly greater foliar P concentrations and fluxes of P from the forest floor than reference

plots at similar elevations, whereas at low and mid-elevations there were no consistent differences between plots. Across all elevation classes, hardwood foliar N:P ratios were lower in plots with declining hemlocks. Collectively, these results suggest that increased N availability enhances bioavailable P, which is sequestered in vegetation until disturbances liberate it.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #13

1. Outcome Measures

Developing Land Use And Agricultural Management Practices That Would Increase Soil Organic Carbon Sequestration

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Our primary objective is to assess the impact of land use change on SOC dynamics and greenhouse gas emissions on the sloping, nearly level, and pothole landscapes subjected to clearing, drainage, soil erosion, cultivation, or grazing. As a result of our findings, we would then recommend land use and agricultural management practices that would increase SOC sequestration and storage and decrease greenhouse gas emissions while sustaining or improving agricultural production, maintaining soil productivity, and reducing soil erosion under changing climate conditions.

What has been done
The 24-year study was conducted in southern Illinois on land similar to that being removed from the Conservation Reserve Program [CRP] to evaluate the effects of conservation tillage systems on: [1] Amount and rates of soil organic carbon [SOC] storage and retention; [2] The long-term corn and soybean yields; and [3] Maintenance and restoration of soil productivity of previously eroded soils. The no-till [NT] plots did store and retain 7.8MgCh-1 more and chisel plow [CP] - 1.6MgCha-1 less SOC in the soil than moldboard plow [MP] during the 24 years. However, no

sequestration occurred in the sloping and eroding NT, CP, and MP plots since the SOC level of the plot area was greater at the start of the experiment than at the end. The NT plots actually lost a total of -1.2MgCha-1, the CP lost -9.9MgCha-1, and the MP lost -8.2MgCha-1 during the 24-year study. The long-term productivity of NT compared favorably with that of MP and CP systems.

Results

The primary objective of this research was to predict changes in soil organic carbon [SOC] and total soil nitrogen [TSN] stocks as a result of land use change from prairie to agricultural land if the mesic-frigid temperature line moved north in the U.S. and the formerly frigid soils were cultivated. The conversion of prairie to agricultural use, as a result of climate shift, would release SOC into the atmosphere and enhance greenhouse gas emissions. The SOC and TSN differences between the prairie site and agricultural land were compared in South Dakota. The agricultural land had 18% less SOC and 16% less TSN [or only half of the expected loss from prairie levels]. An attempt was made to document the land use history of the prairie site to understand why SOC and TSN losses were less than anticipated. The fly ash concentration levels on prairie side slopes suggested that the prairie was historically disturbed and eroded. Intensive grazing and burning contributed to the disturbance. The SOC and TSN stock losses appear to represent the minimal change that would occur in the next 100-year time period if a prairie was shifted to agricultural use as a result of climate shift and the mesic-frigid temperature line in the U.S. was to move north.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
132	Weather and Climate
133	Pollution Prevention and Mitigation

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
2014	9199

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Use/application of pesticides has potential adverse impacts on the environment, crops grown, and the pesticide applicator.

What has been done
Private applicator training was delivered by Extension staff in 14 settings across the state to a total of 1,318 individuals in 2013-2014 that included agricultural producers, agriculture and horticulture sales associates, and Extension master volunteers. Commercial applicator training was offered by Extension staff through 50 clinics located in 26 settings across the state to a total of 9,164 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 9,164 [8,211] 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, pest control decision-making, mixing pesticides properly, and 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 1,318 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 taking steps to prevent it. Using the average figure of $11,000 from the three-year study regarding training participants' estimate of what they are able to save by being able to protect their production and apply appropriate pesticides when necessary, the total estimated dollars for the six percent [79] of the training attendees last year, may well be nearly $900,000 saved.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
211	Insects, Mites, and Other Arthropods Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

A ten-question evaluation was completed by 445 youth who participated in the **I Think Green** program comprised of 208 who participated in the butterfly track and 237 in the worm track. Response tallies for the six questions that were identical for all three groups follow.

Environment Related Questions

77% [343] of youth reported having more ideas about ways they could help care for the environment.

80% [356] of youth reported being more excited about helping to care for the environment.

71% [316] 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

93% [414] of youth reported that the **I Think Green** activities were fun to do.

85% [378] of youth reported that they would like to do more activities like the ones in **I Think Green**.

79% [352] of youth reported that they would like to help with a community garden project.

Butterfly Track Questions

92% [191] of youth reported that the activities helped them learn about butterflies and how they grow.

75% [156] of youth reported that the activities helped them to learn how butterflies interact with other living things.

83% [173] of youth reported that the activities helped them learn about how butterflies contribute to the environment.

73% [152] of youth reported that they were encouraged to ask questions about butterflies and the environment.

Worm Track Questions

92% [218] of youth reported that the activities helped them learn about worms and how they grow.

82% [194] of youth reported that the activities helped them to learn how worms interact with other living things.

83% [197] of youth reported that the activities helped them learn how worms contribute to the environment.

53% [126] of youth reported that they were encouraged to ask questions about worms and the environment.

Key Items of Evaluation

Nearly all of the youth participants 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	25%		10%	
206	Basic Plant Biology	25%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	20%		10%	
212	Diseases and Nematodes Affecting Plants	20%		13%	
213	Weeds Affecting Plants	0%		12%	
216	Integrated Pest Management Systems	5%		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: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	8.0	0.0
Actual Paid	0.0	0.0	10.6	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**
418246	0	894184	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
418246	0	894184	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
3358128	0	12322850	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities in 2014 included studies to observe the effects of the addition of cover crops on organic grain production systems, a discovery suggesting that sigma factor cascade in E. amylovora exists in its regulatory networks and regulates important virulence factors [sigma factors, including alternative sigma factors, are essential transcription initiation factors that direct RNA polymerase to bind specific promoter regions], the testing of over 1,300 individual waterhemp plants from over 320 fields for specific herbicide resistance traits and the evaluation of glyphosate-resistant waterhemp plants from Illinois and other Midwest states for the presence of EPSPS gene amplification [the EPSPS gene encodes the target enzyme of glyphosate, and amplification of this gene is one of the known mechanisms of glyphosate resistance], ongoing work to establish a long-term research experiment plot to provide necessary calibration of a decision support system for agrotechnology transfer [DSSAT], research with the overall goal of understanding the biology of X. cucurbitae and determining the etiology and epidemiology of bacterial spot for developing effective strategies for management of the disease, the development and testing of new experimental lines for yield, agronomic traits, and disease and pest resistance under the University of Illinois soybean breeding program [the program grew over 3,000 4-row yield test plots, over 6,600 2-row yield plots, and over 11,000 plant row plots], a new project that evaluated the effect of cover crops on diseases and pathogens [treatments included 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], the development of a system to measure respiration rates of corn and soybeans [results of the study will be used to estimate dry matter losses and will be used to determine maximum allowable storage times for corn and soybeans in high temperature and high moisture environments], ongoing improvement of the Varietal Information Program for Soybeans [VIPS] database [VIPS provides important results on soybean varieties planted throughout the State of Illinois and how they delivered for yield as well as providing key information on weed resistance, disease and insect resistance, and a renewed focus on quality measurements such as protein and oil content and amino acid profiles], and the use of a high-throughput single nucleotide polymorphism [SNP] genotyping assay to investigate relationships of Malus species, draw inferences on the domestication history, identify traits critical for domestication, and assess potential genetic loci under selection.

Activities in 2014 also included the development of improved winter wheat varieties adapted to Illinois, research with the goal of developing a rapid approach to discovering new viruses in plant parasitic nematodes, work to improve methods used to manage Palmer amaranth [simply attempting to control Palmer amaranth often leads to ineffective herbicide applications, substantial crop yield loss, and increasing weed infestations], research to determine the reproductive stage at which weeds can be terminated and still produce viable seed, work to determine the effects of planting date and plant population on yield of recent corn hybrids [with a view toward formulating new planting and replanting

guidelines and assessing foliar fungicide effects on corn planted at different times], the use of RNA Seq to reveal gene networks involved in seed development and early seedling growth programs, oilseed research focusing on responses of soybeans to growth under elevated ozone and carbon dioxide, and the characterization of the roles of the FT/TFL1 gene family in photoperiodic flowering in Arabidopsis [the flowering transition is central to reproductive success in plants and for determining environmental fitness].

Conference presentations in 2014 included the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, Illinois Fertilizer and Chemical Association, Illinois Specialty Crops, Agritourism, and Organics, XXIV Congreso Argentino de la Ciencia del Suelo y II Reunión Nacional Materia Orgánica y Sustancias Húmicas, Twentieth World Congress on Soil Science, MOSES Organic Farming Conference, NASA Astrobiology Institute Seminar Series, 10th International Congress of Plant Pathology, Society for Horticultural Science International Fire Blight Workshop, Livingston County Farm Bureau Agronomy Day, Northern Illinois Agronomy Research Center Corn Rootworm Session, University of Illinois' Agronomy Day, American Phytopathological Society, Cucurbitaceae 2014, Soybean Breeders' Workshop, North Central Soybean Research Program Board, Molecular and Cellular Biology of the Soybean Conference, West Africa Centre for Crop Improvement, Corn and Soybean Classics, American Society of Agricultural and Biological Engineers, Weed Science Society of America, North Central Weed Science Society, American Association of Cereal Chemists, American Soybean Association, American Seed Trade Association, Corn and Sorghum Seed Research Conference, Short Rotation Woody Crops Operations Working Group, Corn, Soybean, and Sorghum Research Conference, Molecular and Cellular Biology of Soybean, and the Institute of Food Technologists.

Extension activities focused on both food and non-food horticulture crops and pests. The **Ask Extension--Hort Corner** program is comprised of multiple topics [many of which are in Spanish] that received 561,057 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 nine horticulture distance education programs titled **Four Seasons Gardening** was offered at Extension offices throughout the state during the fall and spring with a total attendance of 1,940. Topics included herbs, pest control strategies in the garden, bargain gardens, home orchards, youth gardens, West Nile Virus, day lilies, rain gardens, and hydroponics.

Extension Master Gardeners gave countless hours in providing horticulture information to the public. This past year, 560 new Master Gardeners completed training at various locations in the state [118 were trained via the online program]. Pre- and post-tests indicated that 324 of the trainees who completed both tests increased their knowledge by 26.6%. In total there were 3,200 active Master Gardeners in Illinois who made more than 164,000 direct teaching contacts and contributed more than 198,000 volunteer hours with an overall economic value of their contributions estimated to be $4.77 million. More than half of these hours were devoted to teaching audiences how to grow, preserve, and share or sell excess produce to enhance the consumption of food rich in required nutrients for good health. 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. Award-winning garden projects this past year included creation of an heirloom perennial garden in collaboration with a museum, maintaining a garden at a local hospital site to improve the health of employees and information for guests, school gardens, establishment of a native butterfly hoop house at a wildlife prairie park, a garden at a zoo, and community gardens focused on donating produce to local food pantries.

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 two new modules were added to the existing 10 modules [one for Gypsy Moth and a second for Oak Problems].

The 12 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. Since first offered in 2011-12, credit has been awarded for completion of 2,375 modules.

The **University of Illinois Plant Clinic** had a total of 8,494 diagnostic service contacts in 2014 [1,800 telephone inquiries, 2,500 email and App requests, and 600 walk-in consultations] and 3,807 plant samples. Clinic staff members also made presentations and provided demonstration materials for numerous outreach programs that included Master Gardener plant disease and IPM training courses, the Extension Crop Management Conferences and various plant-related trade shows and conferences. Clinic staff also assisted with the **2014 Illinois First Detector** invasive pests statewide workshops conducted in conjunction with the Illinois Natural History Survey, the Illinois Department of Agriculture, and the Illinois Department of Natural Resources hosted at Extension offices. In addition, 23 articles were prepared for inclusion in one or more of the 16 issues of the **Home Yard and Garden newsletter** which had approximately 232,000 visits and nearly 439,000 page views. Clinic staff also maintained social media activities that included website information [55,333 page views] , Facebook [1,255 followers/80,215 reached], podcasts [2,765 views], YouTube videos [230 views] and 3,000 plant diagnostic App downloads.

The Extension **Digital Diagnostic System** provided outreach to homeowners and commercial producers in diagnosing and providing solutions for 276 samples of invasive and exotic species pests. The Extension **Pesticide Safety Education** training program reached 1,318 private [farmer] pesticide applicators and 9,164 commercial applicators this past year providing information on proper and safe use of pesticides that is vital to Illinois residents with respect to public health protection and environmental stewardship.

2. Brief description of the target audience

Members of the target audience included nematologists and other scientists in the plant protection field, scientists in the fire blight research community and related enterobacterial areas, corn and soybean producers, commercial entomology and crop protection/pest management professionals, Extension personnel, agricultural biotechnology company representatives, college students in the agricultural sciences, the weed science community and practitioners of weed management, plant pathologists, crop scientists, researchers and practitioners focusing on grain harvest, handling, and transportation, researchers interested in woody plant biomass production, evaluation, and yields, scientists engaged in the studies of plant evolution, genetics, and breeding, retail suppliers of agricultural inputs, and public and private media sources. 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 members are members of the Consumer Horticulture or Invasive Species eXtension Communities of Practice.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	74601	239134	22309	0

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

Patent Applications Submitted

Year:	2014
Actual:	4

Patents listed

TF 11129-US [Compositions and Methods for Modulating Anthocyanin Accumulation and Pistil Development] and TF 14053-PRO [Detection and Association of Variation to Heritability]. Issued Patents: 8,680,364 [Soybean Genes for Resistance to Aphis Glycines], and 8,692,053 [Soybean Genes for Resistance to Aphis Glycines].

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	63	63

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2014	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

More Informed User Of Pesticides

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	188

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The demand for good horticultural information by homeowners frequently outstrips the number of Extension educators who can supply the needed input.

What has been done
Master Gardener multl-county training sessions and online training were completed by 560 new volunteers in 2014. An online evaluation survey was completed this past year by 269 new [between two and four years of experience] Master Gardeners. The survey was designed by the state coordinator of Master Gardeners to assess 13 gardening practices, 11 personal improvement skills, and Master Gardener experience in teaching horticulture topics.

Results
Pre- and post-tests completed by 269 of the new Master Gardeners evidenced that 95% [255] of the respondents indicated that they adopted at least one of the 13 gardening practices. Specifically, 188 [70%] of the respondents reported now identifying an insect, disease or weed problem before deciding on a control measure and choosing plant varieties that are known to be resistant to insects and diseases. In addition, approximately one-half are now keeping records of pest occurrence and control methods for later reference. More than one third are now using pesticides according to the container label. Complete results from the survey are indicated in the evaluation section of this planned program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #2

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #3

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
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
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 acetolactate [ALS]-inhibiting herbicides. Our prior field and greenhouse results indicated that this waterhemp biotype is resistant to mesotrione [and all commercial HPPD-inhibiting herbicides used for weed control in maize] and atrazine, from both preemergence and postemergence applications, mainly due to the rapid metabolism of mesotrione and atrazine [although by different detoxification mechanisms and enzymes]. These research findings are particularly significant and relevant for crop production and weed management with postemergence [POST] herbicides in maize because several other waterhemp populations have recently been identified in seed corn fields throughout the Midwest that possess this unique form of multiple herbicide resistance, which is based on herbicide detoxification.

What has been done

Our previous research reported metabolic-based resistance to mesotrione in a waterhemp population designated MCR [for McLean County, Illinois HPPD-resistant]. Elevated rates of oxidative metabolism, presumably catalyzed by cytochrome P450 monooxygenases [P450s], contributed significantly to mesotrione resistance within the MCR population. Experiments were conducted to test the hypothesis that higher expression levels of specific P450s correlate with mesotrione resistance in the MCR population. Another mesotrione-resistant population, CHR [for Champaign County, Illinois HPPD-resistant], and several other mesotrione-sensitive waterhemp populations were used for comparison with MCR. Total RNA extracted from meristem and new leaf tissue from individual waterhemp plants of the same ages and height [10 cm] were used for real-time quantitative reverse transcriptase-polymerase chain reaction [qRT-PCR] analysis to compare transcript levels of candidate P450 genes among populations. Primers were designed from conserved regions between several candidate maize and Helianthus P450 cDNAs and the most similar P450 contigs in the waterhemp transcriptome. qRT-PCR demonstrated that a P450 transcript most similar to a maize P450 gene is more highly expressed in meristem tissue of MCR and CHR seedlings [10 cm] compared with each mesotrione-sensitive waterhemp population. Significant differences in expression were not detected when comparing two additional candidate P450s among these waterhemp populations at a height of 10 cm.

Results

Expression of the maize P450 homolog in waterhemp, in meristem tissues from MCR seedlings harvested at 4, 6, 8, and 10 cm, was significantly higher than in WCS [for Wayne County, Illinois, herbicide-sensitive] seedlings, but not in 2 cm seedlings or in roots harvested from 10 cm plants. Therefore, only expression of this maize homolog in waterhemp correlated with POST mesotrione resistance and growth-stage results in MCR and CHR suggested that P450 expression might be growth-stage dependent. Expression of this P450 marker gene can therefore be used for future molecular-genetic and functional genomics work to further investigate the association of its expression patterns with the resistant phenotype discovered in our research. Additionally, growth-stage results suggest that P450 expression may be growth-stage dependent, which negatively correlates with POST mesotrione control of waterhemp under field conditions. For example, significantly greater waterhemp control is obtained when mesotrione is applied POST to smaller waterhemp plants [2-5 cm tall] compared to plants at 5-10 or 10-15 cm tall. Current research is being conducted to quantify P450 expression in F2 segregating lines as well as to obtain and compare the entire cDNA sequences of this gene in MCR, CHR, and WCS waterhemp populations.

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 #4

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Development Of Rust-Resistant Lines For Illinois Soybean Growers

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Identification Of Nematode Pathogens Using DNA Sequencing

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The initial goal was to develop a rapid approach to discover 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.

What has been done
We were able to obtain 21 different isolates of root-knot nematode and then applied the viral isolation method to the samples. Using a multiplex strategy, we were able to obtain over 150 million DNA sequences from the pooled nematode samples. The sequences were analyzed by

comparing them to a database containing known viral proteins. The initial results showed very significant matches to seven viruses, indicating the root-knot nematodes may contain viruses. However, we now think the viruses may have been from insect eggs that contaminated the nematode preparation and not from the nematodes themselves. Even so, this project has been very successful and shows that viruses can be detected in pooled nematode samples using a fairly simple technique. It may also indicate that asexually reproducing nematode species [root-knot nematodes] may contain different viruses than sexually reproducing species [cyst nematodes].

Results
This approach to virus discovery could be applied to any nematode population either in the laboratory or in the field. Nematode viruses have only been recently discovered, thus this approach has the potential to rapidly identify new viral species. However, it also shows that great care must be taken to use very clean nematode samples to avoid false positives. 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
201	Plant Genome, Genetics, and Genetic Mechanisms
205	Plant Management Systems
206	Basic Plant Biology
212	Diseases and Nematodes Affecting Plants

Outcome #7

1. Outcome Measures

Development Of Improved Soft Red Winter Wheat Varieties

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The development of improved winter wheat varieties adapted to Illinois will benefit farmers and consumers in Illinois and surrounding states. Development of disease-resistant, higher-yielding, high-quality, lodging-resistant varieties decreases the farmer's per unit cost of production by increasing the yield and quality of the product without increased costs. Control of diseases through the use of resistant varieties rather than through the use of fungicides is preferable because using fungicides increases input costs and fungicide use involves several risks, such as the risk of groundwater contamination and the risk of ineffective control because of weather limitations on timely application. Use of improved germplasm will benefit farmers in Illinois since resultant varieties may be well adapted in Illinois as well as in other states. Basic research studies on wheat will contribute to increased understanding of wheat genetics and development, increased efficiency in breeding and evaluation, and better methods of selection including molecular marker assisted selection. This project also performs service functions in the education of future plant breeders through evaluation of germplasm from other programs in the Uniform Eastern Soft Red Winter Wheat Nursery and evaluation of germplasm for resistance to wheat soil borne mosaic virus, scab, and barley yellow dwarf virus.

What has been done

In the 2013-14 growing season about 100 advanced experimental breeding lines were evaluated in replicated tests. About 400 preliminary breeding lines were evaluated. Selections were made based on yield, test weight, milling and baking quality, maturity, height, and resistance to Fusarium head blight [scab]. In addition, about 1,560 breeding lines were evaluated in single plots, and about 350 of these lines were selected for continued evaluation in 2015. About 26,000 F4 headrows were evaluated in 2014, and about 1,800 headrows were selected for further evaluation in 2015 based on height, maturity, disease resistance, and kernel morphology. Preliminary increase blocks of several experimental breeding lines were grown in 2014 in preparation for release of these lines.

Results

We used molecular markers for enrichment of FHB resistance genotypes in about 10 F2 populations. An association mapping study was conducted to identify wheat lines that are most likely to contribute genes to enhanced FHB resistance. Data were collected from about 100 advanced lines. High quality data were obtained from all four locations and used for selection of the best breeding lines. We collected data on grain yield, test weight, height, heading date, Fusarium head blight resistance, leaf blight, and grain quality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
205	Plant Management Systems
206	Basic Plant Biology
212	Diseases and Nematodes Affecting Plants
216	Integrated Pest Management Systems

Outcome #8

1. Outcome Measures

Evaluating The Effectiveness Of Cover Crops In Reducing Disease Severity

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Identification And Evaluation Of The Many Possible Functions Of Cover Crops

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Organic farmers have had some success using cover crops, rotary hoeing, and in-row cultivation during the grain crop growing season to suppress weed populations. But the successful use of tillage is weather-dependent, necessitating development of alternatives. While important for weed control, the extra time spent tilling can be economically and physically detrimental. Extensive tillage encourages organic matter decomposition, breaks down soil aggregates, weakens soil structure and can eventually lead to compaction. Not only are compacted soils physically difficult and costly to reverse, compaction has a multitude of negative consequences on soil quality and crop productivity. Compaction interferes with water infiltration, nutrient cycling, root development, and aeration which in turn can negatively affect crop growth and yield. Compacted soils in organic grain production present a serious issue to the efficiency and success of the system. The addition of cover crops has been proposed as a solution to soil compaction, and studies were started in Illinois to observe the effects of the addition of cover crops on organic grain production systems. Research in other states has suggested that incorporating deep-rooted cover crops minimizes compaction and improves soil quality. Introducing deep rooted cover crops, such as forage radish, into organic grain production systems has the potential to alleviate compaction, improve soil quality, and suppress weed populations. Though the potential benefits from deep rooted cover crops are multiple, the results are highly dependent upon factors such as agronomic

management, length of the growing season, plant species, subsequent cash crop, soil type, and weather conditions.

What has been done
Compaction did not have a significant influence on overall cover crop growth but did have an effect on spring weeds biomass. Spring weeds biomass was lowest for the non-compacted areas of forage radish, harry vetch, and cereal rye NCP FRhvr rotation, and FRhvr cover crop treatment did have the overall fewest number of weeds with 37% less than the control. The FRhvr rotation was the only treatment to reduce counts and biomass, but this effect was only witnessed in the first spring sampling time prior to seedbed preparation and planting. Weed suppression by cover crops was over then and the entire weed population as cover crop did not selectively suppress specific weed groups and did not influence weed diversity. Certain cover crop combinations can effectively control weeds in organic grain production, but trade-offs must be considered with their implementation. In harsh weather conditions, cover crops potentially compete with cash crops for water resources. The drought conditions in 2012 contributed to the 20% yield decrease in the FRhvr in NCP in comparison to the NCP control. This trend was verified with the scaled corn and soybean yields. Additionally, these results speak to the potential benefits of the compacted areas to help retain valuable water resources and improve cash crop growth.

Results
Overall, there is a need for more research in the organic grain sector. Cover crop research has been frequent in conventional systems, but few studies have focused on organic production. Our study shows that cover cropping acts as a great tool for weed management for farmers in the Midwest in organic grain production, but understanding the impact of the practice in variable weather conditions and in long-term systems is required. The benefits of this practice are greatly variable by location and management system so further research is needed in the Midwest in organic grain production systems to verify the potential of these cover crops.

4. Associated Knowledge Areas

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

Outcome #10

1. Outcome Measures

Developing New Strategies For Controlling Fire Blight

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Fire blight, caused by the bacterial pathogen E. amylovora, is a destructive disease of apples and pears. In the United States, regional losses to fire blight and cost of control average over $100 million annually. The use of streptomycin, an antibiotic that targets the blossom blight phase, has been recommended until recent years when the occurrence of streptomycin resistance has rendered this antibiotic ineffective. Moreover, this also raises concerns over the potential impact of agricultural use of antibiotics on human health. Without streptomycin, there are no other reliable fire blight disease control measures available. Thus, new strategies for controlling fire blight are critical for preventing severe losses in susceptible orchards in the near-term along with pursuing strategies for long-term management of fire blight. Sigma factors, small RNA, and protein post-translational modification are part of the global regulatory networks in bacteria. Sigma factors, including alternative sigma factors, are essential transcription initiation factors that direct RNA polymerase to bind specific promoter regions. It is also known that many sRNAs are members of regulatory circuits involved in stress response, virulence, and metabolism.

Furthermore, it is well established that acetylation of proteins can influence their binding to DNA, thus impacting gene expression. However, for plant pathogenic bacteria, studies involving sigma factors, small RNA, and protein lysine acetylation have been very limited. Therefore, there is a critical need to conduct research in these new and emerging areas by determining the role of small RNA, sigma factors, and protein lysine acetylation in regulating virulence factors in E. amylovora. The knowledge gained will further improve our fundamental understanding of how E. amylovora infects hosts and causes disease, and allow us to develop strategies for disease control and for reducing the economic losses. The knowledge could also be extended to other enterobacterial systems such as E. coli and Salmonella, which are great threats to human health and food safety.

What has been done
We investigated the role of RpoN, a nitrogen limitation sigma factor, and its modulation protein YhbH, a novel ribosome-associated protein, in E. amylovora virulence. Our results showed that mutations in hrpS, hrpL, rpoN, and yhbH, but not yfiA and rmf3, resulted in nonpathogenic phenotype on immature pear fruits and apple shoots. Consistently, expression of T3SS genes including hrpL, dspE, hrpN, and hrpA was barely detected in hrpS, hrpL, rpoN, and yhbH mutants. These mutants were also not capable of eliciting hypersensitive response [HR] on tobacco. However, overexpression of hrpL using an inducible promoter rescued the HR-eliciting abilities of these mutants.

Results
Sigma factors, including alternative sigma factors, are essential transcription initiation factors that direct RNA polymerase to bind specific promoter regions. Our results suggest that a sigma factor

cascade in E. amylovora exists in its regulatory networks and regulates important virulence factors. Based on this study and previously reported data, a model is proposed on regulation of T3SS in E. amylovora.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
212	Diseases and Nematodes Affecting Plants

Outcome #11

1. Outcome Measures

Increasing The Yield Potential And Pest Resistance Of Soybean Cultivars In Illinois

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	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 both increasing 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 2014. The program grew over 3,000 4-row yield test plots, over 6,600 2-row yield plots, and over 11,000 plant row plots.

These plots were planted in field locations that include the main South Farm on the University of Illinois campus, the Northern Illinois Agronomy Research Center near Shabbona, the Brownstown Agronomy Research Center near Brownstown, and on land rented from farmers near Pontiac and Arthur [all in Illinois]. The most advanced lines from the program were evaluated in regional tests at 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 2015. Those lines with the greatest yield and resistance over the past few years were selected and nine new potential cultivars were released to a cooperating seed producer for increase and potential commercialization. All nine are non-GMOs and could be useful in filling the need for non-GMO soybean cultivars.

Results

Progress has been made in research on resistance to soybean cyst nematodes [SCN]. Although over 118 soybean accessions have been identified as possible sources of resistance to SCN, most soybean cultivars in the Midwest have resistance that traces only to the PI 88788 resistance source. This reliance on a single resistance source has resulted in the selection of nematode populations that can overcome this resistance. Therefore, it is important to identify and evaluate novel SCN resistance genes. During the past year, we tested a combination of resistance genes that included a quantitative trait locus [QTL] from PI 567516C on chromosome [chr] 10, two resistance QTL from wild soybean [Glycine soja Siebold and Zucc.] accession PI 468916 on chr 15 and 18, and the rhg1 resistance gene from PI 88788. A population segregating for the four genes was tested with two nematode populations. The SCN resistance alleles from PI 88788, PI 468916, and PI 567516C significantly increased SCN resistance compared to the alternative alleles. Lines homozygous for the four resistance alleles had a lower female index [FI] than those homozygous for the susceptible alleles. These results indicate that combining multiple sources of resistance can be an effective means to increase SCN resistance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
212	Diseases and Nematodes Affecting Plants

Outcome #12

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The goal of this project is to quantify and document the occurrence and distribution of herbicide-resistant weed populations in Illinois. Specifically, the project will include the following activities: [1] Verification of herbicide resistance in putative herbicide resistant weed populations by utilizing field, greenhouse, and laboratory experiments to determine the sensitivity of the populations to herbicides from one or more sites of action; and [2] Collate and disseminate the research data to Illinois weed management practitioners who are responsible for making weed management decisions and recommendations.

What has been done
Palmer amaranth is a weed species that must be thoughtfully and carefully managed; simply attempting to control Palmer amaranth often leads to ineffective herbicide applications, substantial crop yield loss, and increasing weed infestations. Ignored or otherwise not effectively managed, Palmer amaranth can reduce corn and soybean yield to near zero. The threat of Palmer amaranth during the 2014 growing season was very real across a large portion of Illinois. We initiated field research experiments in 2014 to investigate herbicide options to manage Palmer amaranth in corn and soybean.

Results
Our results indicated many soil-applied active ingredients provided residual control of Palmer amaranth following application, but residual control rarely persisted for longer than 21 days after application. Foliar-applied herbicides that effectively controlled Palmer amaranth included glyphosate, glufosinate, dicamba, 2,4-D, HPPD inhibitors, and PPO inhibitors; however, the effectiveness of these herbicides was greatly dependent on the size of the Palmer amaranth plants at the time of application. The greatest control was achieved when these products were applied to plants 7 cm tall or less; control was reduced when application was made to plants taller than 7 cm. Anecdotal observations on the emergence of Palmer amaranth plants indicated the first emergence event occurred during the first week of May in 2014, and subsequent emergence events were noted throughout much the growing season, continuing at least through August. These field experiments constituted our first field research efforts with Palmer amaranth in Illinois.

4. Associated Knowledge Areas

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

Outcome #13

1. Outcome Measures

Determining The Reproductive Stage At Which Weeds Can Be Terminated And Still Produce Viable Seed

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Our objective is to determine the reproductive stage at which weeds can be terminated and still produce viable seed.

What has been done
In December 2013 seed counts, viability and germination were determined. Velvetleaf terminated at first flowering did not produce any seed, probably because the flowers were not adequately developed to produce seed. Velvetleaf terminated 10 days after flowering produced greater than 300 seeds/plant. Only in the velvetleaf terminated with glyphosate were viable seed produced but germination was slight possibly due to seed dormancy. Redroot pigweed plants produced upwards of 3,000 seeds but none of the seeds were viable [probably due to inadequate carbohydrate reserves available to complete seed development]. Canada thistle produced the most seed in the glyphosate termination at flowering, probably because of its ability to mobilize carbohydrate reserves from its perennial root system. Although some seeds were viable, few seeds germinated.

Results
Our conclusion is that seed can develop on weeds after termination of growth either by chopping or glyphosate treatment. The message to farmers is that they need to control redroot pigweed, Canada thistle, and velvetleaf before emergence or when small and that rescue treatment should be done before the plants start flowering. This spring we established the experiment again. The termination times were at first flowering or ten days after first flowering. One half of the plants were cut at the base to simulate hand hoeing and the other half of the plants treated with a 2% solution of glyphosate with ammonium sulphate. At termination we measured height of the plants and harvested the plants cut at the base. Immediately after harvesting the cut plants were placed in nylon mesh bags. We let the glyphosate-treated plants remain standing until late September but covered them with nylon mesh bags tied at the base to retain any seed. After harvesting the

plants were placed between soybean rows until late November and then brought in. The plants terminated at first flower range from 46 cm for Canada thistle to 81 cm for velvetleaf. The plants harvested at 10 days after first flowering ranged in size from 51 cm for Canada thistle to 91 cm.

4. Associated Knowledge Areas

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

Outcome #14

1. Outcome Measures

Assessing The Effects Of Various Stresses On Crop Yield And Quality

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The problems addressed by this research are assignable to one of two categories: [1] Assessing new technologies, including determination of optimal input rates where appropriate; and [2] Assessing the effects of various stresses on crop yield and quality. Achieving and maintaining high crop yields is at the heart of competitiveness of Illinois agriculture in the nation and the world. With outstanding soil and human resources, Illinois is well-positioned to maintain its preeminence among crop-producing states. But in order to accomplish this, management practices must constantly be adjusted to reflect changes in cultivars, markets, and available technology. One practice that has gained widespread acceptance in recent years is the use of foliar fungicides on corn [and to a lesser extent on soybean], not only to manage developing fungal diseases, but also to maintain 'plant health' [a euphemism for physiological effects] and thereby increase yield [particularly when the crop is under stress]. Our preliminary work has produced mixed results, with no consistent increase in yield when disease pressure is low or absent. We simply must have better answers to guide the use of a costly practice that counters the IPM approach to

management.

This project will help provide solid answers to real questions that farmers continue to face as they adjust to new demands and opportunities in grain crop production. New options must be evaluated and optimum practices determined in order to prevent deterioration in the state's competitive advantage in grain crop production efficiency. Public welfare is directly increased when farmers, informed about technological options, can make decisions that increase efficiency, stabilize production, and lower food costs. This project will produce information needed to bring this about. At the same time farmers receive this information, publication in scientific journals will assure that this knowledge is available to the scientific community.

What has been done

The 2014 crop year was outstanding, with timely planting of both corn and soybean, below-normal temperatures in July, and little crop stress. Average state corn yield in 2014 is estimated at 12.5 t/ha and soybean yield at 3.8 t/ha, both record highs. Responses to planting date were fairly typical compared to those in recent years. At the northernmost three sites [DeKalb, Monmouth, and Urbana], yields at the earliest planting dates [the first half of April] were highest, and dropped relatively slowly as planting was delayed through mid-May. By the last date in late May yields had dropped by 12 to 18%, close to the predicted loss of yield based on previous work. At the three southern Illinois sites, first planting dates tended to experience stand problems due to wet soils and [at Perry] frost after planting, and the second planting date [in late April or early May] produced the highest yields. At these sites, yield loss from planting in early to mid-June ranged from 25 to 40%. Highest yields averaged 14.5 t/ha among the three northern sites and 12.1 t/ha at the three southern sites [all are higher than normal]. Foliar fungicide increased yield significantly at the DeKalb and Urbana sites, by 4 and 2%, respectively. There was no interaction between fungicide and planting date at either of these sites.

Results

Soybean planting date x row spacing [38 and 76 cm] x foliar fungicide/insecticide studies at five sites produced results similar to those with corn, but with a larger decline as planting was delayed compared to corn. Across four sites in central and northern Illinois, yields dropped from 4.8 t/ha at an average planting date of April 23 to 4.3, 4.1, and 3.7 t/ha at average planting dates of May 10, May 25, and June 11, respectively. This change from early to late compares to previous decreases, but the decrease in 2014 was more linear, with losses per day as high early in the planting period as in the late planting period. Three of these four sites showed a significant yield increase from the use of foliar fungicide and insecticide, with the average over planting dates of 0.3 t/ha, or 6%. At none of these sites did the response to fungicide interact with planting date; the expectation that planting date will influence the development of diseases controlled by fungicide has seldom been demonstrated in this project. At two of these four sites, yield responded to narrow rows, with an average yield increase of 8%.

4. Associated Knowledge Areas

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

Outcome #15

1. Outcome Measures

Determining The Role Of Root Architecture On Abiotic Stress Tolerance In Maize

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Despite significant advances in maize genomics and the development of maize cultivars with improved levels of drought tolerance, the underpinning physiological processes and their consequences for whole plant function are not well understood. Roots are of key importance in water acquisition but the role of root structure and its relationship to drought tolerance is also not well investigated. In this study we examine the dynamics of biomass production and biomass partitioning of maize hybrids with very different root architectural characteristics if exposed to drought at the beginning of their reproductive phase. This developmental stage of maize is particularly sensitive to drought and subsequent yield loss. We envision that knowledge of the dynamic crop physiological processes that determine drought tolerance and are potentially related to differences in root architecture will provide corn breeders with more targeted selection criteria and molecular biologists with more relevant genomic targets.

What has been done
Across all three root studies focusing on biomass partitioning, drought response, and nitrogen response, maize hybrids with high-complexity root systems produced more biomass overall than the low-complexity root system hybrids. This is likely due to the ability of this root system to more immediately capture resources like water and fertilizer in optimal conditions, as seen in the biomass partitioning study, and nitrogen added conditions. In the case of the drought response study, this root system likely allowed better resource capture prior to initiation of drought, thus leading to overall more biomass being produced. Hybrids with low complexity root systems also plateaued, LH82*PHJ40, or even declined, PHG47*PHJ40 and B73*PHJ40, after the V15 stage when looking at the amount of leaf area. From this, it can be speculated that this set of hybrids partitions its resources in such a way that after flowering there is less emphasis on developing or sustaining vegetative biomass.

Results

Under water-limited conditions, low root complexity hybrids yielded higher than high root complexity hybrids. This is likely due to the fact that the root system as a whole was smaller but had a steeper root angle, allowing deeper soil exploration for water and fewer resources allocated to the root system and maintenance of the root system. Low root complexity hybrids also had less drastic rates of increase in leaf area accumulation after the R1/R2 growth stage than the high-complexity hybrids in the water limited conditions. This seems to indicate that these hybrids are partitioning fewer resources to the vegetative organs and, therefore, are better able to produce an appreciable amount of kernels during reproductive development when water is withheld during flowering. Under conditions with no added nitrogen, all hybrids had the same yield, but hybrids with high-complexity root systems had greater overall biomass. However, with added nitrogen, high-complexity hybrids yielded significantly higher. This is likely due to the architecture and complexity of these root systems allowing rapid acquisition of the added nitrogen before it could be converted into plant-inaccessible forms or leached into deeper soil layers. In the nitrogen response study, at a rate of 252 kg/ha added, a similar leaf area production trend was seen as in the water-withheld treatment of the drought response study in that low-complexity hybrids tended to have a less steep increase in leaf area near the time of flowering. However, unlike the drought response study, the low-complexity hybrids yielded less under high nitrogen. This seems to indicate that under non-limited conditions, the increased LA allows better grain fill which would be related to the proposed advantage in resource capture by high complexity root systems. When no nitrogen was added we again saw that two low-complexity hybrids, LH82*PHJ40 and PHG47*PHJ40, plateaued with respect to the amount of LA produced around flowering. This did not relate to any yield advantage.

4. Associated Knowledge Areas

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

Outcome #16

1. Outcome Measures

Investigating The Impact Of Elevated CO2 And O3 On Soybeans

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2014 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Dramatic atmospheric alterations have occurred during the past several decades that may have a serious impact on agriculture. Elevated ozone has been estimated to amount to a loss of agricultural productivity of as much as $3 billion yearly in the U.S. and Canada. Carbon dioxide [CO2] and ozone [O3] are increasing steadily in the atmosphere and are expected to double from pre-industrial levels by the end of the 21st century. Elevations of CO2 and O3 have been associated with multiple negative impacts on plants. Ozone is considered one of the most toxic pollutants in the troposphere and soybeans are one of the most sensitive plants to O3 damage. Responses of soybean plants to elevated CO2 and O3 include increased photosynthesis [as a result of elevated CO2] and thus enhanced yield, balanced by decreased yield caused by elevated O3.

What has been done

The University of Illinois has the perfect opportunity to investigate the impact of elevated CO2 and O3 on soybeans, the largest single source of protein meal and vegetable oil in the human diet. We have the only free air gas concentration environment [FACE] facility in the world that has been established to study the impact of altered CO2 and O3 on the soybean crop [the SOYFACE facility]. Soybeans serve as a significant source of biologically-important compounds, the alteration of which could have significant impacts on product quality and human health. We will study the impact of these growth conditions on the food quality and nutritional value of soybeans as well as on the ability of soybean plants to adapt to the atmospheres of the future. One of the impacts will be the ability to select soybeans to meet the needs of consumers for growth under these altered conditions.

Results

Our oilseed research is focused on responses of soybeans to growth under elevated ozone and carbon dioxide. Soybean composition is greatly impacted by growth under these different environmental conditions, and there are dramatically different outcomes depending on the cultivar of soybeans under investigation. Observation of fatty acid profiles and correlation with isoflavones led to the result of a negative correlation of oleic acid with total isoflavones [and with two major isoflavones, genestin and daidzin]. This together with the fact that oleic acid is indicated as a potential key signaling compound of plant defense [with salicylic and jasmonic acid synthesis] indicates that oleic acid may also play a role in control of isoflavone production.

4. Associated Knowledge Areas

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

Outcome #17

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 Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	141

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 at six locations in Illinois focused on training tree care professionals, Master Gardeners, Master Naturalists, forestry and natural resource professionals, and conservationists. Training focused on : [1] Increasing their awareness of emerging and current oak problems in Illinois [Oak Splendor Beetle, Goldspotted Oak Borer, European Oak Borer, and Sudden Oak Death] and invasive plants introduced as ornamentals [Burning Bush, Bradford Pear, and Japanese Barberry]; [2] Reducing potential risks from these pathogens, pests, and plants; and [3] Increasing knowledge of plant diagnostic support. Extension specialists delivered course elements for each pest that included: [1] Identification/detection; [2] Life cycle/biology; [3] Hosts; [4] Sampling; [5] Management; [6] Commonly confused look-alikes; and [7] Regulation. Following the training 108 of the 175 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, 5=a lot].

In addition, the two IPM modules developed and released this past year to increase Master Gardeners' knowledge about gypsy moths and oak problems provided them with continuing education opportunities. When finished with a module, participants took a short quiz and completed an evaluation before being able to print a certificate of completion.

Results
With respect to knowledge related to Sudden Oak Death, all but one of the 108 [99.1%]

evaluation respondents increased their degree of understanding regarding at least one of the six topics. 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 [121.5%] was 'commonly confused look-alikes' followed by 'sampling' [118.9%], 'life cycle/biology' [108.1%] and 'management' [104.5%]. Changes in knowledge of Sudden Oak Death 'identification/detection' and 'hosts' were 95.7% and 82.6% respectively. It is worth noting that all scores for these topics were above 3.69 after the training as compared to 2.08 and below before the training.

When reviewing the knowledge areas for Invasive Oak Insects, the before training average group scores for topics related to this pest ranged from 2.09-2.28 and after training scores ranged from 3.80-3.99. However, percentage changes in knowledge of the topics were lower for these Oak insect pests ranging from 71.5% [detection and symptoms] to 81.4% [life cycle/biology]. These findings are not surprising based on the more recent discovery of these pests. Ninety-seven percent [105 of 108] increased their degree of understanding in at least one of the Invasive Oak Insect topics.

For the Invasive Ornamental Plants, a comparison of group ratings for degree of knowledge change revealed a 39.7% increase by 91 of 108 [84.3%] participants. When asked to indicate the number of people they encounter in regard to tree care, as many as 25,050 people could be reached by these trained First Detectors.

Responses to the IPM modules evaluation [which used a rating scale of 1=low to 5=high] indicated that the 39 individuals who complete the Gypsy Moth module reported a 53% average increase in knowledge of this insect pest after completing the module. Results for the Oak Problems module were somewhat lower for the 30 individuals who completed the evaluation [a 47% average increase in knowledge of the pathogen].

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes 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

Master Gardener Evaluation Study

A study with slight modifications to the evaluation instrument used in 2007 and 2012 was conducted in 2014 with Master Gardeners who had 2-4 years of experience. The online evaluation was designed by the state coordinator of Master Gardeners who asked county Extension coordinators to send a prepared email to these newest Master Gardeners inviting them to participate in the survey. The survey addressed perceived changes in 13 practices, 11 personal improvement skills, and experience in teaching horticulture topics.

The first set of findings was based on two questions that asked respondents to indicate their use of 13 gardening practices before and after becoming a University of Illinois Master Gardener. It should be noted that all but 14 of the 269 respondents indicated an increase in at least one or more of the recommended gardening practices. Results follow.

71.4% [192 of 269] now prune landscape plants properly.

69.9% [188] now identify an insect, disease or weed problem before deciding on a control measure.

66.9% [180] now chose plant varieties that are known to be resistant to insects and diseases.

53.5% [144] now choose landscape plants based on the conditions of the planting site.

52.0% [140] now use water saving strategies in the garden.

51.3% [138] now take soil tests.

51.3% [138] now mulch landscape plants properly.

50.6% [136] now keep records of pest occurrence for later reference.

49.4% [133] now follow recommendations on soil test reports.

49.4% [133] now keep records of results of control methods for later reference.

45.0% [121] now install landscape plants properly.

36.8% [99] now recycle organic materials in the yard through mulching and composting.

27.9% [75] now use pesticides only according to the directions on the label.

The second set of questions addressed frequency in teaching the above gardening practices to others. Response choices included 'Almost never', 'Occasionally', 'Often', 'Very often', and 'Don't know'. Approximately one fourth of the respondents [62] indicated that they had occasionally, often, or very often taught all thirteen topic areas. The topics 'Often' or 'Very often' taught include the following:

64.7% [174 of 269] taught mulching landscape plants properly.

61.3% [165] taught installing landscape plants properly.

60.2% [162] taught choosing landscape plants based on the conditions in the planting site.

58.7% [158] taught recycling organic materials in the yard through mulching and composting.

57.2% [154] taught choosing plant varieties that are known to be resistant to insects and diseases.

56.1% [151] taught pruning landscape plants properly.

53.9% [145] taught identifying an insect, disease or weed problem before deciding on a control measure.

50.9% [137] taught using water saving strategies in the garden.

49.4% [133] taught using pesticides only according to the directions on the label.

A third set of questions was developed to assess the Master Gardener's perceptions in changes related to 11 skills for working with others. Response options to each skill included 'Not at all', 'Slightly', 'Moderately', 'Much', and 'A great deal'. Of the 235 who answered this question, 82.6% indicated that their skills for one of more of those listed had improved 'Much' or 'A great deal'. Skills improvement rated 'Much' or 'A great deal' follow in order of frequency:

70.6% [166 of 235] increased their skill in solving gardening problems.

66.8% [157] acquired information better.

44.7% [105] indicated they were willing to accept more challenges.

37.0% [87] gained skill in communicating more effectively with others.

36.2% [85] increased skills in working more productively with a group.

36.2% [85] indicated setting goals more effectively.

36.2% [85] could reach goals more effectively.

27.7% [65] could speak to a group more effectively.

26.4% [62] could lead a group more effectively.

23.4% [55] gained skill in delegating responsibilities within a group.

13.6% [32] improved computer skills.

Key Items of Evaluation

Master Gardener Evaluation Key Finding

Ninety-five percent [255] of the **Master Gardeners** indicated an increase in at least one or

more of the recommended gardening practices after participating in their training. More than two-thirds now prune landscape plants properly, identify an insect, disease or weed problem before deciding on a control measure, and choose plant varieties that are known to be resistant to insects and diseases. Since these Master Gardeners teach others, their outreach likely has a similar effect on the practices of those they reach [including more than 164,000 face-to-face teaching contacts in 2014]. In addition, University of Illinois Extension has contributed to effectively building skills that will enhance the Master Gardener's teaching and leadership to serve both individuals and communities.

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	0%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		15%	
206	Basic Plant Biology	35%		15%	
402	Engineering Systems and Equipment	15%		20%	
601	Economics of Agricultural Production and Farm Management	10%		10%	
603	Market Economics	0%		10%	
801	Individual and Family Resource Management	10%		0%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	15%		5%	
806	Youth Development	10%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.0	0.0
Actual Paid	0.0	0.0	3.5	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**
103332	0	555991	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
103332	0	555991	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
829655	0	3438968	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities in 2014 included the development of a better process to produce biofuels [substrate and product inhibition on yeast was removed by using granular starch hydrolyzing enzymes and vacuum fermentation], research focused on examining the riskiness of energy crop production for farmers and the impact of farmer risk and time preferences on their willingness to grow energy crops, a study focused on developing a welfare economic framework to analyze the rationale for fuel policy choices in Brazil and the trade-offs they have engendered in the fuel and sugar sectors, work investigating second-generation biofuel production capacity in the U.S. focusing on the decision facing potential investors [the decision to invest in building a cellulosic ethanol facility involves a number of risks which provide incentives to delay the investment decision until a later date despite required blending or use levels outlined by federal biofuel policy in the U.S.], an investigation into the possibility of developing sustainable biomass production systems on marginal land, the establishment of a demonstration laboratory for environment-enhancing energy to convert swine manure and algae into biocrude oil via hydrothermal liquefaction, research to assess the potential of telomere manipulation in plant improvement with regard to adaptation to global climate change and increasing yield of both food and fuel endpoints, efforts to develop information on the genome size, ploidy level, and genomic polymorphisms among accessions of the genus Miscanthus to assist in taxonomic studies, improve our understanding of the evolution of the genus, and provide valuable information to biomass crop improvement programs, the use of replicated, experimental micro-landscapes to assess how animal movements are affected by biofuel crops, and the evaluation of twenty-one species of perennial woody species for their potential as short rotation bioenergy feedstocks.

Conference presentations in 2014 included the International Symposium on Nitrogen Fixation with Non-Legumes, Ecological Society of America, American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, American Society of Agricultural and Biological Engineers, American Society of Chemistry, American Society of Chemical Engineers, American Institute of Chemical Engineers, Corn Utilization and Technology Conference, Short Rotation Woody Crops Operations Working Group, University of Illinois Agronomy Day, American Association of Cereal Chemists, American Soybean Association, American Seed Trade Association, and the 68th Corn and Sorghum Seed Research 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 as well as good Earth citizens when they leave campus. Of note, an Extension field staff

member has provided information on the availability and cost considerations that facilitated a decision to add a biomass gasification burner unit on the University of Illinois Energy Farm. A biomass heating system was also installed at a farm site this year.

In addition, Extension has facilitated the installation of a farm site biomass burner system and contributed knowledge of perennial grass feedstock production that has contributed to the establishment of a project with the Illinois Department of Transportation [IDOT] to use roadside and right-of way grasses as a more economical heating fuel substitute for propane at one of several IDOT regional maintenance sites in Illinois. The site has been identified and a press event was held to announce the project that also includes a bio-refinery to be built on campus in association with the IDOT project.

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. The site and related Extension programs have helped build the foundation of biomass utilization using a farm-scale model to improve biomass harvesting methods, utilization strategies, and services to provide inventories of harvestable biomass to reduce nutrient run-off. In addition, this applied research matches crop nutrient requirements with crop production goals to help protect fragile or impaired waters and watershed areas. An Extension Educator continues to provide educational field days at this research farm and to assist in managing the tropical maize research and in seeking additional resources for future biomass crop/cover crop interdependences and the environmental advantage of simultaneous research strategies.

Other Extension sustainable energy programming included presentations to college students and staff on biomass energy crops, as well as multiple presentations to consumers on landscaping, alternative energy for small acreages, and energy-efficient homes [**Reducing Energy Costs in Your Hom**e]. Using the solar/gasification demonstration trailer, posters, and samples of energy grasses and tropical maize plants, Extension Educators interacted directly with approximately one half of the 600 attendees at the **Southern Illinois Sustainable Living Expo** held at the Dixon Springs research center regarding solar, biomass, and wind technologies. Extension Educators also worked with the Illinois Wind Working Group, the Illinois Biomass Working Group, the Illinois Solar Association, and the Illinois Geothermal Association to plan and conduct the **Illinois Renewable Energy Conference** held in central Illinois that attracted over 250 participants who could attend sessions in three tracks: [1] Solar; [2] Biomass; or [3] Wind. Extension Educators also conducted a panel and presented information at the Northern Illinois Renewable Energy Summit held in Ames, Iowa. Enrollment in the **4-H Wind Energy** project provided an opportunity for 546 youth to learn about an alternative energy source.

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. Extension also worked with the Smart Energy Design Assistance Center on campus to discuss a pilot project to partner in educating the public about the new smart grid infrastructure and alternative pricing programs in certain regions of the state.

2. Brief description of the target audience

Members of the target audience included academic researchers, policy makers, farmers, feedstock producers, potential biomass processors, biomass feedstock researchers, microbial ecologists and researchers interested in biological nitrogen fixation in non-legumes, plant breeders who wish to develop improved cultivars of Miscanthus for bioenergy, undergraduate horticulture students and students interested in bioenergy, graduate students working in bioenergy, producers, researchers, and government employees interested in biomass feedstocks, sod growers, athletic field, golf turf, and lawn care managers, homeowners, plant breeders, ecologists, ethanol producers, starch producers, commodity associations,

researchers involved with fouling phenomena, cleaning chemical suppliers and equipment suppliers, conservation biologists, wildlife ecologists, agronomists, and land managers. Extension targeted crop producers, 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 members are members of the Sustainable Agriculture Energy or Wood Energy eXtension Communities of Practice.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3513	1811	651	0

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

Patent Applications Submitted

Year:	2014
Actual:	3

Patents listed

TF 11147-US [Xylitol production From Cellulosic Biomass] and TF 13135-PRO [Separation Process of Oil and Sugars From Biomass]. Issued Patents: 8,518,467 [Fiber Separation From Grain Using Elusive Process].

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	45	45

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2014	2

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 The Components Which Increase Evaporator Fouling Rates
3	The Development Of A Protocol To Rapidly Estimate Variation In Miscanthus Cell Wall Composition
4	Developing A Welfare Economic Framework To Analyze Fuel Policy Choices In Brazil
5	Quantifying The Contribution Of Nitrogen-Fixing Bacteria To Miscanthus Plant Nitrogen
6	Practice Changes To Reduce Energy Use And Energy Costs

Outcome #1

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Determination Of The Components Which Increase Evaporator Fouling Rates

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As the biofuels industry grows, efficient utilization of water and recovery of nutrients will become increasingly important. In the U.S., 175 fuel ethanol plants are in operation and 25 plants are under construction; nearly all of these plants use corn, an important crop for Midwestern states. Plant capacities range from 40 to 120 million gallons of ethanol per year. Fuel ethanol plants use multi-effect evaporators to concentrate thin stillage. Evaporators must be cleaned every week or two, resulting in economic and capacity losses. Labor and chemical costs are incurred to clean the evaporators, a plant must reduce processing or shut down entirely during cleaning, and additional evaporator capacity must be installed if the plant wants to continue operating during cleaning. Cleaning procedures add water to the process, and water and cleaning chemicals must be routed appropriately. When processing difficulties arise [such as during poor fermentation or incomplete liquefaction] evaporators can be expected to foul more rapidly. Separation processes upstream from the evaporator affect its efficiency. Process designs to produce valuable coproducts also affect process efficiency and long-term sustainability. As the biofuels industry grows and matures, long-term economic operations will become increasingly important and impact the communities where they are located. Developing new uses and, more importantly, higher value for coproduct solids in process streams is needed to retain bioprocessor competitiveness and can be accomplished through new process designs, incorporation of new

technology, or a combination of both.

What has been done
The most common separation process in grain processing is the separation of water from other agricultural solids. This results in primary products and coproducts that can safely and efficiently be stored and transported. 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, fundamental causes of increased fouling in maize processes are not well understood. The objective of this research is to develop a better understanding of the components that accelerate fouling in maize processing evaporators.

Results
For model systems [simple mixtures with known compositions], we now have a better understanding of the components that accelerate fouling or have a small impact by themselves. Pure starch mixtures had higher mean fouling rates, higher maximum fouling resistances, and no induction periods. Addition of glucose and corn syrup solids to starch decreased mean fouling rates and maximum fouling resistances, contrary to our hypothesis. Maximum fouling resistances were dependent on overall carbohydrate polymer length. Fouling rates increased in the order: 1% starch > 1% starch + 6% corn syrup solids > 1%starch + 3% corn syrup solids + 3% glucose > 1% starch + 6%glucose. Induction periods [initial time with no fouling resistance] of pure mixtures of either glucose or corn syrup solids were longer than a pure starch mixture which had no induction period. Mixtures containing shorter chain carbohydrates, glucose, and corn syrup solids did not cause fouling either alone or in combination during the 5 hour test period.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment

Outcome #3

1. Outcome Measures

The Development Of A Protocol To Rapidly Estimate Variation In Miscanthus Cell Wall Composition

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2014 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Energy Independence and Security Act [EISA] of 2007 calls for 36 billion gallons/year of biofuels by 2022 to reduce national dependence on foreign oil [of which about 21 billion gallons are to be from sources such as lignocellulosic biomass]. New dedicated energy crops are essential to provide lignocellulosic biomass to meet targeted demands for biofuels production in addition to corn grain and stover. A number of annual and perennial C4 grasses and herbaceous crops and trees [such as Miscanthus, switchgrass, willow, and sweet sorghum] are currently identified as potential sources of lignocellulosic biomass. Rapid determination of biomass composition is critical for the screening and selection of Miscanthus genotypes with properties suitable for conversion to bioenergy, biofuels, and renewable chemicals. Variation in Miscanthus biomass composition can be used to identify and breed for superior germplasm with enhanced lignocellulosic properties conducive to bioenergy and renewable chemical generation.

What has been done

Information on genome size, ploidy level, and genomic polymorphisms among accessions of the genus Miscanthus can assist in taxonomic studies, help to better understand the evolution of the genus, and provide valuable information to biomass crop improvement programs. Taxonomic investigation combining variation in plant morphology, genome size, chromosome numbers, and simple sequence repeat [SSR] marker polymorphisms were applied to characterize 101 Miscanthus accessions. A total of 258 amplicons generated from 17 informative SSR primer pairs were subjected to cluster and principal coordinate analysis and used to characterize genetic variation and relationships among 31 Miscanthus accessions, including four interspecific Miscanthus hybrids created from controlled pollinations, and four Saccharum, six Erianthus, and one Sorghum bicolor accessions. Miscanthus accessions were distinct from accessions in the genera Erianthus and Saccharum Miscanthus accessions fell into five taxonomic groups, including the existing taxonomic section Miscanthus, diploid and tetraploid Miscanthus sacchariflorus, and a fourth [M. x giganteus] and fifth group [Miscanthus 'purpurascens']; the last two being intermediate forms. In contrast to previous work, our findings suggest diploid and tetraploid M. sacchariflorus are taxonomically different, the latter more closely related to M. sacchariflorus var lutarioriparius. We also suggest that Miscanthus 'purpurascens' accessions are interspecific hybrids between Miscanthus sinensis and diploid M. sacchariflorus based on DNA content and SSR polymorphisms. The evolution of Miscanthus and related genera is discussed based on combined analysis and geographical origin.

Results

In light of rising energy costs, lignocellulosic ethanol has been identified as a renewable alternative to petroleum-based transportation fuels. In an attempt to reach government mandated ethanol production levels, potential plant biofeedstock candidates have been investigated, and cold-tolerant, perennial accessions within the C4 grass genus Miscanthus have been identified as leading contenders in the Midwestern U.S. To facilitate the development of improved cultivars through marker-assisted breeding, a quantitative trait locus [QTL] study was conducted on a full-sib, F1 mapping population segregating for flowering time, height, leaf width, and yield using a genetic map consisting of 846 segregating SNP and SSR markers. This was a three year study investigating the genetic architecture underlying traits important to biomass production in a population of 221 progeny from a cross between M. sinensis 'Grosse Fountaine' and M. sinensis 'Undine' established in the spring of 2010; 72 QTLs with LOD scores above the genome-wide, permuted threshold equivalent to a P-value of 0.05 were identified across 13 traits. Of the 36

QTLs identified in 2011, 22 were detected again the following year. Both the use of spring emergence and vigor rating as a covariate to account for variation related to differences in establishment increased the power to detect QTLs in the two-year establishment period. Finally, a dry period in the middle of the 2012 growing season suggested that yield declines were due to a decrease in tiller diameter.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Developing A Welfare Economic Framework To Analyze Fuel Policy Choices In Brazil

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Our research on Brazil has focused on developing a welfare economic framework to analyze the rationale for the fuel policy choices in Brazil and the trade-offs they have engendered in the fuel and sugar sectors.

What has been done
We also examined their distributional impacts on producers and consumers in the sugar, oil and biofuel sectors and on government revenues. Additionally, we have undertaken 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.

Results

We find that the status quo policies are likely to have been motivated by the objectives of increasing oil exports, raising government revenue, and promoting rural development through the sugarcane sector and have had a significant adverse impact on fuel and sugar consumers, aggregate social welfare, and greenhouse gas emissions in Brazil.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #5

1. Outcome Measures

Quantifying The Contribution Of Nitrogen-Fixing Bacteria To Miscanthus Plant Nitrogen

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Plant productivity is often limited by the availability of nitrogen, and application of nitrogen fertilizer can account for a major portion of fossil fuel use in agricultural systems. Because nitrogen fertilizers are primarily derived from fossil-fuel intensive processes, low-N fertilizer inputs are especially important for the sustainability of bioenergy crops such as Miscanthus. Nitrogen-fixing bacteria have demonstrated the capacity to supply significant levels of biologically-fixed nitrogen in some non-leguminous crops; however, we currently lack information on the factors that govern the abundance and activity of these beneficial microbes in perennial grasses.

What has been done
To fulfill our objective of quantifying the contribution of nitrogen-fixing bacteria to Miscanthus plant N, we conducted a field experiment to estimate the contribution of biological nitrogen fixation to plant nitrogen acquisition in first year Miscanthus × giganteus using a yield-dependent N-15 isotope dilution model. Temporal changes in plant-associated diazotroph relative abundance and community composition were analyzed with quantitative PCR and terminal restriction fragment length polymorphism of the nifH gene in rhizome and rhizosphere DNA extracts.

Results
We estimate that 16% of new plant nitrogen was derived by nitrogen fixation during the growing season, despite non-limiting soil nitrogen. Diazotroph communities from rhizome and rhizosphere changed with plant development and endophytic nitrogen fixers had significantly higher relative abundance and altered community composition at sampling dates in July and August. This study provides evidence for a small, but measurable, benefit of associative nitrogen fixation to first year Miscanthus × giganteus that underscores the potential and need for selection of breeding lines that maximize this trait.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Practice Changes To Reduce Energy Use And Energy Costs

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	22

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Sustainable energy is a concern of consumers as well as environmentalists and scientists who are seeking identifiable and cost-effective renewable energy sources. Consumers of energy who recognize the challenge would also like to lower their energy costs.

What has been done
Three Extension Educators with assigned responsibilities in natural resources and the environment have developed and delivered 10 Reducing Energy Costs in Your Home programs to more than 200 home owners to share information on actions and options that can be taken to save costs as well as serving as responsible stewards of non-renewable energy sources.

Results

A follow-up 'post card survey' was developed and mailed to the 41 participants in two of the ten Reducing Energy Costs in Your Home groups of participants. Twenty-three [56%] of the participants returned the completed post card. Twenty-two of the 23 respondents [96%] reported that they continue to use home heating and cooling information taught/learned at the home energy program. Eighteen of 23 [78%] believe they realized an energy cost savings from applying this knowledge. Twenty of 23 [87%] would attend additional home energy cost reduction programs in the future.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

A follow-up 'post card survey' was developed and mailed to the 41 participants in two of the ten **Reducing Energy Costs in Your Home** groups of participants. Twenty-three [56%] of the participants returned the completed post card. Twenty-two of the 23 respondents [96%] reported that they continue to use home heating and cooling information taught/learned at the home energy program. Eighteen of 23 [78%] believe they realized an energy cost savings from applying this knowledge. Twenty of 23 [87%] would attend additional home energy cost reduction programs in the future.

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
724	Healthy Lifestyle	10%		0%	
806	Youth Development	90%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	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**
1800919	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1800919	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
14459705	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

4-H Club enrollment in Illinois totaled 24,011. Slightly more than 158,250 different youth were involved in some type of 4-H program such as after-school group programs, conferences, and camps.

Metro Educator positions were established in population areas of over 100,000 and now include 13 educators who are creating opportunities for inclusion for youth of Hispanic ethnicity and other younger youth to become involved in sustained science and/or gardening opportunities and helping older youth to develop civic engagement and leadership skills. Educational priorities for all 4-H delivery systems remain focused on: [1] Learning employment skills; [2] Experiencing healthy relationships; [3] Becoming physically fit; [4] Thinking green; and [5] Engaging in science.

Several activities and programs focused on youth career exploration and workforce preparation. **Illinois Summer Academies** three-day conferences were held on the University of Illinois campus and provided high school teens with opportunities to explore a college campus as well as hands-on workshops to explore potential careers in 4-H science or leadership development training. **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].

Illinois has placed a strong emphasis on engaging youth in science that this year included 115 4-H National Youth Science Day events involving 3,500 Illinois youth participants. The events consisted of completing a **Rockets to the Rescue** aerospace engineering experiment to build an aerodynamic food transportation device that could deliver nutritious food to disaster relief victims. The 4-H robotics project involvement increased in enrollment again this year with 4,993 youth enrolled in one of five project options. Forty-five teams participated in the sixth annual Illinois 4-H **State 4-H Robotics Team Competition**. **4-H Tech Wizards**, an initiative designed to establish mentoring programs for at-risk or underserved youth in an after-school setting, continued to engage youth participants at multiple 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 92 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 engineering campus for 49 female participants. This program aims to dispel myths that science is too difficult, not fun, and more suited to males. 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 [also discussed in the Natural Resources and the Environment planned program]. The second year of training **4-H Citizen Scientists** raised the total from 40 to 69 junior and senior high youth 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.

Building youth leadership skills is both a national and Illinois area of focus. At the state level opportunities and training were provided for **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. A grant-funded national program, **4-H Food Smart Families** partnered 4-H with the **Supplemental Nutrition Assistance Program - Education** [**SNAP-Ed**] in supporting 84 teens who taught more than 1,400 youth at after school programs and summer camps to make healthy food choices [also discussed in the Human Health and Human Development planned program]. What began in four metro areas expanded with support from the Illinois 4-H Foundation to 21 Illinois counties and nearly 500 **Teens as Teachers** in just one year. 4-H Teen Teachers developed, planned, and delivered lessons in such topics as STEM, gardening, and nutrition. More than 75 **Youth Science Ambassadors** were involved in leading and facilitating the **Rockets to the Rescue 4-H National Science Day** event.

Volunteers are a key in delivering 4-H Youth Development programs and are instrumental as caring adults who create an environment that is a critical element of positive youth development. This past year 20,640 volunteers gave their time and talents to the 4-H Youth Development program in Illinois with slightly more than 3,800 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 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.

2. Brief description of the target audience

4-H youth development has broadened its target audiences to include youth between the ages of 8 and 19 that focuses on outreach to urban youth including Hispanic youth, military family youth, youth leaders [paid and volunteer], adult and 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

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	170391	0	370854	523375

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- No Output Measures For This Fiscal Year

Year	Actual
2014	0

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	Number Of Youth Who Indicate Increased Knowledge of Science, Engineering And Technology
7	Number Of Youth Indicating Gains In Teaching And Leadership Skills

Outcome #1

1. **Outcome Measures**

Increased Knowledge About Science And Health Careers

Not Reporting on this Outcome Measure

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

Number Of Youth Who Indicate Increased Knowledge of Science, Engineering And Technology

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	10500

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 in K-2 classrooms, but youth in grades 3-12 were also engaged in the activities this past year. Curriculum development and training was provided by the Extension poultry faculty member and local educators. Evaluations were collected from 191 teachers in nine counties in Northeastern Illinois to determine their perceptions of impact related to their 12,161 students' science ability gains.

Results
Using a scale of 1-4 [1=Not at all; 2=Sometimes; 3=Usually; 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 86% of the 159 teachers who answered these questions. More detailed results from this evaluation are provided in the Evaluation section of this planned program.

4. Associated Knowledge Areas

KA Code	Knowledge Area

806 Youth Development

Outcome #7

1. Outcome Measures

Number Of Youth Indicating Gains In Teaching And Leadership Skills

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	84

3c. Qualitative Outcome or Impact Statement

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

What has been done
University of Illinois Extension 4-H in conjunction with the Supplemental Nutrition Assistance Program - Education [SNAP-Ed] engaged teens to teach primarily fifth-grade youth to make healthy food choices through a new program titled 4-H Food Smart Families that was conducted in after school programs and summer camps. Additionally, the program was designed to encourage youth to share what they learned with their families. Both the teen teachers and the youth were asked to complete a post-program questionnaire that included questions related to food choice knowledge and actions taken by the youth and their families. The teen teacher questionnaire also included items related to positive youth development.

Results
The 4-H Food Smart Families questionnaire was completed by 84 teen teachers. Eight of the items use a pre-post format to identify program outcomes. Using a 4-part scale ranging from 1=strongly disagree to 4=strongly agree, increases in the percentage of teens indicating 'agree' or 'strongly agree' were noted for seven of eight statements in the following order from highest to lowest.

8.4% increase [from 84.5% to 92.9%] 'I have the skills to teach younger youth'.

8.3% increase [from 84.6% to 92.9%] 'I am a role model for younger youth'.

8.3% increase [from 84.5% to 92.8%] 'I have experienced a successful youth-adult partnership'.

7.6% increase [from 81.7% to 89.3%] 'I am good at teaching younger youth'.

6.0% increase [from 86.9% to 92.9%] 'I want to contribute my skills to help others'.

3.5% increase [from 90.5% to 94.0%] 'I feel comfortable teaching younger youth'.

1.2% increase [from 88.1% to 89.3%] 'I want to contribute my skills to help my community'.

The percentage [92.5%] remained the same from pre-test to post-test for 'I want to be a role model for others'.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

4-H Incubation and Embryology Program.

Using materials developed by a University of Illinois poultry specialist in conjunction with state and local 4-H staff, 191 teachers in nine 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 7,368 students were enrolled in grades K-2 and 4,793 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 3-12].

With respect to the science abilities of students in grades K-2, 88 [83%] of the 106 teachers who answered this question indicated a perceived increase in at least one of five [5] science abilities. More than one-half of the teachers reported perceived increases in their students' observation ability [72% of the teachers], predicting ability [55%], organizing/ordering/classifying ability [51%], and comparing and contrasting ability [48%].

With respect to students in grades 3-12, 48 [91%] of the 53 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' hypothesizing ability [66%], and observation ability [65%]. More than one-half of the teachers reported perceived increases in their students' ability to interpret/analyze/reason [56%], question [56%], collecting data [54%], predict [52%], problem solve [52%], and evaluate [50%]. In addition, nearly one-half of the teachers perceived increases in their students' communication/demonstration ability [46%] and ability to summarize [44%].

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

4-H Science Evaluation Studies

In 2012, a questionnaire seeking to establish a baseline regarding 4-H members attitude/interest in science, their opinion regarding the relevance/value/utility of science, encouragement to engage in science, and aspirations regarding pursuing a career in science or using it to solve everyday problems was distributed to youth at 4-H science group meetings or science-related 4-H events and collected after completion by a 4-H staff member and volunteer during the summer of 2012. The questionnaire included 15 statements regarding science and 4-H. Youth were instructed to rate the statements as 'Strongly disagree', 'Disagree', 'Agree', and 'Strongly agree'. Those coding data for analysis assigned values ranging from 1='Strongly disagree' to 4='Strongly agree'.

This past year, an evaluation containing ten of the same eleven questions and five additional ones were added specific to 20 various 4-H science programs of interest--robotics, Science Siesta, I Think Green, Tech Wizards, and Geographical Information Systems [GIS]. The data collection protocol involved a 4-H staff person distributing paper copies of the questionnaire and collecting completed questionnaires. A total of 1,024 were collected. Preliminary results of an analysis of the responses that includes a comparison to the findings from the 2012 baseline study of a cross-program stratum of 405 youth participants follows.

Attitude/Interest in Science

I like science [86.87% agreed or strongly agreed as compared to the 82.2% baseline study].

I am good at science [84.4% agreed or strongly agreed as compared to the 82.9% baseline study].

I do science-related activities that are not for schoolwork [64.6% agreed or strongly agreed as compared to the 70.7% baseline study].

Relevance/Value/Utility

Science is boring [83.1% disagreed or strongly disagreed as compared to the 87.2% baseline study].

I think science, engineering, or technology will be important in my future job [82.8% agreed

or strongly agreed as compared to the 80.6% baseline study].

I can explain to others how I use science, engineering, or technology in my 4-H program/project [69.6% agreed or strongly agreed as compared to the 76.6% baseline study].

Encouragement

I often get to do hands-on activities in my 4-H program/project [84.9% agreed or strongly agreed as compared to the 87.6% baseline study].

I am encouraged to ask questions about science, engineering, or technology [81.1% agreed or strongly agreed as compared to the 79.5% baseline study].

When I graduate from high school, I would like to have a job related to science [60.5% agreed or strongly agreed as compared to the 61.2% baseline study].

Aspiration

Science is useful for solving everyday problems [82.1% agreed or strongly agreed as compared to the 70.5% baseline study].

I want to learn more about science [88.1% agreed or strongly agreed as compared to the 85.3% baseline study].

In response to four additional questions, all of the respondents agreed that they: [1] Have helped with a community service project that relates to science; [2] Used science tools to help in the community; [3] taught others about science; and [4] Organized or led science-related events.

4-H Workforce Preparation Experiences Evaluation Study

Extension 4-H Youth Development staff engaged in a national effort to pilot 'Common Measures' regarding the effectiveness and impact of workforce preparation experiences for youth. A questionnaire that included 14 of these 'Common Measures' was distributed to 12 groups of youth that were participants in various workforce prep programs that included **Welcome to the Real World**, a STEM camp, or an alternative life skills program. The questionnaire included 14 statements regarding career exploration, self-assessment of skills and interests, and educational plans after high school. Youth were instructed to rate the statements as 'Strongly disagree', 'Disagree', 'Agree', or 'Strongly agree'. Those coding data for analysis assigned values ranging from 1='Strongly disagree' to 4='Strongly agree'. A total of 526 youth completed the questionnaire. Results of a preliminary analysis follow.

As a result of my experience in this 4-H program or project:

I thought about my career decisions [94.7% agreed or strongly agreed].

Someone spent time talking to me about what I want to do in the future [79.0% agreed or strongly agreed].

Someone talked to me about what skills I need to achieve my goals [70.5% agreed or strongly agreed].

I talked to someone who works in a career that interest me [49.5% agreed or strongly agreed].

I have identified my strengths and weaknesses [72.5% agreed or strongly agreed].

I know how my actions and decisions will affect my career choice [95.1% agreed or strongly agreed].

I know where to go to find dependable information about jobs [78.4% agreed or strongly agreed].

I know a college campus I would like to visit [73.4% agreed or strongly agreed].

I can think of ways to use my skills as a business [75.3% agreed or strongly agreed].

I know of careers that are related to my interests [92.8% agreed or strongly agreed].

I plan to go to college or trade school after high school [92.8% agreed or strongly agreed].

I feel more confident in finding a job [85.9% agreed or strongly agreed].

I will make a good employee [97.5% agreed or strongly agreed].

I've learned a skill that I can use in a future job [82.6% agreed or strongly agreed].

In response to a final question, 485 of the 526 respondents shared information about a job they would like to have.

Key Items of Evaluation

4-H Incubation and Embryology Program

After conducting the **4-H Incubation and Embryology** program in their classrooms, more than half of the K-2 and 3-12 teachers perceived observed increases in their students' observation skills. More than half of the K-2 teachers also reported observed increases in their students' hypothesizing, predicting, and organizing/ordering/classifying abilities. In addition, more than half of the grades 3-12 teachers reported observed increases in their student's ability to hypothesize, observe, interpret/analyze/reason, question, collect data, predict, problem solve, and evaluate.

4-H Science Evaluation Studies

More than half and as many as 88% of the 1,024 4-H science group participants responded favorably to the science related statements. In addition, all percentages were near or slightly below the 2012 baseline with the exception of a larger percentage indicating that science is useful for solving everyday problems and a smaller percentage indicating that they do science-related activities that are not for schoolwork and can explain to others how they use science, engineering, or technology in their 4-H program program/project. Complete findings are still being reviewed but will be available upon request**.**

4-H Workforce Preparation Experiences Evaluation Study

Approximately one-half and as many as 97.5% of the 526 4-H group participants responded favorably to the workforce preparation-related statements. More than 90% indicated that as a result of their the 4-H workforce preparation experience they: [1] Thought about career decisions; [2] Know how their actions and decisions will affect their career choice; [3] Know of careers that are related to their interests; [4] Plan to go to trade school after high school; and [5] Believe they will make a good employee. Complete findings are still being reviewed but will be available upon request**.**

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
1267	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
62	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)	
11	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
3	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.