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

Status: Accepted

Date Accepted: 07/15/2016

I. Report Overview

1. Executive Summary

The 2015 Combined Report of Annual Accomplishments and Results includes many examples of how formula funds impacted Indiana, the nation and the world. Formula funding is awarded to three distinct colleges at Purdue University--the College of Agriculture, the College of Veterinary Medicine and the College of Health and Human Sciences. These colleges were among the first in the land-grant system to integrate research, education and extension in the classroom, the field and in research projects. Our strong integrated research and extension programs allows us to effectively and efficiently translate research to the field for the full benefit of our Indiana, regional, national and international stakeholders. Our team-oriented discovery efforts pull from expertise across many disciplines and engage like-minded partners, whether from industry, other academic institutions, non-governmental organizations, or government. The three colleges combined have over 350 faculty that conduct state-of-the-art research and teach more than 7,000 undergraduate and 1,200 graduate students. There are about 260 Extension Educators across the state located in each of the 92 counties of Indiana. Educators' roles are in four program areas: 4-H Youth Development, Agriculture and Natural Resources (ANR), Community Development (CD), and Health and Human Sciences (HHS). Extension Educators with ANR specialties offer programs and information on agricultural production and financial management for farmers, food and fiber processors, manufacturers and consumers. They also provide expertise in environmental issues, natural resource conservation and land use. HHS educators help communities analyze, identify and meet the needs of families; train volunteers and paraprofessionals to assist in areas of critical concern to families; motivate people to become leaders in addressing community issues; and collaborate with agencies, community organizations, and educational groups to address the needs of families. CD experts work to increase community vitality, build leadership capacity, enhance public decision-making, and resolve public issues. A dedicated network of Extension Educators, parents, local leaders and volunteer staff, makes Indiana 4-H one of the most valued youth programs in the state. The 4-H educators support youth in developing individual talents, life skills and leadership abilities through the traditional venue of 4-H clubs, county fairs and through field-tested school enrichment materials and local-led community programs.

The 2014 Farm Bill has been described as a sweeping overhaul of agricultural policy and ushered in significant changes for farmers. It eliminated direct support payments and replaced them with new, insurance-based programs for many important commodities in our state. Farmers needed to make long and short term planting decision based on this Farm Bill. Extension educators and specialists quickly rallied to develop workshops to support farmers who had a short time frame to make decisions.

The College is continually seeking ways to streamline the administrative work of faculty and staff and USDA Plan of Work and Annual Report of Accomplishments are not exempt. For reporting on 2015 results, research and extension educators used a new reporting portal in Digital Measures (DM). DM is a customizable database that allowed us to leverage stories in REEport, easily capture key outputs based on Planned Program areas, and to report on outcomes identified in the USDA National Outcomes and Indicators in the AREERA Plan of Work Reporting System. As with any new reporting process, we have identified ways to improve the system and places to expand training for users. After reviewing the data that users provided, we found the quantity and quality of reporting to be significantly higher than from the old system and hope that reviewers will notice this as well. We are open to constructive suggestions from

the reviewers regarding the quality of the report as we work with our researchers and extension staff to improve the system overall.

The remainder of the Executive Summary is intended to capture highlights and impacts from formula funding NIFA's 5 Planned Program areas, Purdue's 2 Planned Program areas, plus observations on the role of technology and efforts to promote diversity.

CHILDHOOD OBESITY

Researchers and Extension specialists and educators are using some unique approaches to address childhood obesity, evaluating the "energy" level in foods, and researching the beneficial actions of the micronutrient selenium, which is known to exhibit beneficial functions in cancer.

GOALS (Get Outside and Learn Something) Camp, was a collaborative effort between Purdue Extension, Lake County Parks and Recreation, and the Boys and Girls Clubs of Northwest Indiana. This 3-day camp got 46 children outdoors and involved in physical activity and away from tech screens of all kinds. They learned about nutrition and the value of daily exercise through activities such as making their own worm compost farms, creating herb terrariums and preparing healthy snacks.

One of the factors contributing to obesity is that people take in more "energy" in the food they consume than they expend. Managing the energy balance is important for maintaining current weight and shifting the balance impacts weight gain and loss. One research lab contends that free fatty acids produce a signaling mechanism with regard to taste. The research begins with understanding if humans have a true taste for fat by conducting tasting comparisons between free fatty acids triglycerides, oils or solid dietary fats. The research provided evidence that preferences differ by younger versus older individuals and by females compared to males but little difference existed between lean and obese individuals. Identifying the signaling mechanism of free fatty acids is expected to help unravel issues related to obesity.

Temporal dietary patterns is an emerging area of research that theorizes that health is not only a function what type of food is eaten, but is also related to the time of day its eaten and the amount of energy it contains. A multidisciplinary team has developed and applied novel data patterning techniques to US population clusters exhibiting similar daily temporal dietary patterns. USDA uses the Health Index to measure compliance with the Food Guidelines for Americans and is an important tool for tracking health in low-income communities. (www.usda.gov). Researchers found that the cluster with a dietary pattern that spread the energy content over three evenly spaced meals had a significantly better Health Index-2005 score than other energy consumption patterns. Understanding these patterns is certain to have an impact on childhood obesity as well, though this particular research hasn't yet been extended to that population cluster.

CLIMATE CHANGE

While the debate continues regarding the reality of climate change, it has certainly provoked a great deal of new research to prove or disprove it. This research has taught us a great deal about how we can improve practices in growing crops, sequestering carbon and managing industrial pollutants.

Scientists from non-climate disciplines believe that average global temperatures are higher than pre-1800's levels and that the increase is due in large part to human activities according to a survey conducted in 2015. This is the first study of its kind to show that there is consensus among the broader scientific community that human activities have been a significant player in climate change and that the science is considered to be credible. While the data is considered trustworthy, many researchers believe this is not yet a mature science. For example, the study showed that scientists don't dispute rising temperatures, but there is not agreement on the predictions of potential impacts of climate change. The study also showed that cultural values play a strong role among the scientists regarding what they believe impacts climate change.

One change widely observed in forest ecosystems in eastern North America is the species composition shift. Different tree species have different levels of carbon sequestration capacity. A significant change in species composition will affect the overall level of carbon sequestration by the eastern forests, which in turn will influence the global carbon dynamics. These shifts in species composition in forest ecosystems will have serious economic, ecological, and environmental effects. Research is being done that examines large-scale species distribution patterns and processes and their ecological and environmental impacts. A modeling framework for species richness and cover of invasive plants in 42,626 plots in Eastern U.S.

forests was used to show that the more diverse the forest, the less likely to have invasive species. Greater resistance to invasive species was found in the contiguous forests of the Appalachian Mountains and parts of the agricultural Midwest. Evaluating magnitude, rate, and large-scale spatial variability of biomass change caused by species composition change will significantly advance understanding of forest ecosystem functioning in relation to the global carbon cycle.

While many are studying what causes climate change, others are looking at the impact of these climatic shifts. For example, the nitrogen cycle is impacted by rising temperatures and affects carbon sequestration in soils, atmospheric concentrations of carbon dioxide, methane and nitrous oxide, and increase ammonia emissions. As a result, significant research is being done to reduce inputs such as nitrogen, to reduce runoff and to develop best practices and application prescriptions.

FOOD SAFETY

In 2015, Purdue researchers played significant roles in reducing the impact of the Porcine Epidemic Diarrhea virus (PEDv) that swept through nearly 70% of the swine herd killing nearly 100% of the neonatal pigs. Extension jumped into action to get information to swine producers in the state so that they could make the best decisions for their business and their herds.

This past year saw 15 U.S. states with bird flu outbreaks at poultry farms resulting in the loss of more than 48 million birds and $3 billion in revenue. Wild birds are typically the source of the flu which makes it challenging to understand where the flu originated and the specific strain. Most vaccines are focused on protecting birds from specific strains, but a Purdue researcher is creating a vaccine that could cover a wide span of strains to address the rapid mutation of the H1N1 virus.

GLOBAL FOOD SECURITY AND HUNGER

There continues to be concern about the welfare of farm animals. In a 2008 poll (Journal of Am Vet Med Assoc), the majority of respondents felt that decisions about the welfare of farm animals should be based on science and not public opinion. Purdue's Center for Animal Welfare Science (CAWS), has been at the forefront of animal welfare science. The CAWS mission is to promote animal welfare through science-based information and education to advance socially responsible decisions concerning animal care. The goal of CAWS is to facilitate interdisciplinary collaborations to identify animal welfare challenges, strategies to alleviate them and education to support their implementation. Several high profile food retailers and restaurants have commented that CAWS work has been important for managing emerging issues both on the animal welfare and public perceptions fronts.

Farm income had been strong in Indiana with record highs in 2013 ($5.5 billion). Incomes in 2014 fell by 48% to just $2.9 billion. Flooding in the summer of 2015 reduced corn yields approximately 15% below trend. In both 2015 and 2016, crop prices are expected to be below costs of production for many. This will put additional downward pressure on Indiana farm incomes for 2015 and 2016 when total income is expected to fall to the $1.8 to $1.9 billion range. This level of income has not been seen since the early 2000's. Crop farms are seeing very tight margins. Land values are slowly declining and cash rents are falling some as well. Crop costs are falling for fertilizer, fuel and crop insurance. Livestock margins are near breakeven for hogs and dairy production while poultry has maintained positive margins. The beef cow sector continues to have positive margins as well. Indiana agriculture sector is in a period of downward adjustment. The overall financial strength has been eroding since 2015 with sharply reduced farm incomes and declining asset values. Some additional erosion is expected to continue in 2017 and 2018. Financial stress is expected to be apparent in some segments of Indiana agriculture. Those who are likely to be most vulnerable are crop farms that cash rent most of their land, farms that have purchased large amounts of land at record high prices, and farms that have high costs of production.

While much of the work of Purdue researchers is focused on long-term solutions to critical food issues, many researchers, extension specialists and educators are focused on handling acute issues such as the flooding across Indiana in 2015. The flooding severely impacted crop inventories used to feed animals in the winter months. Several workshops were held across the affected area to provide farmers with farm management tools to make sound financial decisions, use of cover crops and cost/benefits of flood insurance. More than 100 farms totaling in excess of 69,000 acres were represented at the workshops. Seventy-five percent of those in attendance indicated adoption of new practices from these workshops with one farmer reporting savings of $29,000 in feed costs for his 2,000 head of cattle from

planting Sudan grass in the affected area. Attendees reported an increase in understanding crop insurance considerations, grain market conditions, forage crop issues and cover crop options. They also reported confidence in being able to their ability to evaluate the health of perennial forage crops and make more informed market and 2016 crop acreage decisions. This ability to collaboratively spring into action is the epitome of the land grant mission.

The Purdue Agricultural Centers (PACs) are an extensive network of farms across Indiana that provide research space--in fields, buildings, high tunnels, ponds, ditches, and more--for Purdue researchers. A key activity for these farms are "Field Days" where researchers, extension specialists and educators, and farmers come together to share knowledge gained in the research fields, economic forecasts, good practices and general fellowship. In 2015, more than 5500 people attended events at these farms. Research on the PACs is extremely valuable, but sometimes we need more information on the local level. Southwest Indiana has more acres of wheat grown than any other region of Indiana. Wheat researchers conducted wheat plot trials on 45-50 varieties of wheat, representing more than a dozen seed companies, to provide local, research-based, unbiased data for wheat producers. Eighty percent of the farmers who hosted the field trials valued the unbiased and cross-company research results and that they use the test plot trials for their business. Incorporating farmers into the research process clearly adds value to the farmers and is a powerful way to leverage USDA dollars.

NATURAL RESOURCES AND THE ENVIRONMENT

Water is essential for sustaining life, from human consumption to watering crops and hydrating farm animals. As the human population grows, so does the need for high quality water and access to sufficient quantities. In some ways, water usage and drainage is obvious whether its water flowing into and out of a home or used to water crops. Exciting new research is being conducted on subsurface water drainage in farm fields. Much of the water that is not directly taken up by the plant after a rainfall or irrigation is intentionally shuttled to subsurface tiles to reduce the speed by which it moves out of the soil. New research is being conducted on how to contain or store this water in the subsurface areas so that it can be reused. This research is in its early stages and there will be more to report in 2016.

Consumers dearly love fruit and vegetables year round that are perfect in color and without blemish. To accomplish this feat, many fruits and vegetables are grown in containers in greenhouse conditions. These soils tend to dry out much more quickly than field soils and need regular watering. Researchers are exploring different types of soil amendments such as parboiled rice hulls to replace peat as a way to store more water in the container. They are also exploring the impact on plants from reducing water quality in container situations. For example, can growers use grey-water or lightly treated water for growing container plants? Does the plant uptake all elements from the water and if so, what is the impact? The objective of this research is to use water that has been through fewer cleaning processes resulting in lower energy use, more available water, and less chemicals applied to plants.

The Indiana Master Gardener program continues to expand in 2015 with more than 3000 volunteers, 160,000 volunteer hours value at at $3.5 million, 27 tons of produces donated to Indiana Food banks and $40,000 in college scholarships from Master Gardener groups to students in horticulture or related fields.

Indiana has seen an increase in periodic flooding resulting from torrential storms and rising rivers and lakes. Purdue, as part of the Indiana Coastal No Adverse Impact Workshop, provided 41 certified flood plain managers, planners, attorneys, coastal resource managers, health department staff, storm water managers and local officials with information about the core tenants of floodplain management, common legal issues faced by floodplain managers and planners in the region, specific actions that have been taken in Indian to enhance flood resilience and the value of green infrastructure, wetlands and how they are regulated. Post workshop surveys indicate that participants plan to incorporate information into the various on-going projects and initiatives and pass it along to others.

Natural resources is more than water. It includes forests, wildlife, production animals, recycling and mapping to name a few. Our Extension team continues to find ways to make it easy to recycle items that can't be picked up curbside such as computers, paints, and medicines. In particular, medicines are being found in our drinking water, as current technology can't filter them out in the wastewater treatment facilities. Making it easy to drop off unused, unwanted and expired medicines keeps the water clean for human use, but also for birds, fish and other wildlife that count on our rivers and lakes.

SUSTAINABLE ENERGY

Meeting the demands for airline fuel, gasoline, and home heating in sustainable and economically viable ways is the focus of several of research areas at Purdue.

From an economic perspective, our lead economists predict that natural gas prices will be even lower in the 2016 winter season. There are several "supply-and-demand drivers" that are keeping the price of natural gas so low including: there is a large supply of natural gas and the increase in supply has been faster than demand. This has resulted in price reductions. There is little international trade in natural gas, so the export market is quite limited. Drilling has become so efficient over the past few years that it's easier to access and store natural gas than in the past. In addition, the past winter was warmer than usual, so supplies stayed high in storage. As the facilities stay full, prices come down to reduce the inventories. In another good sign for low energy costs for consumers, ag economists predict that gasoline prices will stay in the range of $2 to $2.50 a gallon for much of 2016.

Work continues to grow biomass more efficiently in multiple crops from switchgrass to Miscanthus to poplar trees, in addition to using corn and other farm crops. For farmers to shift away from growing more traditional crops such as corn and soybeans to biomass crops, the crop must be highly efficient and have a strong demand from biomass users. Researchers continue to improve quality and quantity of the biomass crops, but low prices keep farmers from converting.

Meanwhile, work is being done to identify new bioproducts from the conversion of biomass into liquid fuels. Biomass goes through a fermentation process in preparation for conversion into fuel. It turns out that fuel made from agricultural biomass contains chemical building blocks that can be extracted and used for making everyday products. Many of the by-products from pre- and post- fermentation are tossed away or destroyed and could be recovered for other values. One lab is focused on identifying products and developing methods to recover the products to ensure nothing goes to waste in the biomass-to-energy process.

HUMAN, FAMILY, AND COMMUNITY, HEALTH AND WELL-BEING

Indiana's 92 counties are home to a wide variety of individuals, families, and communities who are served on-the-ground by Purdue Extension educators at the intersection of health, employment, community development and school readiness. Manufacturing jobs are down 150,000 and total non-farm employment is down by 5,600. Of the individuals working in industries that are experiencing net growth, 45% earn less than $13.00 per hour. As a result, each county has special needs and opportunities as educators work to overcome increasing poverty, access to healthy fresh foods at reasonable prices, and ensure children under 18 get the education needed to be self-sufficient when they enter the workforce. Our educators are translating agricultural research across the farm value chain in addition to creatively addressing long- and short-term needs of the communities they serve.

The National Math and Science Initiative reports that 26 nations scored higher than US high school students in math and 19 nations performed better in science. Thirty-eight percent of students who start with a STEM major don't graduate with one. While the statistics can appear grim, Purdue's 4-H teams reported significant progress in preparing teens to be leaders through our Teens as Teachers programs using STEM as a context. These programs provide teens with leadership training, science education, communication and presentation skills. These teens are part of a national 4-H pilot program that is jointly funded by the National 4-H Council and the United Soybean Board to provide more hands on STEM exposure and training. As with other 4-H teams across the US, Purdue has begun using the National 4-H survey and outcome measures for its programs and the 2016 Annual Report of Accomplishments is expected to reflect these changes in the document. In 2015, there were more than 145,000 youth in Indiana's 4-H programs, 12, 772 adult volunteers, and $106,900 in scholarships given to 215 Senior class 4-H members.

Many communities are rebuilding or pursuing a new vision but don't always know how to come together as a community to design and accomplish such a daunting task. Purdue, Ball State, and the Indiana Office of Community and Rural Affairs created the Hometown Collaboration Initiative (HCI), a pilot program focused on building collaborations in the community and producing a capstone project that demonstrates the group's ability to make a positive impact in the community. 125 people participated in the 6 pilot communities. Some early outputs from these HCI pilot programs include the creation of a young

professionals networking group, a community leadership commitment to $2.3 million toward a community trails project, plus the expansion of local leadership pipelines and improving hometown attractiveness. Five additional communities will be included in the 2016 program.
To make ends meet, many families turn to credit cards. Low interest rates on savings accounts and CDs don't motivate people to save. In 2015, the average US household had $15,762 in credit card debt and $133,922 in total debt with a median income of $53,657. Research shows that children learn behaviors, including money behaviors, by observing parents, television, and other media outlets, which may not be the best role models for ensuring future saving, budgeting and living within their means. Purdue's highly successful Captain Cash program covers 4 major financial literacy topics (earning, saving, spending, and borrowing) with grade school students to begin grounding them in financial basics that can interrupt the cycle of poor money management and using debt to survive.
DIVERSITY
The College of Agriculture has a strong commitment to encouraging and welcoming diversity. We know that cultivating a diverse and inclusive community that values the unique contributions of staff, faculty and students will be a benefit to our campus community, extension community and our stakeholders.
In 2015, we awarded $152,000 in assistantship funds, tuition ($92,056) and fees ($12,544) to fund 8 graduate students through our Diversity Assistantship Program. The goal of this program is to facilitate the entry, persistence and success of underrepresented groups in graduate programs and to ensure their full development as professionals through a combination of financial support and mentoring by engaged faculty.
Our Office of Multicultural Programs has two active USDA Multicultural Scholars Programs (MSP). The overarching theme of one program is to develop a diversity of leaders. It goes beyond getting the students in the door and addresses the complex web of needs and concerns of today's competitive, global marketplace. These 6 students have gained leadership skills, engaged in professional development programs, assisted in recruitment efforts for underrepresented minorities into the college and have studied abroad as part of their program. The second MSP is focused on expanding student cultural competence. College students who demonstrate success in the sciences then transfer into non-STEM majors or leave school completely is often due to the conflict they experience between "the enduring sense of who they are and who they want to become" and their perceptions on how they fit into the STEM workforce as academicians or employees. An individual's various social identities--sex, race, gender, age, socioeconomic class, religion, and ability, among others--shape their attitudes, behaviors, worldviews, and experiences. The 6 students in this program are learning how to proactively develop new social identities that would allow them to feel kinship with new schools of thought or career groups. Students are developing a scientist social identity through a framework of Cultural Competence.
Our National Needs Fellowship Program is educating outstanding and diverse Fellows with a focus on land use and landscape analysis (LULA) in forest and agricultural sustainability and resilience, which directly addresses the national targeted expertise shortage area (TESA) of Forest Resources. The 3 fellows have been making great progress as evidenced by the following activities and achievements: Chair of the Speakers Committee for the ESE Symposium; Logistics Chairperson for ESE Symposium; and Blosser Environmental Travel grant. All Fellows are on target to reach their research goals.
ROLE OF TECHNOLOGY AND SENSORS
2015 saw a significant expansion in the use of nanotechnology and sensors and will continue to be an important focus in all areas of agriculture. Nanotechnology is technology that operates at a very small scale (1 to 100 nanometers) and encompasses many fields including medicine, science, engineering, chemistry, electronics, and more. Chemically modified starches that are nano-sized are the standard in the food and medical industry as adhesives, emulsifiers, and stabilizers of food and medicines. Chemically modified starches provide stability and consistency in delivery, but are challenging to biodegrade under all conditions and often have a negative environmental impact. A dendrimer-like biopolymer (DLB) was derived in our Food Science department from corn as potential replacement for some chemically modified starches. Dendrimers are repetitively symmetrically branched molecules that look like trees. This DLB, named Nano-11, has been proven as an adjuvant for vaccines (enhances the body's immune response to the vaccine), demonstrated to encapsulate pathogens such as E. coli 0157,

Listeria monocytogenes, and Salmonella on the surface of cantaloupe rind to allow antibacterial treatments to be effective, and permitted the delivery of small molecule drug substances.
Preparing food samples for evaluating if they contain food-borne pathogens is cumbersome and arduous. Purdue developed a user-friendly pathogen enrichment device (PED) and biosensors that proved to be a one-step procedure to prepare the samples. Improved biosensors were inserted into BARDOT (bacterial rapid detection using optical scatter technology), which was able to identify Salmonella positive samples in fresh chicken with 100% accuracy.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	78.2	0.0	273.2	0.0
Actual	63.0	0.0	193.2	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 External Non-University Panel

2. Brief Explanation

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 the general public

Brief explanation.

{NO DATA ENTERED}

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

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Open Listening Sessions
- Needs Assessments

Brief explanation.

{NO DATA ENTERED}

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

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

Brief explanation.

{NO DATA ENTERED}

3. A statement of how the input will be considered

- To Identify Emerging Issues
- Redirect Extension Programs
- In the Action Plans
- To Set Priorities

Brief explanation.

{NO DATA ENTERED}

Brief Explanation of what you learned from your Stakeholders

As a result of the Lt. Governor visits to the 92 counties of Indiana, eight regional conferences were held in communities across the state to present a new initiative, the Hometown Collaboration Initiative (HCI). This effort is for communities under 25,000 people to expand their pipeline of local

leaders, strengthen and expand jobs by build on existing economic assets, and embrace place making strategies focusing on natural and built resources and improving attractiveness and quality of life for the hometowns. A core principle of HCI is broad-based input and buy-in vital to long-term success and sustainability. In 2014 communities across Indiana applied for the new initiative. As a result, five were selected to become the HCI community finalists. Each of these five communities have selected their focus - leadership, economics, or quality of life, and began working with Purdue Extension in collaboration with the Lt. Governor's office and the Indiana Office of Community and Rural Affairs in 2015. Four additional counties began the process in 2015 and more will come online in 2016 and beyond.

The College of Agriculture rolled out a new 5-year strategy in 2015. A 35-member task force of faculty, staff and students that broadly represented the college. Five teams worked through a provocative series of questions that focused on Understanding our world/Assessing our college; Defining global leadership and Making it happen. The teams conducted surveys of faculty, staff and students, held 27 listening sessions around Indiana and engaged nearly 800 stakeholders to learn more about how the college could impact their set of needs and goals. All of this informed the final mission, vision and value statements.

In 2012 Ag Research interviewed individuals at the Indiana State Fair who entered the Purdue sponsored exhibit. This qualitative survey indicated that directionally we are focused on the right things: food security/scarcity, crop production and environmental impact, food handling, obesity, alternative fuels, companion animal health and livestock health. These surveys were not intended to produce statistically significant results, but to experiment with different models for gathering information about Purdue's agricultural research. 174 people were surveyed, with 10% being from underserved populations. Of the 174 surveyed, over 75% agreed or strongly agreed with our current research focus. This mirrors the demographics of our state.

In 2012, 4-H expanded use of the Expansion Review Committees (ERC). ERCs are a group of adults and youth which are representative of the county demographics and review the county 4-H program to ensure that it is relevant, current, and provides impact based on local county needs. Since 2012, these committees continue to meet at least annually and document efforts, activities and findings.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
9179071	0	6398625	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	9099273	0	6112129	0
Actual Matching	19849815	0	28145846	0
Actual All Other	2722338	0	7453183	0
Total Actual Expended	31671426	0	41711158	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	5213983	0	3023798	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	4%		4%	
201	Plant Genome, Genetics, and Genetic Mechanisms	4%		4%	
205	Plant Management Systems	10%		10%	
206	Basic Plant Biology	4%		4%	
302	Nutrient Utilization in Animals	4%		4%	
304	Animal Genome	4%		4%	
305	Animal Physiological Processes	4%		4%	
307	Animal Management Systems	10%		10%	
315	Animal Welfare/Well-Being and Protection	4%		4%	
402	Engineering Systems and Equipment	10%		10%	
501	New and Improved Food Processing Technologies	2%		2%	
502	New and Improved Food Products	2%		2%	
512	Quality Maintenance in Storing and Marketing Non-Food Products	2%		2%	
601	Economics of Agricultural Production and Farm Management	10%		10%	
604	Marketing and Distribution Practices	3%		3%	
606	International Trade and Development	4%		4%	
608	Community Resource Planning and Development	10%		10%	
801	Individual and Family Resource Management	3%		3%	
802	Human Development and Family Well-Being	3%		3%	
805	Community Institutions, Health, and Social Services	3%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	37.2	0.0	171.4	0.0
Actual Paid	34.6	0.0	99.4	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**
2919725	0	3210129	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
4052685	0	11236460	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
753830	0	1642938	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

• Develop publications, workshops, consultations, seminars, certification programs, distance education modules, field days, and other opportunities.
• Conduct research
• Collaborate with other agencies
• Coordinate meetings with important stakeholders (researchers, industry, organizations, farmers, regulatory, etc.)
• Increase number of participants in life-long learning programs
• Foster leadership and economic development and facilitate strong partnerships and participation in state, regional, national, and international agencies, organizations, and groups
• Encourage participation by extension specialists in: Taskforces, Review Committees, Advisory Boards, Editorial Boards, Commodity committees/boards, Invited presentations, Honors and Awards, Common Interest Groups, Professional Societies

2. Brief description of the target audience

National and International: livestock and crop producers, livestock and crop industry (entire value chain), elected officials and decision makers, agencies, extension specialists, potential 3rd party partners (NGO's, educational institutions, etc.), consumers

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	187286	1311242	50559	79083

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

Patent Applications Submitted

Year: 2015

Actual: 6

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	155	353	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops conducted

Year	Actual
2015	2189

Output #2

Output Measure

- Number of Extension publications written, new or revised

Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of research publications

Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of volunteers

Year	Actual
2015	3189

Output #5

Output Measure

- Number of consultations

Year	Actual
2015	24842

Output #6

Output Measure

- Number of research projects

Year	Actual
2015	136

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	An impact on livestock resulting from new knowledge related to the environment, productivity, and/or health & welfare.
2	An impact on crops resulting from new knowledge related to the environment, productivity, and/or biotic/abiotic stress.
3	An economic and/or community impact resulting from new knowledge about food production systems, marketing & retail management, logistics & systems, and/or business development.
4	An impact on hunger and/or malnutrition resulting from new knowledge about food products, food quality, and/or food quantity.
5	An impact on non-food products resulting from new knowledge related to non-food products, and/or non-food systems.
6	An impact on disaster preparation, education, and/or recovery.
7	GF 1.2 - # Of improved animal genetics
8	GF 1.3 - # Of increased efficiencies (i.e.. (% pregnant), or increases in yield/unit (bushels/acre; lbs. product (meat, protein, milk) per animal ; lbs. feed per gain).
9	GF 2.1 - # New or improved innovations developed for food enterprises
10	GF 2.4 - # Producers (and other members of the food supply chain) that have increased revenue
11	GF 2.6 - # New diagnostic technologies available for plant and animal pests and diseases.
12	GF 2.11 - # Acres that incorporate ecosystem services and/or biodiversity considerations
13	ANR-S-Farm&AgMgmt - # of farms informed about succession planning
14	ANR-S-FieldCrops - # of participants informed about agronomic issues
15	ANR-S-Livestock - # of participants informed about livestock management practices
16	ANR-M-FieldCrops - # of participants who self-report that they adopted a recommended practice for their operation
17	ANR-S-Field Crops - # of participants informed about crop production issues

18	GF 2.3 - # Innovations adopted in food enterprises including production, allied services, processing, and distribution
19	ANR-S-DivAg - # of people who learned about role of diversified agriculture in a local food system

Outcome #1

1. **Outcome Measures**

An impact on livestock resulting from new knowledge related to the environment, productivity, and/or health & welfare.

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

An impact on crops resulting from new knowledge related to the environment, productivity, and/or biotic/abiotic stress.

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

An economic and/or community impact resulting from new knowledge about food production systems, marketing & retail management, logistics & systems, and/or business development.

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

An impact on hunger and/or malnutrition resulting from new knowledge about food products, food quality, and/or food quantity.

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

An impact on non-food products resulting from new knowledge related to non-food products, and/or non-food systems.

Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

An impact on disaster preparation, education, and/or recovery.

Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

GF 1.2 - # Of improved animal genetics

2. **Associated Institution Types**

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	4502

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The growth and maintenance of skeletal muscle is fundamentally important for production of meat in domestic animals. Callipyge sheep are a naturally occurring model that shows that carcass composition can be improved with better feed efficiency and without changing net live weights. Research on the callipyge model will improve our understanding of the control of postnatal muscle growth lead to methods to improve the efficiency of meat animal production.

What has been done
Callipyge lambs have a 30-40% increase in muscle mass and 6-7% decrease in carcass fat without a net effect on animal growth. The trait has a novel mode of inheritance called polar over dominance because only heterozygous animals that inherit a normal allele from the dam and the callipyge allele from the sire have the muscle hypertrophy phenotype. The callipyge mutation is a regulatory mutation in the DLK1-DIO3 imprinted gene cluster that increases the expression of Delta-like-1 homologue (DLK1) and Retrotransposon Like-1 (RTL1) in the muscles that undergo hypertrophy. Hypertrophy is the process of growing the muscle by increase the size of the muscle cells as opposed to hyperplasia where the cells stay the same size but the number of cells increases. The objective of this project will address a major unknown in the callipyge trait: the genetic mechanism of polar over dominant inheritance.

Objective 1. Determine the effect of the callipyge mutation on epigenetic modifications and regulation of transcripts within the DLK1-DIO3 locus.

Results
Determining the effect of the callipyge mutation on the expression of the maternal allele-specific expression of several long non-coding RNA. The PD has been using the Tuxedo suite of programs with existing RNA sequencing data to develop a more accurate model of the gene structure for the maternal long non-coding RNA. These genes are highly up-regulated due to the callipyge mutation but the annotation of these genes is very sparse. The identification of splice junctions using splice read mapping program,Tophat2, shows a highly variable region of transcript splicing in MEG8 (Maternal Expressed Gene 8) that is a host gene for both small nucleolar RNA and microRNA.

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome

Outcome #8

1. Outcome Measures

GF 1.3 - # Of increased efficiencies (i.e.. (% pregnant), or increases in yield/unit (bushels/acre; lbs. product (meat, protein, milk) per animal ; lbs. feed per gain).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	48

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Annual gain in soybean yield over the past few decades has been minimal, especially compared to corn. However, soybean yield over the past 90 years have increased annually ~0.34 bu ac-1 in the US and ~0.40 bu ac-1 across the Midwest. Yield gains were attributed to advances in genetics, pest control, and production practices. Recent studies have documented faster yield gains since the ~1970s than the previous ~50 years. Yet, much of the fertility recommendations for soybean and the nutrient allocation by soybean were based on research from the 1970s. A greater rate of yield gain is desired by growers to increase profits (or at least maintain profits with increasing input costs). Maximizing the yield potential of soybean demands an updated investigation in nutrient uptake and allocation. Additionally, fertilizer inputs are among the most

costly inputs in soybean production. Improving the efficiency at which soybean uses phosphorus and potassium will improve grower profitability while potentially reducing the environmental impact (e.g., phosphorus in surface waters). Improved soybean production would aid in the supply of much needed protein for the livestock industry and subsequently human consumption. Greater soybean production is also needed to meet the rising demands for soybean oil from human to industrial needs.

What has been done
Determine what, if any, gaps exist in the generally recommended management strategies for soybeans that were established based on 1970?s research. First, established solid foundations in soil fertility by identifying changes in critical soil fertility levels for modern soybean cultivars and determine optimal fertilization approaches in current crop rotations. Second, fine-tuning plant nutrition. This was done by determining the appropriate methods to improve plant nutrition from cropping systems (previous crop, management intensity, cover crops), application methods (soil, seed, foliar, irrigation), timings (previous season, pre-planting, in-season), and nutrient sources/additives (commercial fertilizer, manures, cover crops, product formulations).

Results
The growth and the yield of older soybean varieties, released in the 1970s and 1990s, were not adversely affected from suboptimal levels of phosphorus and potassium. Whereas, the growth (biomass) and development (leaf nodes) of modern varieties (~2010s) were severely hampered in under suboptimal levels of phosphorus and potassium. Corrective applications of phosphorus and potassium significantly improved the development and yield of the modern varieties. It appears that the modern varieties are more sensitive to soil levels that are near the critical range than the older varieties, which were the ones that the soil fertility recommendations are based on.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #9

1. Outcome Measures

GF 2.1 - # New or improved innovations developed for food enterprises

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	86

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dramatic increases in international agricultural commodity prices both during the 2007-08 food crisis and again in 2011 brought policy and agricultural production adjustments in key markets for U.S. agricultural exports. In the short run, stabilization policies helped to achieve record U.S. agricultural exports. Countries are now seeking greater self-sufficiency through more rapid agricultural development in the long run, however. Macroeconomic factors influence both the affordability of short run stabilization strategies and incentives to produce or trade agricultural commodities in the long run. This research is influencing debates on both multilateral and bilateral trade negotiations and in policy formation both here and abroad. Issues related to trade and economic policy of developing countries and how those impact markets for U.S. agricultural exports need to be better understood in those debates.

What has been done
This project uses new economic models incorporating relevant market imperfections and institutions. Focus is on why world prices increased, how countries responded, and what influence that had on U.S. agricultural trade. Attention is given to why these spikes occurred, how exporters and developing country importers responded in the short and long run, and what role the dramatic changes in macroeconomic factors that occurred at about the same times played in both price run-ups and trade policy responses. Impacts on U.S. agricultural trade, national welfare and farmer income will also be evaluated as well as U.S. agricultural and trade policy responses. Specific objectives are: to understand better the relative importance of various factors believed to lie behind world agricultural price spikes (in 2008 and 2011) and later declines; to examine stabilization policies, including both trade and stockpiling policies, utilized in developing countries as a short run response to world price spikes, as well as other policy tools to respond to domestic supply shocks; to consider long run responses that foster more rapid agricultural development and to achieve greater self-sufficiency; from a methodological perspective, to collect new data and test hypotheses on the conduct of agricultural trade in order to better understand market institutions and imperfections, to develop trade models that capture dynamic elements of economic development, and to incorporate relevant institutions and market imperfections into economic models of international agricultural trade.

Results
Work related to volatile international commodity prices this year emphasized the extent to which world price signals are transmitted to domestic markets in developing countries. Case studies looked at Nigeria and Afghanistan. Using related methodology, we continued to examine exchange rate effects on US agricultural prices. Those results demonstrate that those impacts are sensitive to underlying market conditions, such as the extent of carry-out stocks. Monetary policy was found to be less important in explaining impacts.

4. Associated Knowledge Areas

KA Code	Knowledge Area
606	International Trade and Development
608	Community Resource Planning and Development

Outcome #10

1. Outcome Measures

GF 2.4 - # Producers (and other members of the food supply chain) that have increased revenue

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1134628

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
An increasing number of marine shrimp enterprises have started up in Indiana. The high market price of the shrimp, coupled with the lower capital costs and variable scale of production make these types of operations attractive to many entrepreneurs and farmers. In a survey of Indiana shrimp farmers in 2014, it appeared that both novice and experienced farmers need knowledge that is more technical. Two big issues are the source of shrimp larvae and information on Best management Practices for rearing shrimp in Indiana.

What has been done
A demonstration project using commercial feedstuffs was conducted. The theory was that the producers could produce their own shrimp larvae and would not have to rely on shipments from tropical regions as this can produce significant risks. By using commercial feedstuffs, the footprint of operations could be reduced.
Additionally, a one-day workshop for both existing and potential producers is planned for February 2016. Two of the leading experts in shrimp rearing in the US are to present their research results and Best Management Practices for shrimp production. There will also be information on economics, marketing and engineering principles for shrimp buildings by Purdue specialists.

Results
Although this first of its kind demonstration project was unsuccessful, with larval mortalities due to shipping, research will likely continue with gravid adults being shipped in. Industry members and extension staff are not deterred and plan to continue experimenting on ways to increase revenue through new sources of larvae and by refining best management practices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

Outcome #11

1. Outcome Measures

GF 2.6 - # New diagnostic technologies available for plant and animal pests and diseases.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The soil-borne bacterium Ralstonia solanacearum causes bacterial wilt, one of the most destructive diseases of tomato worldwide. Host plant resistance is the most effective measure of disease control, but is poorly understood. Since Ralstonia first infects root systems, understanding how root architecture is affected by this pathogen is an important step in understanding bacterial wilt resistance in tomato.

What has been done
The focus this year was on investigating how root architecture is differentially altered by Ralstonia solanacearum in wild and domestic tomato varieties with different levels of resistance and susceptibility.

Results
Significant differences were found in the number of lateral roots produced between resistant and susceptible lines. Resistant lines seem to produce an extreme amount of lateral roots when in contact with Ralstonia solanacearum. This indicates that we may be able to use genetic markers for roots to develop a solution.

4. Associated Knowledge Areas

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

Outcome #12

1. Outcome Measures

GF 2.11 - # Acres that incorporate ecosystem services and/or biodiversity considerations

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	436

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Larvae from the Hessian fly can destroy the productivity of an entire wheat field by stunting the growth of the plants.

What has been done
The Hessian fly genome has been sequenced by a team of researchers from 26 institutions around the world.

Results
34% of the fly's genes do not look like that of other insect genomes, which lead researchers to believe that the genome is rapidly evolving. Researchers have discovered at least 35 genes in wheat that can fight against the Hessian fly but resistance fades after 5-10 years due to the rapid evolution of the fly. We're starting to understand how the insect and plant are interacting and which proteins the insect uses to avoid or overcome plant defenses. In the future, those effector proteins could be the basis from which we generate new ways of controlling the insect.

4. Associated Knowledge Areas

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

Outcome #13

1. Outcome Measures

ANR-S-Farm&AgMgmt - # of farms informed about succession planning

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	256

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As Indiana families face the issue of transferring the farm business to the next generation of operators, the need for information and resources in the area of business transfer and succession planning has become crucially important for the smooth transition of the business. In addition, nearly 30% of farm operators are women. Even if not considered the principal operator, many farm women are currently managing some or all aspects in many farming operations. Farm women are asking for more programming geared toward their special needs.

What has been done
Several workshops were held including Annie's Project (a joint effort between 3 counties in Indiana), Farming Together: Planning for the transfer of Farm Ownership and Management, and Midwest Women in Agriculture Conference. The Midwest Women in Ag conference offered for the first time a 1st Young Ladies in Agriculture Forum.

Results
Nearly 300 people attended the various sessions. 88% of the women in the Annie's Project workshop believed they were equipped to start the discussion and make decisions relating to succession planning. 96% from Farming Together workshop felt better prepared to develop a management transfer plan, and 87% planned to meet with or assemble a succession planning advisory team. 23 young women participated in the 1st Young Ladies In Agriculture Forum where participants said they'd like to learn more about entrepreneurship in agriculture, growing career choices and job options for women, ag management, and make the forum more known to FFA and 4-H girls.

4. Associated Knowledge Areas

KA Code	Knowledge Area

601 Economics of Agricultural Production and Farm Management

Outcome #14

1. Outcome Measures

ANR-S-FieldCrops - # of participants informed about agronomic issues

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	18565

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Producers, fertilizer and chemical dealers, county Extension Educators, company agronomists, and crop consultants want and need to be kept abreast of pest development and problems, and agronomic situations and issues on Indiana's field crops. Producers rely on agribusiness professional to identify and inform them of existing or potential pest problems on their farms and to assist with appropriate management tactics related to pesticides. The better informed the agribusiness personnel are, the greater their ability to guide producers toward economically and environmentally sound pest management decisions.

What has been done
The Purdue Pest Management Program coordinates an interdisciplinary team of specialist from the departments of Agronomy, Botany and Plant Pathology, and Entomology to produce and publish the weekly Pest&Crop newsletter. The newsletter gives forecast and up-to-date information on pests and their damage throughout the state using graphics, videos, scouting procedures, management guidelines, pesticide regulations and opportunities for continuing education as key elements for informing readers.

Results
The information assists users in making real time economic risk assessments for pests and other agronomic issues. By online evaluation, readers indicated that the newsletter was timely (96%), applied pest identification information to the 2015 crop (91%), used Pest & Crop information on treatment decisions (68%), and increased their, or the company's, profitability (49%). 43% indicated they make, or influence, pest management decision on over 10,000 acres.

4. Associated Knowledge Areas

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

Outcome #15

1. Outcome Measures

ANR-S-Livestock - # of participants informed about livestock management practices

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3039

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Several states across the U.S. have developed successful Master Cattleman programs that have offered cow-calf producers the opportunity to increase their knowledge of beef production. Beef producers in Indiana are in need of in-depth educational programming that will help them evaluate their production system and allow them to create a unique business plan that will increase productivity, efficiency, and profitability of their operations. We believe the Master Cattleman program will fill a void in the current educational programming available to Indiana's beef producers and will allow for public recognition of Educator specialization across the state. Additionally, the development and implementation of a Master Cattleman program for Indiana would demonstrate Extension's role in education resulting in significant economic impact.

What has been done
Purdue Extension created a 10-week Master Cattleman Program that utilizes industry experts to teach material in an interactive, discussion-based forum, tailored to fit the needs of the participants. This is an advanced series of classroom-based lessons where participants gain knowledge in all aspects of cattle production and build a business plan for their operation. Lessons in the classroom are scenario-based with optional field days after completing the program. Participants receive their Beef Quality Assurance certification upon completion of the program. 2015 was the second offering of the program.

Results

Despite being in its early phases of statewide implementation, the program confirmed its ability to meet the needs of the Indiana's beef producers. Most notable on follow-up evaluations was that 100% of respondents indicated that the program helped increase the revenue potential of their operation. Half of the respondents estimated increases of $1,000-5,000 while the rest said $5,000-10,000. This is a significant impact in such a short period of time. Participants believed many elements of the program were helpful in increasing the revenue potential, including: 91% of participants said marketing information; 93% said they had a better understanding rumen physiology and feeding strategies; 77% have the ability to develop and implement a comprehensive herd health plan; 92% had a better understanding of environmental issues related livestock production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

Outcome #16

1. Outcome Measures

ANR-M-FieldCrops - # of participants who self-report that they adopted a recommended practice for their operation

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	13087

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Farm Bill, noted as the biggest change to federal farm policy in a generation, presented many changes to the nation's farmers in the fall and winter. Farmers found it complicated and difficult to understand, yet deadlines loomed in February and March. Farmers and farm operators require timely information on pesticide and fertilizer/nutrient use and regulations, and farm management issues. Issues such as farm bill decisions, seed purchases and planting operations, grain handling and storage, and herbicide resistance are a few of the sometimes difficult and costly topics farmers must manage.

What has been done
Purdue Extension, with the Purdue Center for Commercial Agriculture, provided educational opportunities for Indiana landowners and operators regarding implementation of the 2014 Farm

Bill. Purdue Extension County Educators were provided in-depth, hands-on training regarding farm bill options and analyzing impact using web-based tools. They are able to assist producers one-on-one with program choice selections. Further, Purdue Extension Educators were trained to conduct local workshops jointly with their local Farm Service Agency. Training sessions by the Center for Commercial Agriculture included one (internal) webinar and one all-day workshop for Purdue Extension Educators. Training sessions addressed: 1) mechanics and economic impact of base reallocation and yield update, 2) safety net choices of Price Loss Coverage (PLC) and Agricultural Risk Coverage (ARC), 3) Supplemental Coverage Option (SCO) with how to combine with PLC for shallow loss coverage with price loss safety net. Meetings on the MPP program for dairy producers were conducted: 1) seven with Indiana Farm Service Agency, Indiana State Department of Agriculture, Indiana Soybean Alliance, and Indiana Corn Marketing Council on field crop coverage; 2) six on Dairy Margin Protection Program (MPP-Dairy) available decision tools to help producers make informed enrollment decisions; 3) 81 county meetings (71 in partnership with local FSA) on safety net choices of Price Loss Coverage (PLC) and Agricultural Risk Coverage (ARC) with county and individual options; 4) Buy-up decisions with Noninsured Crop Disaster Assistance Program (NAP). Web-based educational resources were posted on Purdue Extension and Purdue Center for Commercial Agriculture websites to provide producers, landowners, and other interested parties with information to supplement information obtained via meetings. Many resources were developed: 1) fact sheets on programs via 2014 Farm Bill; 2) models to compare effective prices; 3) videos addressing issues farmers face when using online decision tools developed by the Univ. of Illinois and Texas A&M Univ.; 4) two webinars on Farm Bill education. Over 500 viewers participated live, over 2,000 additional views via YouTube playlist; 5) Seven regional meetings had an overall attendance of 1,271, while 4,749 individuals attended 81 county meetings. More than 400 received individual consultations. Milk Margin Protection Program meetings had 220 attendees.

Results

Self-evaluated knowledge of Milk Margin Protection Program on a scale of 1 to 7, increased from a mean of 2.42 prior to the meetings to 5.59 after. The degree to which the material would be used was scored at 6.12 (scale of 1 to 7) by respondents. Many positive comments were shared of the training sessions, here is a sample: 1) Farmers really appreciated Purdue Extension's role in the information delivery and evaluation of the Farm Bill. One farmer said, "Purdue was a life saver." - referring to the explanation and information provided by the local Purdue Extension Service regarding Farm Bill decisions. 2) One person commented that farmers now understand what to do and another training is not needed. 3) "I have clarity on what decision I should make for the new farm bill program."

4. Associated Knowledge Areas

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

Outcome #17

1. Outcome Measures

ANR-S-Field Crops - # of participants informed about crop production issues

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	19575

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Because of extended and intense spring and early summer rains of 2015, the Farm Service Agency announced a State of Emergency for Indiana. Flooding created abnormal planting and growing conditions resulting in poor crop performance. Concern about large acreage needing to be replanted with new crop selection or take losses was brought to surface. An aerial fly over helped show conditions needing to be addressed. Saturated soil conditions and inability to perform necessary field operations impacted farmers and landowner with challenges, leading to prevented planted acres, salvaging damaged crops, remedying compacted and anaerobic soils, managing financial issues and navigating crop insurance decisions.

What has been done
Purdue Extension, collaborated across counties, in partnership with Extension specialists on campus, Ohio State University, local representatives for insurance and government programs, the Soil and Water Conservation District, and USDA's Farm Service Agency developed and presented programs throughout Indiana's flooded areas. In the northwest and east parts of the state, programs on agricultural practices included: 1) planting dates and seeding rates of alternative crops to salvage fertilizer and save soil loss, 2) integrated pest management, and 3) crop rotation of crops, to help improve water quality and reduce additional cost for soil health benefit. In addition, farm management tools for financial decisions, cover crops, and flood insurance were addressed. In Jasper and Newton counties, 39 farms managing a total of 69,000 acres were represented. In Blackford County over 80 area farmers and landowners attended.

Results
This assistance led one farmer to plant Sudan grass as a rescued crop for 50 acres. This adopted new practice saved over $29,000 in feed cost for 2,000 cattle. Other farmers planted hay in water ponded areas to let land stay unproductive when flooding has destroyed a crop. Because of these programs changes in practices occurred with over five times more cover crops being planted to help recycle fertilizers not taken up by lost crop. This cover crop planting helped keep soil in place, increased organic matter and improved water quality. Based on results from a program evaluation, timely information was delivered to area farmers impacted by the extreme 2015 rainfall events. Attendees self-reported that they increased their understanding of crop insurance considerations (89%), corn crop issues (95%), soybean issues (94%), grain market conditions (70%), forage crop issues and options (78%), and cover crop options for prevented planting acres (89%). Attendees self-reported that they are more likely to make more informed crop insurance decisions (72%), improve grain harvest and storage practices (59%), take steps to prepare for the 2016 crop year (72%), seed a cover crop on prevented or damaged crop acres (39%), evaluate

health of perennial forage crops (44%), and make more informed market and 2016 crop acreage decisions (78%). Results from the evaluation indicate that many growers increased their knowledge of what affects the extreme rainfall had on the growing season and how to manage their crops, soils, and markets in 2015 and beyond. A comment from one farmer in attendance highlighted the importance of the educational program during a time of emotional and financial strain for many area farmers: I'm glad I came. It was informative and I feel less pessimistic.

4. Associated Knowledge Areas

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

Outcome #18

1. Outcome Measures

GF 2.3 - # Innovations adopted in food enterprises including production, allied services, processing, and distribution

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	14

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Southwest Indiana has more acres of wheat grown than any other region of Indiana. Soft, red winter wheat is a traditional cool season crop for southwestern Indiana. It is commonly planted in October following corn, and then double-cropped to soybean after harvest in June. Thus allowing producers to grow three crops in 2 years. As a result, wheat producers in need local information on the best wheat varieties to grow in order to maximum their yield and income potential.

What has been done
Purdue Extension in Posey and Spencer Counties, conduct winter wheat plot yield trials each year on 45-50 varieties of wheat, representing more than a dozen seed companies, to provide local, research-based, unbiased data for wheat producers. This wheat variety evaluation is conducted on farms in conjunction with farmer cooperators. In addition, a multi-county farmer survey was conducted to get feedback on usefulness of the local wheat variety test for their operations.

Results

Average grain yields were from 81 to 114 bushels per acre. The top entries averaged across location ranged in yield from 105 to 114 bushels per acre. This variety test is used by local growers and consultants to aid in selecting appropriate varieties for economic and reliable winter wheat production. In addition, 41 of the 62 respondents to the survey indicated they do use this information to make appropriate variety selections for use on their farms. In a survey of crop producers and agribusiness representatives from across Southwest Indiana, nearly 80% (79.3%) of the respondents replied that they use one or more of the test plot trials for their business. Local farmers, when asked about their use of plot information, value the unbiased and cross-company research results. One farmer specifically stated that Purdue Extension wheat plot results are the only location to get good wheat data for Southwestern Indiana. A majority of wheat producers in the region report a significant financial benefit to their operations by having the data from these plots for use in variety selection.

4. Associated Knowledge Areas

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

Outcome #19

1. Outcome Measures

ANR-S-DivAg - # of people who learned about role of diversified agriculture in a local food system

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1726

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Urban agriculture is a growing area of economic and community development. Urban farmers are often new farmers and growing at the scale of five acres or less. It is crucial to their success that they have access to beginning farmer resources, a peer network, and that others know and understand the benefits of urban agriculture enterprises in order for urban farms to receive support. Urban agriculture can beneficially impact health, social, environmental and economic factors. Health impacts of urban agriculture include: improving food access to food insecure areas, increasing fruit and vegetable consumption and more healthful food consumption overall, raising food and health literacy, and many more.

What has been done

In 2014-2015, Urban Ag Educator completed several activities to strengthen the support network for Indianapolis' urban farmers. First, built up an existing but underutilized cooperative network of urban farms called IndyGrown, by convening four farm members of IndyGrown and helped them set goals for the coming year, completing their website, collectively marketing their farm stands, and hosting a tour of the farms. Activities have potential to benefit urban agriculture community at large.

Results

A total of 55 people attended the urban ag tour, including an outdoor dinner in partnership with a local chef. This tour raised awareness of urban agriculture in Indianapolis and provided time when the networking could build among people who farm urban land and the people who want to support that. Attendees responded about what they enjoyed of the tour: "Making new connections. Seeing great urban farming in action" "Seeing how each farm produces their crops & different varieties of crops they all grow." "I enjoyed seeing the farms. I didn't know they existed before today." "Impressed by the support for the ?urban farms." The passion the individuals farming these farms have and the education these centers for agriculture are giving to their communities. The tour registration website received more than 1,000 page views. In addition, 2 months later a local journalist found out about these farms via the tour website and did a feature article on these farms in August. At least one IndyGrown member felt the website and farm stand advertisement resulted in increased attendance and sales. An IndyGrown farmer said: "We have noticed great improvement, about double the attendance and sales."

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Field and lab research projects monitor progress and completion of tasks to determine

effectiveness and accomplishment. Extension programs monitor participation or conduct evaluation surveys to measure change in knowledge and intentions of participants, and follow-up surveys to assess change in behavior or practice, and results of actions. Evaluation examples: new soybean germplasm created; improvement in pig growth rate, feed efficiency, and/ore diet digestibility, winter canola varieties for grain yield and quality; new simulation tools developed toward design of new hydraulic systems; increased efficacy of vaccines; follow-up surveys after Farm Bill enrollment and sign-up deadlines determined if information was adequate to help farmers make decisions; follow-up surveys sent to assess adoption of beef production practices since the educational series.

Key Items of Evaluation

Research compared soy bean varieties and found modern varieties more sensitive to soil levels near critical than older varieties, but current fertility recommendations are based on the older varieties. Shrimp enterprises refinement of best management practices are expected to increase revenue with new sources of larvae. Interaction between hessian fly and wheat discoveries
enhance understanding of effector proteins for new ways to control the insect. Bacterial wilt destroys tomatoes, but investigations of root architecture show differences in wild and domestic tomato varieties in resistance and susceptibility, with resistant lines producing an extreme amount of lateral roots when in contact with the bacterium.
Extension in-person and web-based training, fact sheets, decision models, and videos were implemented to assist producers in navigating the Farm Bill and to provide information needed to make decisions resulted in increased knowledge and ability to make decisions for their operation. One producer commented, "I have clarity on what decision I should make for the new farm bill program." Extension organized on-farm wheat research plots which resulted in an average grain yield increase from 81 to 114 bushels. Extension assistance for producers whose acreage was flooded resulted in increased knowledge of to mange their crops, soils and markets resulted in adaptation of practices to rescue acres with alternative and cover crops and feed, and improved grain harvest and storage practices.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	10%		10%	
112	Watershed Protection and Management	5%		5%	
123	Management and Sustainability of Forest Resources	10%		10%	
132	Weather and Climate	10%		10%	
135	Aquatic and Terrestrial Wildlife	10%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	10%		10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	10%		10%	
212	Pathogens and Nematodes Affecting Plants	5%		5%	
213	Weeds Affecting Plants	5%		5%	
306	Environmental Stress in Animals	5%		5%	
605	Natural Resource and Environmental Economics	15%		15%	
610	Domestic Policy Analysis	5%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	5.9	0.0	12.3	0.0
Actual Paid	2.8	0.0	7.4	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
862584	0	360351	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2499308	0	1986120	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
306744	0	895701	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Conduct meetings, conferences, workshops
- Publish research and extension publications
- Establish web sites
- Organize field days
- Consultations
- Work with mass media

2. Brief description of the target audience

Producers, consumers, youth, elected officials and policy makers, professionals involved in weather and climate

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	483	1571	123	664

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

Patent Applications Submitted

Year: 2015

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	13	15	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Extension publications, written, new or revised
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of research publications
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of research projects

Year	Actual
2015	8

Output #4

Output Measure

- Number of consultations

Year	Actual
2015	205

Output #5

Output Measure

- Number of educational workshops or seminars conducted

Year	Actual
2015	40

Output #6

Output Measure

- Number of volunteers

Year	Actual
2015	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of observers monitoring weather and climate
2	Number of research-based studies, publications, and reports for policy organization members and legislators on climate change
3	Number of participants who increase their knowledge about climate change
4	Number of participants who reduce pesticide, nutrient and water inputs while maintaining high quality turf
5	Number of participants who increase knowledge of pesticides, nutrients and water inputs for maintaining high quality turf
6	Number of participants who increase knowledge of management practices that maximize environmental stewardship
7	Number of participants who adopt management practices that maximize environmental stewardship
8	Number of participants who increase their knowledge of opportunities and challenges for agriculture under carbon dioxide emissions policies to address climate change
9	CC 1.2 - # Current year climate relevant education programs
10	CC 1.3 - # Current year climate relevant research programs
11	CC 1.6 - # New assessment and management tools developed, including models and measurements of greenhouse gas emissions
12	CC 1.7 - # Climate relevant social media products, web-based products and communication tools
13	CC 1.8 - # New climate relevant databases, monitoring systems, and inventories managed or under development
14	NRE 1.16 - # Projects that incorporate ecosystem services and/or biodiversity considerations

Outcome #1

1. **Outcome Measures**

Number of observers monitoring weather and climate

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Number of research-based studies, publications, and reports for policy organization members and legislators on climate change

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Number of participants who increase their knowledge about climate change

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Number of participants who reduce pesticide, nutrient and water inputs while maintaining high quality turf

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

Number of participants who increase knowledge of pesticides, nutrients and water inputs for maintaining high quality turf

Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

Number of participants who increase knowledge of management practices that maximize environmental stewardship

Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

Number of participants who adopt management practices that maximize environmental stewardship

Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

Number of participants who increase their knowledge of opportunities and challenges for agriculture under carbon dioxide emissions policies to address climate change

Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

CC 1.2 - # Current year climate relevant education programs

2. **Associated Institution Types**

- 1862 Extension

3a. **Outcome Type:**

Change in Knowledge Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2015	13

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

Issue (Who cares and Why)

About 1,400 Indiana 4-H members study the 4-H Soil and Water project each year and approximately 2,400 4-H members study the 4-H weather project each year. The resource materials for both were over 20 years old and in critical need of updating, revising, a new look, and linking to technology that was unavailable when these resources were written.

What has been done
Two new curricula, Soil and Water Science and Weather and Climate Science have been developed to help youth learn about important natural resources. A guide for parents, educators, and volunteers is available for each youth manual to help them work with youth and enhance their education. Both passed peer review by National 4-H. The Soil and Water Science curriculum is designed for youth who enjoy learning about science and two very important natural resources: soil and water. Level 1 introduces basic terms and concepts for youth in grades 3-5, with activities on understanding important soil and water processes. Level 2, for youth in grades 6-8, help youth put basic skills into action to understand more complex soil and water concepts and interactions with the environment. Level 3, for youth in grades 9-12, has chapters based on how youth might use the information? as a homeowner, as a resident of a watershed, as a food and fiber producer, and as a mayor, teacher, or legislator. The 4-H Weather and Climate Science curriculum is for youth who enjoy learning about science, especially weather and climate. Level 1 introduces basic terms and concepts for youth in grades 3?5 with activities on understanding the signs of weather. Level 2 for youth in grades 6?8 addresses more complex weather topics, understanding climate, and making and using weather instruments. Level 3 has 2 sections: weather and climate to focus learning on more complex topics in these areas. A Facilitator?s Guide, written for each youth manual, has information about learning goals, life skills, experiential learning, youth development stages, answers to questions in the youth manual, and suggests ways to enhance the activities. The curricula are available at Purdue Extension?s The Education Store, www.edustore.purdue.edu.

Results
Both curricula were jury reviewed and accepted by National 4-H. The Soil and Water Science curriculum, won the Universities Council on Water Resources Education and Public Service Award and Indiana Association of Floodplain and Stormwater Managers, Education and Outreach Award in 2015. Over 800 educational manuals and over 1,000 educational manuals were sold in 2015.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate

Outcome #10

1. Outcome Measures

CC 1.3 - # Current year climate relevant research programs

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	11

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Based on a 2009 inventory assessment, agriculture is responsible for 6% of total U.S. greenhouse gas emissions. Methane and nitrous oxide are the primary greenhouse gases emitted by agriculture. Enteric fermentation (25%) and manure management (9%) contribute to total methane emissions.

What has been done
This project is developing methods to measure greenhouse gases from open-air agricultural operations. Measures of ammonia, carbon dioxide, methane, and nitrous oxide emissions from cropping and livestock agriculture operations are compared across a range of management practices and geographic/climate zones. A combination of scanners were used on manure storage facilities at two Midwestern dairies (one Indiana dairy using lagoon manure processing and one Wisconsin dairy using settling basin manure processing). Instrumentation included a scanning Fourier Transform Infrared Radiation (FTIR), Tunable Diode Laser (TDL) ammonia absorption spectrometer, difference frequency generation (DFG) laser-based nitrous oxide analyzer, and a non-dispersive infrared (NDIR) spectrometer carbon dioxide/water analyzer, 3D sonic anemometer, photoacoustic infrared (PA) absorption spectroscopy, and flame ionization gas chromatography.

Results
Methane contributed about ten times as much equivalent carbon dioxide emissions as carbon dioxide at both dairies. Methane and carbon dioxide emissions correlated with temperature at both dairies, and wind speed and direction correlated with emissions, and variability by time was identified at the Indiana dairy. Results will enhance the farm operation database of greenhouse gas emissions and add to the understanding how these emissions are influenced by regional, climatological, and management parameters. This will improve the ability to estimate U.S. greenhouse gas emission inventories.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
605	Natural Resource and Environmental Economics

Outcome #11

1. Outcome Measures

CC 1.6 - # New assessment and management tools developed, including models and measurements of greenhouse gas emissions

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Global environmental changes pose threats to natural ecosystems and to human welfare. Characterizing potential impacts of these changes is important, for informing decisions that have consequences for the rate of environmental changes, and for preparing society for the future. Understanding whether climatic and atmospheric changes will cause ecosystem carbon stocks to grow or shrink is critical to estimating expected rate of climate change. If warming leads to carbon release from ecosystems, then that "positive feedback loop" will accelerate climate change. While plant responses to short-term changes in temperature (minutes to hours) are well represented in most models, longer-term responses to temperature are not yet understood. Although processes clearly acclimate to temperature, the degree of acclimation varies across species, functional types, and biomes. Temperature responses of plants constitute one of the greatest sources of uncertainty in modeling future climate feedback from terrestrial ecosystems.

What has been done
The Earth System Models used to make climate projections simulates how the world's climate works by combining multiple sub-models of the atmosphere, oceans, land and ice. The research team added formulas describing photosynthesis and respiration in plants to a land model and ran simulations of carbon exchange from 15 temperate and tropical forest sites across the globe. They compared the model's carbon exchange simulations with historically observed rates to see how well the data matched.

Results
For temperate forests, the model that included acclimation was not more accurate. But for tropical forests, the model was 36% more accurate when acclimation was included. Using the acclimation formulas in the models was significantly better. This will help with the accuracy with future projections. The next step is to further refine acclimation equations that are species specific.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
605	Natural Resource and Environmental Economics

Outcome #12

1. Outcome Measures

CC 1.7 - # Climate relevant social media products, web-based products and communication tools

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Excess nutrients have become a worldwide environmental challenge with risks to the environment and human and animal health. Better management of the nitrogen cycle has been identified as a major environmental Challenge of the twenty-first century. This concern is not as dramatic as some climate change dire predictions, but is interrelated, as nitrogen in the atmosphere can be a potent greenhouse gas. Projected climate changes toward more extreme and variable rainfall patterns may move greater amounts of reactive nitrogen down major river systems to large water bodies already suffering from low oxygen due to nutrient over-enrichment. Nitrogen fertilizer is the largest single source of manufactured nitrogen (32%) being introduced into the environment. Current U.S. regulation of pollutants has successfully reduced reactive nitrogen from point sources like power plants and automobiles. The major remaining nitrogen problem is reactive nitrogen from non-point sources, especially agriculture. Only 30-40% of nitrogen applied to farm fields may end up in the corn plant, some portion is held by the soil, with the remainder released into waterways or the air. Critical questions are how to technically mitigate or control this flow of excess nitrogen, what practices or on-the-ground measures will accomplish this in a cost-effective way, and what institutional approaches (voluntary action, incentives, etc.) are likely to be successful in this done.

What has been done

The research objective is to identify and assess alternative policies that would lead to reductions in negative environmental impacts of agriculture. The focus is on nutrients, primarily nitrogen, on working agricultural lands. Attention is given to potential impact of climate change as increased variability and extreme events influence nutrient flows and losses. We have updated and highlighted existing research on climate change impacts on soil erosion. This stems from recent observations on increasing frequency of intensive rainfall events in the Upper-Midwest that increase erosion and excess nutrient flows. An initial multi-disciplinary team including Land Grant and ARS scientists has been formed to assemble available information and to update knowledge that will result in increased awareness of the problem and identify approaches for conservation agencies and policy makers to mitigate this threat. Activities include updating climate trends since 2000 and assessing erosion impacts of recent precipitation trends and potential future erosion in the Upper-Midwest.

Results

Based on these efforts, we have validated climate and plant growth models to capture more extreme climate variability for corn. This is especially important as we examine potential impacts of climate driven negative impacts greatly magnified by extreme events. As we face more such events, we have more confidence in our ability to project their future impacts and mitigate them. While NIFA-funded Purdue Agriculture's Useful 2 Useable (U2U) multi-state project (PI Linda Prokopy) is focused on providing information to producers on climate change and corn production, some of the tools developed are also critical for helping producers reduce excess nutrients. The split-nitrogen app gives producers the management and economic parameter estimates to reduce their risk exposure while applying nitrogen closer to the time it can be taken up with less loss by the plant. This also informs policy discussions by highlighting the risk parameters that producers operate under when adopting practices to reduce excess nutrients.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants

Outcome #13

1. Outcome Measures

CC 1.8 - # New climate relevant databases, monitoring systems, and inventories managed or under development

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2015 2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One change widely observed in forest ecosystems in eastern North America is the species composition shift. Evaluating magnitude, rate, and large-scale spatial variability of biomass change caused by species composition change will significantly advance understanding of forest ecosystem functioning in relation to the global carbon cycle. The shift in species composition in forest ecosystems will have serious economic, ecological, and environmental effects.

What has been done
Because different tree species have different levels of carbon sequestration capacity, change in species composition will affect the overall level of carbon sequestration by the eastern forests, which in turn will influence the global carbon dynamics. Findings of this research will allow policy makers to better guide regional practices in forest resource protection and utilization as well as land use planning and regulation. This research examined large-scale species distribution patterns and processes and their ecological and environmental impacts. Researchers used a modeling framework for species richness and cover of invasive plants in 42,626 plots in Eastern U.S. forests.

Results
Findings showed that the more diverse the forest, the less likely to have invasive species and to limit invader dominance. Greater resistance to invasive species was found in the contiguous forests of the Appalachian Mountains and parts of the agricultural Midwest. These large-scale results show the importance of diversity for biotic resistance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
132	Weather and Climate
605	Natural Resource and Environmental Economics

Outcome #14

1. Outcome Measures

NRE 1.16 - # Projects that incorporate ecosystem services and/or biodiversity considerations

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	61

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agricultural soils require ongoing efforts to maintain and improve their productive capacity, increase their resilience to climate variations, and enhance environmental quality.

What has been done
This project evaluates different strategies to improve soil quality, reduce nitrate leaching into drainage waters, and enhance agricultural sustainability. Particular emphasis is placed on managing drained agricultural lands for water quality and crop productivity, and on integrating cover crops into corn-soybean production systems. Specific analyses were conducted on: 1) effects of subsurface drain spacing on drain flow volumes, nitrate leaching, soil quality, and crop yields on poorly-structured silt loam soil in southeastern Indiana; 2) impacts of drainage water management (controlled drainage) practices on nitrate loads, soil quality, and crop productivity at a site in eastern Indiana; and 3) impacts of various cover crops on soil quality, nutrient cycling, and crop productivity at several sites in Indiana.

Results
Results show cover crops can effectively reduce nitrate-nitrogen losses from the root zone by scavenging residual nitrogen in fall and spring, and those reductions are greater with greater cover crop growth. It is still a challenge to establish cover crops in fall after corn and soybeans. Further innovation and research is needed. Cover crops that survive the winter, such as cereal rye, generally scavenge more nitrogen but also keep it unavailable until later in the cropping season, which poses practical management challenges. Cereal rye cover crops have improved soil aggregation, decreased penetration resistance, and increased soil water content in some of our study locations, all of which would eventually lead to improved crop production in the long-term. At Purdue research centers and farmer cooperator fields, numerous cover crop and soil samples were taken. In the first few years of this study, there have not yet been any significant changes in crop yields. Soil physical properties are starting to show improvements in some locations, but it is anticipated that larger changes will be observed after four or five years of treatment. Data analysis for a 2-year project on farmer cooperator sites is currently underway. The fifth and final year of a large project on resiliency of corn-based cropping systems is finishing soon, and data analysis for the fifth year of soil measurements is underway, to determine if significant changes in soil health properties have occurred after four years of cereal rye cover crop growth. The long-term tile drainage/water quality study continued at the Southeastern Purdue Agricultural Center. Measurements include tile drain flow, nitrate concentrations in drain flow, and crop growth and yield, as affected by four drain spacings (5, 10, 20, 40 meter). Crop yields are now generally similar among the 5, 10, and 20-meter spacing plots, all of which are greater than the 40 meter undrained control plot. Results from 2000 to 2015 are being compared to the first 15 years of the project. Nitrate-Nitrogen concentrations are still holding in the 7 to 10 mg/liter range, similar to the concentrations near the end of the first 15-year period, because of cover crop and fertilizer nitrogen practices. However, nitrate-nitrogen loads have increased compared to the 1997-1999 period, due to increased precipitation and greatly increased drain flow compared to the first 15 years of the study. These results continue to increase knowledge about cover crops and drainage management strategies with implications for adoption of these

practices in Indiana and the Midwest.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
132	Weather and Climate

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Field, lab and economic research projects monitor progress and completion of tasks to determine effectiveness and accomplishment. Example evaluations: cooperation and bringing together nutrient management agencies to identify and highlight existing research on climate change; instrument performance tracking; and evaluations of outreach events.

Key Items of Evaluation

Research efforts validated climate and plant growth models to capture more extreme climate variability for corn for the Midwest, and tools provided helped producers reduce excess nutrients. Field tests showed cover crops effectively reduced nitrate-nitrogen losses from the root zone by scavenging residual nitrogen in fall and spring, and those reductions are greater with greater cover crop growth.

V(A). Planned Program (Summary)

Program # 3

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
102	Soil, Plant, Water, Nutrient Relationships	10%		10%	
131	Alternative Uses of Land	5%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	10%		10%	
204	Plant Product Quality and Utility (Preharvest)	15%		15%	
213	Weeds Affecting Plants	5%		5%	
216	Integrated Pest Management Systems	5%		5%	
402	Engineering Systems and Equipment	10%		10%	
511	New and Improved Non-Food Products and Processes	10%		10%	
605	Natural Resource and Environmental Economics	20%		20%	
610	Domestic Policy Analysis	10%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	11.1	0.0	35.2	0.0
Actual Paid	5.2	0.0	15.4	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**
1155039	0	614961	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2600499	0	2994285	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
327448	0	1036764	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Conduct meetings, conferences, workshops, seminars
- Conduct research projects
- Publish research and extension publications
- Publish newsletters
- Establish web sites
- Organize field days and demonstrations
- Consultations
- Work with mass media

2. Brief description of the target audience

Producers, consumers, youth, professionals related to energy, agribusiness, elected officials and public policy decision makers

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1249	1245	1038	330

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

Patent Applications Submitted

Year:	2015
Actual:	3

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	2	47	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Extension publications written, new or revised
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of research publications
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of research projects

Year	Actual
2015	18

Output #4

Output Measure

- Number of consultations

Year	Actual
2015	207

Output #5

Output Measure

- Number of educational workshops or seminars conducted

Year	Actual
2015	44

Output #6

Output Measure

- Number of volunteers

Year	Actual
2015	49

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of energy producers, farmers, and consumers who increase their knowledge of the technical and economic implications of various Indiana crops being used for biofuels
2	Number of technologies developed and disseminated that will increase the efficiency of bio-fuel production
3	Number of participants who increased their knowledge of policy issues related to sustainable energy
4	Number of research-based studies, publications, and reports for policy organization members and legislators on sustainable energy
5	SE 5.4 - # Alternative uses of feedstock identified
6	SE 4.4 - # New production/logistic practices developed
7	SE 4.1 - # New technologies developed
8	SE 5.1 - # Decision tools available

Outcome #1

1. **Outcome Measures**

   Number of energy producers, farmers, and consumers who increase their knowledge of the technical and economic implications of various Indiana crops being used for biofuels

   Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

   Number of technologies developed and disseminated that will increase the efficiency of bio-fuel production

   Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

   Number of participants who increased their knowledge of policy issues related to sustainable energy

   Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

   Number of research-based studies, publications, and reports for policy organization members and legislators on sustainable energy

   Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

   SE 5.4 - # Alternative uses of feedstock identified

2. **Associated Institution Types**

   - 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A broad aim of the bio-based economy is to produce goods from vegetation to replace petroleum-based products. Agricultural biomass contains many chemical building blocks that can be removed and turned into everyday goods such as plastics, solvents, adhesives, composites and fuel additives. Bio-based alternatives are considered co-products since they are obtained concurrently with the production of liquid transportation fuels from flora. The petroleum industry does not profit solely from the sale of gasoline, which means that bio-refineries will also require revenue from more than just the sale of ethanol. Currently, government subsidies are necessary for the production of ethanol and other transportation fuels to be profitable.

What has been done
The overall goal of this research is to identify and characterize additional products from the conversion of biomass into liquid fuels and to determine how much additional revenue the products will contribute to the bio-refinery. This research is identifying additional bio-based products, either prior to processing into liquid fuels or from the waste that is generated during production. Second, the method to recover or isolate the bio-based product is being explored. The development of methods to recover bioproducts involve extraction and purification steps, which align with current or proposed pre-treatment methods and not degrade quality of the final product.

Results
Current work performed on the removal of fermentation inhibitors determined that ethyl acetate and butyl acetate were the best solvents to extract acetic acid from a fermentation broth using liquid liquid extraction (LLE). The additional cost from adding this process to an existing bio-refinery would be relatively low since LLE is a straightforward technology. Research is currently underway evaluating the biocompatibility of these two solvents with yeast during a fermentation. The next step will be to create a computer simulation to determine the cost to produce the product, both in energy and operations. This process model will help determine the complimentary value of the additional products.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

SE 4.4 - # New production/logistic practices developed

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Current grain-based cropping systems are designed to optimize production but are not necessarily well suited to the production of cellulose-containing biomass. On-going bioenergy crop work with Purdue's Gebisa Ejeta has identified three sorghums with desirable feedstock traits and apparent high nitrogen use efficiency (NUE). Potential herbaceous perennials being considered for biofuels are switchgrass, a warm-season perennial grass very productive during warmer, drier summer months, and Miscanthus a warm-season grass, but may be superior to switchgrass in productivity and NUE. To date, Miscanthus production has been confined to the European Union and only limited data exist on potential U.S. productivity and nutrient management. Native grasses have been advocated as low-input, sustainable biofuels feedstock. Ecological data from comprehensive comparisons for existing systems are limited and data for more novel systems (switchgrass for biomass, Miscanthus, and sorghum and maize with residue removal) are lacking.

What has been done
This research is comparing dedicated perennial and annual biomass crops grown on marginal sites by analyzing biomass yield, composition, and bio-oil/ethanol yield per hectare; assessing systems-level sustainability of soil microbial processes controlling cycling of carbon, nitrogen and greenhouse gas emissions; and determining input use efficiencies for water, nitrogen, and solar radiation. We assembled multi-year data from a dozen experiments located at four sites in Indiana. Several biomass cropping systems including Miscanthus, several sorghum lines, and switchgrass are providing high biomass yields with little nitrogen, phosphorus, or potassium fertilization.

Results
Yield stability is particularly high in Miscanthus where biomass production occurs even under drought conditions and averaged >25 metric ton/hectare for five years. Sorghum yields are

excellent at locations where maize yields are near zero. Concentrations of sugars, starch, cellulose, hemicellulose and lignin do not vary markedly with location or management, but do differ with species. Greenhouse gas production is extremely low in a native prairie control, and highest in conventional maize plots. Switchgrass and Miscanthus produce intermediate levels of greenhouse gases (mainly nitrous oxide) reflecting the lower rate of nitrogen fertilizer applied to these plots. Surface run-off is infrequent from switchgrass plots with little nitrogen and phosphorus lost to surface waters. Maize and sorghum have frequent run-off events and lose the greatest mass of nitrogen and phosphorus of the systems studied. Miscanthus exhibits intermediate nitrogen and phosphorous losses to surface waters. These findings help determine how to grow biomass more efficiently.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

SE 4.1 - # New technologies developed

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Federal mandates for production and use of advanced biofuels in the U.S. have increased the importance of developing technologies to reduce costs and improve efficiencies for cellulose-to-fuel production processes. Technologies that reduce costs associated with generating fermentable sugars from plant biomass, e.g. pretreatment and hydrolysis, can have immediate and substantial impacts. Costs associated with cellulose hydrolyzing enzymes are an order of magnitude more expensive than starch-degrading enzymes.

What has been done
This research project has established fundamental knowledge of molecular and engineering processes required for sustainable conversion of renewable resources to transportation fuels and value-added products that reduce the carbon footprint of U.S. agriculture and industry.

Fundamental studies were conducted on catalytic mechanisms by which transformations may occur using enzyme, chemical or microbial (fermentative) catalysts.

Results
A counter-intuitive result showed that with increasing severity of pretreatment the greater exposure of lignin to liquid resulted in non-specific binding of the enzyme reducing its effectiveness in hydrolyzing cellulose. Experiments quantified the amount of blocking agent required to block this non-specific adsorption to enhance enzyme effectiveness. This approach was demonstrated using wood and herbaceous biomass (corn stover). Further results showed that pretreatment to remove or disrupt lignin in plant biomass enhanced the yields of sugars and derivative products from chemical catalyst conversion of cellulose. Furthermore, after pretreatment minimal disruption of the crystallinity of the cellulose with solvents more than doubled the yields of products obtained from catalyzed conversion of plant cellulose. Chemical makeup of lignin in the plant cell wall, which can be controlled genetically, significantly affects the removal and rearrangement of lignin in the plant cell wall structure during pretreatment. These results illustrate the wide use and application of pretreatment processes for both biological (enzymes and fermentation) and chemical (acid catalyst) conversion of plant biomass to fuels and chemicals.

4. Associated Knowledge Areas

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

Outcome #8

1. Outcome Measures

SE 5.1 - # Decision tools available

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Energy and the environment are central to the health and well-being of humankind, and inextricably linked. Promoting efficiency in energy use will have strong environmental benefits relative to business as usual. Understanding the impact of alternative environmental policies on

the energy delivery system and on the environment is critical to the development of good policy.

What has been done
This project uses mathematical programming, and statistical and simulation techniques, to determine economically efficient strategies for operation of energy systems and to evaluate impacts of alternative energy and environmental policies. It focuses on how the behavior of agricultural producers and international trade in agricultural products changes because of global climate change, and on the benefits of alternative approaches to operating electricity generation and transmission resources internationally and domestically.

Results
Progress was made toward developing a scheme for allocating land across alternative uses -- in particular allocating cropland to individual crops. The economic analysis allocation method works at a fine spatial scale (5 minutes longitude by 5 minutes latitude) for explanatory variables and at a large scale for land use observations. Progress was also made in understanding motives and impacts of financial participants in the "virtual markets for electricity" (like a carbon trading market). Preliminary results indicate virtual electricity products are bad for electricity consumers and drive up their cost of electricity. Essentially, there is a welfare transfer from consumers to the financial participants. These preliminary outcomes can help provide guidance for policy makers regarding the most effective and economically efficient policy designs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics
610	Domestic Policy Analysis

V(H). Planned Program (External Factors)

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Lab, field and economic research projects monitor progress and completion of tasks to determine effectiveness and accomplishment. Evaluation examples: tracking of energy

audits on Indiana's farms to enable farmers to replace equipment with more energy efficient ones; and post training surveys on knowledge learned about native perennial grasses as sustainable energy feedstock.

Key Items of Evaluation

Research has found additional products of value from biomass conversion, increased efficiency of the biomass conversion process, and determined how to grow biomass more efficiently.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Food Safety

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	5%		5%	
204	Plant Product Quality and Utility (Preharvest)	5%		5%	
212	Pathogens and Nematodes Affecting Plants	5%		5%	
216	Integrated Pest Management Systems	5%		5%	
308	Improved Animal Products (Before Harvest)	5%		5%	
501	New and Improved Food Processing Technologies	15%		15%	
503	Quality Maintenance in Storing and Marketing Food Products	10%		10%	
504	Home and Commercial Food Service	5%		5%	
607	Consumer Economics	10%		10%	
702	Requirements and Function of Nutrients and Other Food Components	5%		5%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	15%		15%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	15%		15%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	4.5	0.0	7.0	0.0
Actual Paid	3.1	0.0	19.0	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**
1011058	0	501130	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2554506	0	3066594	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
318948	0	997140	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research-based programs will focus on conducting research experiments and programs emphasizing our key interest areas including detection and control of foodborne pathogens.
We have developed a diverse team of extension, research and agency specialists to provide guidance to the food value chain regarding the FDA Food Modernization and Safety Act (FSMA).
The Center for Food Safety Engineering is developing new knowledge, technologies and systems for detection and prevention of chemical and microbial contamination of foods. Through CFSE, Purdue University is positioned as a national leader in multi-disciplinary food safety research. The multi-disciplinary approach, including a strong engineering component, makes Purdue University truly unique.
Purdue Extension Service educators' provide Serv Safe ® training and proctor the exam for food service employees to have food handler certification. Using the National Restaurant Association's Serv Safe ® curriculum and partnering with the Indiana Restaurant Association hundreds of food service employees are certified or re-certified in food handler certification annually in Indiana. Serv Safe ® training and certification sets the standard in food safety with the most up-to-date and relevant information. It brings together the current best practices to meet the industry's changing needs. Participants in the training's stay engaged, retain the information better, and understand how to apply it.

Purdue Extension educators and specialists also provides training for farmers to create food safety plans .

We expect to increase our offerings through distance education and/or web-based materials. Most programs involve some type of collaboration or partnerships with our stakeholders, with industry, with consumers, or with regulatory agencies. Evaluation tools vary greatly depending on the intended audience and program type ranging from surveys, to pre-and post test, to national certification exams, and intensive follow up surveys to better assess knowledge gain.

2. Brief description of the target audience

Commercial and local foods producers, including animal production personnel, plant production personnel, food manufacturing and processing plant personnel, food service and food retail workers, consumers, youth, state and county health departments, federal regulatory officials, state industry associations, first responders.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4432	1602598	3114	11878

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

Patent Applications Submitted

Year: 2015

Actual: 3

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	20	54	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops conducted

Year	Actual
2015	356

Output #2

Output Measure

- Number of research projects

Year	Actual
2015	15

Output #3

Output Measure

- Number of research publications
  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of Extension publications written, new or revised
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Number of volunteers

Year	Actual
2015	235

Output #6

Output Measure

- Number of consultations

Year	Actual
2015	2619

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of incidents (reduction is goal) of foodborne illness associated with unsafe food handling practices
2	Number of persons who increased their knowledge of cooking foods adequately
3	Number of persons who increased their knowledge of avoiding cross-contamination
4	Number of persons who increased their knowledge of keeping food at a safe temperature
5	Number of persons who increased their knowledge of storing foods properly
6	Number of persons who increased their knowledge of proper hand washing
7	Number of participants passing food handler certificate
8	Number of participants adopting best management practices related to food safety
9	FS 3.2 - # Food handlers receiving food safety training and education in safe food handling practices
10	FS 1.2 Number of viable prevention, control and intervention strategies for all food production scales for foodborne threats along the food production continuum.

Outcome #1

1. **Outcome Measures**

Number of incidents (reduction is goal) of foodborne illness associated with unsafe food handling practices

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Number of persons who increased their knowledge of cooking foods adequately

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Number of persons who increased their knowledge of avoiding cross-contamination

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Number of persons who increased their knowledge of keeping food at a safe temperature

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

Number of persons who increased their knowledge of storing foods properly

Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

   Number of persons who increased their knowledge of proper hand washing

   Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

   Number of participants passing food handler certificate

   Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

   Number of participants adopting best management practices related to food safety

   Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

   FS 3.2 - # Food handlers receiving food safety training and education in safe food handling practices

2. **Associated Institution Types**

   - 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3561

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

CDC estimates that each year roughly 1 out of 6 Americans (or 48 million people) get sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases. The 2011 estimates provide the most accurate picture of which foodborne bacteria, viruses, microbes (pathogens) are causing the most illnesses in the U.S., and estimating the number of foodborne illnesses without a known cause. The estimates show that there is still much work to be done specifically in focusing efforts on the top known pathogens and identifying the causes of foodborne illness and death without a known cause. Reducing foodborne illness by 10% would keep about 5 million Americans from getting sick each year.

What has been done
In partnership with the Indiana State Board of Health, Indiana Restaurant Association, National Restaurant Association and County Boards of Health, educators, family nutrition program assistants, and staff in Food Science taught ServSafe, a retail food safety workshop, and proctored certification exams throughout the state of Indiana. 12 educators attended a specialized training on food preservation that was useful for enhancing food safety practices in homes and small restaurants. There were a total of 628 attendees in the 127 sessions for training and recertification. 653 completed the exams with 63% passing. Average exam score was 84%.

Results
As a result of the ServSafe trainings: 49.23% of participants reported washing their hands more frequently during food preparation and service, 50% reported checking the temperature of food to make sure that it is cooked to a safe temperature, 55% reported taking temperature of food to make sure that it has been cooled quickly to a safe temperature, 49% participants reported keeping raw foods (such as fish, poultry, and ground beef) separate from ready-to-eat foods (such as cooked foods, fresh fruit and vegetables), 46% made sure that all work surfaces, equipment, and utensils have been cleaned and sanitized before preparing and serving foods, 46% have conducted training in safe food handling practices for staff, and 30% received more training in safe food handling practices. Participant comments were: "very useful training and the materials were presented at the proper level", "class atmosphere allowed for asking questions", "instructors were very clear and easy to follow", and they appreciated the incorporation of videos during the training. Participants indicated that the objectives of the program were realistic and they learned a lot from the classes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
504	Home and Commercial Food Service

Outcome #10

1. Outcome Measures

FS 1.2 Number of viable prevention, control and intervention strategies for all food production scales for foodborne threats along the food production continuum.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Porcine Epidemic Diarrhea virus (PEDv) swept through nearly 100% of the swine heard in the US last year killing 70% of neonatal pigs. Tools for identify and managing this virus weren't available to the pork community to test and treat the herds.

What has been done
Extension jumped into action to get information to swine producers in the state so they could make the best decisions for their business and their herds. The Comparative Biology researchers in the College of Vet Medicine were focused on developing tools to identify approaches for detection, prevention and control of PEDv. Extension researchers and educators teamed up to produce 3 workshops at the county, state and via webcast.

Results
The workshops updated more than 80 attendees representing commercial producers, show pig producers, state and federal regulars and Extension educators gained awareness of the broader impact PEDv has on operations, immediate cash flow planning and the terrible toll on swine caretaker morale. Workshops also provided best practices designed to prevent further infection and disease spread. In the labs of the College of Vet Medicine, one researcher developed several diagnostic assays for rapidly detecting PEDv.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Collaboration of lab Research projects for detection of the virus and Extension programs for practices to reduce disease spread were monitored for success by the containment of the PEDv outbreak in swine. Other evaluation examples: evaluation of sensitivity of bio-sensors to detect bio-entities; detection of new viruses; DNA sequencing; post survey at end of workshops, and examination by the Indiana Restaurant Association for food handlers.

Key Items of Evaluation

Pig producers, state and federal regulators gained awareness of PEDv impact on operations, immediate cash flow planning, and best practices to prevent further infection and disease spread. A researcher developed several diagnostic assays for rapidly detecting PEDv.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Childhood Obesity

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	10%		10%	
502	New and Improved Food Products	10%		10%	
607	Consumer Economics	10%		10%	
610	Domestic Policy Analysis	5%		5%	
701	Nutrient Composition of Food	5%		5%	
702	Requirements and Function of Nutrients and Other Food Components	10%		10%	
703	Nutrition Education and Behavior	20%		20%	
806	Youth Development	30%		30%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	1.2	0.0	11.0	0.0
Actual Paid	0.7	0.0	5.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
748266	0	236836	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2436350	0	1695416	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
283857	0	912109	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Conduct research
- Conduct educational workshops, seminars, short courses, conferences
- Partner with other agencies interested in childhood obesity
- Work with the media
- Develop curricula, publications, web sites, distance education materials
- Publish research and Extension articles

2. Brief description of the target audience

Parents, youth, children, consumers, day care providers, healthcare providers, state and county health departments, professional organizations

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2665	1578488	17600	20076

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

Patent Applications Submitted

Year:	2015
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	5	12	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Extension publications written, new or revised
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of research publications
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of research projects

Year	Actual
2015	6

Output #4

Output Measure

- Number of consultations

Year	Actual
2015	891

Output #5

Output Measure

- Number of educational workshops or seminars conducted

Year	Actual
2015	548

Output #6

Output Measure

- Number of volunteers

Year	Actual
2015	225

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of persons who adopt one or more practices to improve food choices
2	Number of participants who have increased their knowledge of how to raise healthy eaters
3	Number of persons who increased their knowledge of selection and preparation of foods with reduced fat and/or calories
4	Number of persons who increased knowledge of USDA serving sizes
5	Number of participants consuming appropriate serving sizes
6	Number of participants demonstrating ability to choose or prepare foods with reduced fat and/or calories
7	Number of youth who increased knowledge of the importance of physical activity
8	Number of participants who adopt increased physical activity levels
9	Number of participants who increased their knowledge of the connection between food choices and risk of chronic disease
10	Number of participants who increased their knowledge of the relationship between nutrition and health
11	Number of participants who adopt one or more practices to improve food choices and activity levels
12	CO 3.3 - # Of discoveries, innovations, technologies that relate to how food is enhanced, processed, or prepared that impacts childhood obesity (including sensory qualities)
13	CO 4 - # Of discoveries, innovations, technologies that relate to understanding the causes of childhood obesity
14	CO 2.1.a. # of children and youth that understand the benefits of physical activity
15	CO 2.1.c. # of children and youth that reported increasing their physical activity and/or reducing sedentary time

Outcome #1

1. **Outcome Measures**

Number of persons who adopt one or more practices to improve food choices

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Number of participants who have increased their knowledge of how to raise healthy eaters

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Number of persons who increased their knowledge of selection and preparation of foods with reduced fat and/or calories

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Number of persons who increased knowledge of USDA serving sizes

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

Number of participants consuming appropriate serving sizes

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number of participants demonstrating ability to choose or prepare foods with reduced fat and/or calories

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Number of youth who increased knowledge of the importance of physical activity

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Number of participants who adopt increased physical activity levels

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results

{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
806	Youth Development

Outcome #9

1. Outcome Measures

Number of participants who increased their knowledge of the connection between food choices and risk of chronic disease

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

Number of participants who increased their knowledge of the relationship between nutrition and health

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

Number of participants who adopt one or more practices to improve food choices and activity levels

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

CO 3.3 - # Of discoveries, innovations, technologies that relate to how food is enhanced, processed, or prepared that impacts childhood obesity (including sensory qualities)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Obesity is a national and global public health crisis. It is our contention that the positive energy balance that drives the problem stems, in part, from poor dietary compensation. Consequently, an approach that minimizes the energy density of foods holds promise for preventing or ameliorating overweight and obesity and their complications. Fat replacers and high intensity sweeteners provide a means for preserving the sensory properties of foods while reducing their energy content.

What has been done
Current lab studies focus on determining whether humans have a true taste for fat. Tasting component comparisons are made to better understand free fatty acids rather than triglycerides, oils or solid dietary fats because they may act more like signaling molecules.

Results
The work on fat has provided further evidence that dietary fatty acids are: 1) detected by a taste mechanism in the oral cavity; 2) rated as equal intensity by individuals who are lean and obese; 3) rated as stronger by younger versus older individuals and by females compared to males; 4) perceived as a quality unlike any of the other basic or primary qualities; 5) rated as similar in quality when similar in chain length but different in degree of saturation; 6) primarily sour at short chain length; 7) irritating when medium in chain length; 8) unique in quality at longer chain length; and 9) more potent taste stimuli when polyunsaturated compared to monounsaturated. These results contribute to understanding of mechanisms of fat taste and how properties of fats can be modified to improve their acceptability. Identifying the signaling mechanism of free fatty acids will help unravel issues related to obesity.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components

Outcome #13

1. Outcome Measures

CO 4 - # Of discoveries, innovations, technologies that relate to understanding the causes of childhood obesity

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Obesity is a global health problem. Obesity and its associated chronic diseases such as type 2 diabetes and coronary heart disease are leading causes of morbidity in the U.S. A micronutrient selenium exists in various forms with different biological activities. Although selenium is known to exhibit a beneficial function in cancerous cells, its role in metabolically active tissues such as adipose tissue and liver is unknown.

What has been done
Research actions to clarify the beneficial function of selenium, an essential trace mineral, in adipose development and function, is targeted at testing mechanisms underlying prevention of fat cell development in vitro and in vivo.

Results
Findings of the protective function of selenium in obesity and its-associated energy metabolism in fat cells provide new ground to study the health benefit of selenium and selenium-rich foods/fruits. This will extend knowledge in dietary control of adipose biology, and ultimately lead to design of dietary strategies in preventing and/or delaying the development of obesity and its associated chronic diseases.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components

Outcome #14

1. Outcome Measures

CO 2.1.a. # of children and youth that understand the benefits of physical activity

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2948

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Youth are at risk of disconnect with nature by spending time indoors behind the screens of televisions, computers, cell phones, etc. This can lead to a lack of physical activity, which often leads to childhood obesity. Childhood obesity has both immediate and long-term effects on health and well-being. Children become more at risk for health problems such as heart disease, type 2 diabetes, stroke, several types of cancer, and osteoarthritis.

What has been done
GOALS (Get Outside and Learn Something) Camp was a collaborative effort between Purdue Extension, Lake County Parks and Recreation, and the Boys and Girls Clubs of Northwest Indiana. Limited income children in grades one through four were invited to participate in a three-day camp designed to get them outdoors and involve them in physical activity, away from tech screens of all kinds. 46 children learned about nutrition and the value of daily exercise. They made their own worm compost farms, created herb terrariums, prepared healthy snacks, learned about common pollinators, danced, and participated in several physically challenging relays. Water day included paddle boating, water safety skills, pond water studies, and swimming. The day camp experience provided new knowledge, skills, and understanding that will last a lifetime - all in the great outdoors. Throughout GOALS Camp, adult mentors nurtured a corps of youth leaders, ages 15 to 19, working side-by-side on training and mentoring, which provided valuable experience for these youth.

Results
Of the 18 children completing post-camp surveys: 88% said they would choose more fruits and vegetables to eat; 72% said they will be more physically active; 72% indicated they know more about being safe in or near water; and 55% said they know more about nature and the environment.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
806	Youth Development

Outcome #15

1. Outcome Measures

CO 2.1.c. # of children and youth that reported increasing their physical activity and/or reducing sedentary time

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1851

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Childhood and adolescent obesity rates have reached epidemic proportions in the U.S. Sedentary routines found in schools and in the home as well as over-exposure to unhealthy snacks and non-nutritional foods contribute to the pervasiveness of this disease that afflicts America's children. Obese children face significant health risks such as Type 2 diabetes, tooth decay, and depression. One study shows that children who are substantially overweight throughout much of their childhood and adolescence have a higher incidence of depression than those who are not. Low-income children and adolescents are more likely to be obese than their higher income counterparts, but the relationship is not consistent across race and ethnicity groups. At the same time, the U.S. food supply contains an abundance of foods high in energy with appealing taste, but which are low in nutrient content.

What has been done
Through the leadership of Purdue Extension, the development and ongoing actions of the Adams County and Henry County health coalitions, have taken on childhood obesity in the community. These two counties received $5,000 a year for four years as part of an AFRI grant to mobilize rural low-income communities to assess and improve the ecological environment to prevent childhood obesity. Community activities in Adams County have included: training and administering North Carolina Extension's curriculum, Color Me Healthy, for 15 preschools in the county to include healthy food options and more physical activity for the children; organizing a "Color Me Healthy" fitness walk for preschoolers and their families; hosting the First Annual Active

Living Week; facilitating a community workshop in partnership with the Indiana Department of Health and Health by Design for a walkability study; and providing transportation for seven community citizens to attend the Clinton County "Healthy Communities Workshop". Both Adams County and Henry County health coalitions have collaborated with community organizations/agencies, hospitals, park and recreation departments, libraries and preschools to establish "Born Learning Trails" a national campaign by United Way, with ten interactive signs/learning activities to get children and adults interacting and promote language, literacy and motor skills needed for kindergarten. In Henry County, a display case at the head of the trail shows educational posters about nutrition for youth to read. During Knightstown Jubilee Days, the Girl Scouts hosted a fun walk/run along the preschool trail. Kids could dress up as superheroes and walk/run the trail. Those who completed the trail received goodie bags with a t-shirt, healthy fruit and water bottle.

Results

In Henry County, the health coalition has seen an increase in the number of people walking the trail and a decrease in vandalized property along the trail. Coalition members work at the trail on upkeep, and many individuals that have walked the trail have commented on how nice it looks and how they appreciated the efforts made along the trail. In Adams County, 394 children attended the 15 preschools were the Color Me Healthy program is being implemented. 13 of the 15 preschool directors rated Color Me Healthy materials as "excellent" or "very good." Preschool directors strongly agreed that Color Me Healthy curriculum: increased physical activity of the children (43%), increased children's knowledge about movement and physical activity (43%), increased children's knowledge about healthful eating (64%), and helped raise parents' awareness of the importance of physical activity and nutrition (36%). One preschool director believes preschoolers are at the perfect age to learn about nutrition and exercise. She was happy with the Color Me Healthy curriculum, and stated, "A lot of families didn't understand reading the labels at the stores. So it's really nice that this curriculum enables us to be able to teach the children, and then they go home and sometimes teach the parents, which I think is fabulous."

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Lab research projects monitor progress and completion of tasks to determine effectiveness and accomplishment. Extension programs conduct evaluation surveys to measure change in knowledge and intentions of participants, and follow-up surveys to assess change in behavior or practice, and results of actions. Evaluation examples: evaluation of preschool directors on the strengths and weaknesses of the curriculum, Color Me Healthy; and monitoring of research project objectives, publications, training and mentoring of students, and presentations at scientific research professional speaking engagements.

Key Items of Evaluation

Extension trained teachers and staff to implement curriculum in preschools which resulted in increased daily physical activity for children at almost half of the centers.
Lab research determined the signaling mechanisms for human taste of dietary fatty acids and how fat properties can be modified to improve their acceptability to help unravel issues related to obesity.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Human, Family, and Community, Health and Well-being

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
608	Community Resource Planning and Development	12%		12%	
610	Domestic Policy Analysis	3%		3%	
611	Foreign Policy and Programs	3%		3%	
701	Nutrient Composition of Food	3%		3%	
702	Requirements and Function of Nutrients and Other Food Components	10%		10%	
703	Nutrition Education and Behavior	10%		10%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	3%		3%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%		10%	
721	Insects and Other Pests Affecting Humans	3%		3%	
723	Hazards to Human Health and Safety	3%		3%	
801	Individual and Family Resource Management	12%		12%	
802	Human Development and Family Well-Being	12%		12%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	10%		10%	
805	Community Institutions, Health, and Social Services	3%		3%	
806	Youth Development	3%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	16.9	0.0	29.6	0.0
Actual Paid	11.1	0.0	27.6	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**
1337596	0	572836	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
3074192	0	4078681	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
397646	0	1072690	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

• Develop, workshops, consultations, seminars, certification programs, distance education modules, field days, and other opportunities
• Develop and implement curriculum
• Conduct evaluation/research
• Provide youth and volunteer training and development
• Develop web sites
• Provide staff development
• Collaborate with other agencies/stakeholders
• Publish research and extension articles
• Increase number of participants in life-long learning programs.
• Foster leadership and economic development and facilitate strong partnerships in state, regional, national, and international agencies, organizations, and groups.
• Encourage participation by extension specialists in: Taskforces, Review Committees, Advisory Boards, Editorial Boards, Commodity committees/boards, Invited presentations, Honors and Awards, Common Interest Groups, Professional Societies

2. Brief description of the target audience

Families, parents, youth, 4-H youth/volunteers/administration/parents, children, appointed and elected public officials, Commodity boards and committees.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	127368	4042110	127958	853063

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

Patent Applications Submitted

Year: 2015

Actual: 2

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	98	94	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops conducted

Year	Actual
2015	7737

Output #2

Output Measure

- Number of research publications

  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of Extension publications written, new or revised

  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of community collaborations, coalitions, partnerships

Year	Actual
2015	4148

Output #5

Output Measure

- Number of volunteers

Year	Actual
2015	11119

Output #6

Output Measure

- Number of research projects

Year	Actual
2015	51

Output #7

Output Measure

- Number of consultations

Year	Actual
2015	58796

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	An impact on human health resulting from new knowledge about nutrition & wellness, chronic diseases, and/or environmental factors
2	An impact on family well-being resulting from new knowledge about family resources management, parenting & relationships, and/or child development.
3	An impact on youth development resulting from new knowledge about youth leadership, life skills, volunteers, and/or career development.
4	An impact on economic and/or community development resulting from new knowledge about leadership, economic development, government operations and/or community development
5	An impact on policy and/or regulation related to human, family and community, health and well-being.
6	# of youth demonstrate their ability to work effectively in teams
7	# of youth express interest and be engaged in Science related activities
8	# of youth demonstrate a capacity for science process skills
9	# of youth demonstrate leadership efficacy
10	# of key stakeholders engaged and active in community and economic development locally, countywide and regionally
11	NC - # of participants reporting new leadership roles and opportunities undertaken
12	NC - $ value of grants and resources leveraged/generated by communities
13	GF 3.5. - # of food councils and institutes created to promote practical food systems policies
14	ANR-S-DivAg - # of farmers/food producers who learn about available assistance
15	# of participants adopted one or more practices to improve food choices and/or activity levels
16	# of childcare providers who reported adoption of recommended practices for math, science and vocabulary development in children
17	# of childcare providers who reported intention to adopt best practices for nutrition education activities with children, parents, families

18	# of childcare providers reported ability to apply strategies to improve quality of early childhood classrooms
19	# of participants reported plans to apply money management strategies to their personal finances
20	# youth made changes in knowledge and behavior about financial literacy
21	# of participants evaluating new business ventures
22	# of discoveries that relate to human nutrition and chronic conditions
23	# of discoveries that relate to human health
24	# of discoveries that relate to human nutrition and well-being
25	# of technologies that relate to human nutrition and well-being

Outcome #1

1. **Outcome Measures**

   An impact on human health resulting from new knowledge about nutrition & wellness, chronic diseases, and/or environmental factors

   Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

   An impact on family well-being resulting from new knowledge about family resources management, parenting & relationships, and/or child development.

   Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

   An impact on youth development resulting from new knowledge about youth leadership, life skills, volunteers, and/or career development.

   Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

An impact on economic and/or community development resulting from new knowledge about leadership, economic development, government operations and/or community development

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

An impact on policy and/or regulation related to human, family and community, health and well-being.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

# of youth demonstrate their ability to work effectively in teams

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3725

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
From 2011-2013, 340 cases of H3N2v infection (influenza virus in pigs that can spread to humans), were reported in 13 states in the U.S.; of these, 154 (45%) occurred in Indiana, more than any other state. Indiana is expected to continue to be important in the regional epidemiology of H3N2v, being the first state to report human cases in 2013 and one of only two states to report human cases every year during 2011-2013. Sporadic infections and even localized outbreaks of H3N2v will likely continue to occur. People at risk for H3N2v infection via agricultural exposure can protect themselves by taking precautionary measures, but education on these measures has largely been limited to passive means (posters, handouts, and media releases). Active outreach

targeted to youth exhibitors at agricultural fairs may prevent additional H3N2v cases.

What has been done
Combining leadership training and science education, our program approach was to develop and conduct a train-the-trainer workshop on biosecurity and zoonotic disease with a specific focus on H3N2v influenza prevention. The two-day workshop was presented to four county teams of 4-H participants. Workshop participants received 20 hours of science-based experiential learning from subject matter experts. After the workshop, those trained teams of teens led presentations on biosecurity and zoonotic disease prevention to 4-H participants and other interested parties in their own communities at 4-H club educational sessions, classrooms, after-school programs, 4-H Club meetings, 4-H Friends and Family meetings, swine club meetings, livestock workshops, and other settings. These "teens as teachers" provided 12 community presentations with a total of 525 attendees.

Results
These "teens as teachers" developed leadership, communication and presentation skills through this training and community presentations experience. Attitudes about science and self-assessment of scientific skills were similar on the post-evaluations compared with pre-evaluations. Teens were also developing in their leadership skills. A quote from a parent of a teen leader, "My son prior to this experience would not speak in front of a crowd of people. He has really stepped out of his shell and I see such a huge difference in his public speaking. He has really enjoyed this opportunity." Those who attended the teen presentations responded positively. A total of 175 attendees completed evaluations of the teen community presentations. 154 of 173 (89%) responded that they agreed, "This class showed me that my animals can catch germs from other animals." 140 of 172 (81%) responded that they agreed, "This class showed me that I can get sick if I catch germs from animals." 139 of 172 (81%) responded that they agreed, "This class showed me how to make sure that I do not catch germs from animals."

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #7

1. Outcome Measures

# of youth express interest and be engaged in Science related activities

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	5939

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Today the United States ranks 27th among developed countries with college graduates receiving degrees in science or engineering, and in the next decade, most of the fastest growing occupations will require at least some background in Science, Technology, Engineering, and Mathematics (STEM).

What has been done
The Steuben County 4-H Program has a Bio-Tech Team, which is a team of young science enthusiasts who went to a training in Indianapolis called The Science Behind Agriculture. Teens Teaching Youth Biotechnology. The 4-H Bio-Tech Team used unique ingredients like gummy bears, Nesquik, drain cleaner, strawberries, Kool-Aid, and others to inspire science exploration about DNA, genetics, and water properties. This "teens as teachers" team has led and conducted science experiments with youth audiences at 4-H clubs, school classrooms, and afterschool programs to encourage youth to think about science in fun and dynamic ways.

Results
Teens trained to lead these science explorations developed leadership, communication and presentation skills. One teen stated, "I am writing you this as I'm sitting here soaking all of the bio-tech training and teaching it. Thank you so much for nominating me and allowing me to have this opportunity. I love it! I've been able to get more comfortable with large group teaching and meets lots of new friends." During these teen-led programs, attendees commented: "This is awesome!" and "Can we do this again next time?" In response to the biotech activities, a classroom teacher commented, "This is really neat!" and her colleague enthusiastically agreed. One of the first year 4-H members quickly ran to her mother and exclaimed, "I learned what makes Nesquik magical when it mixes with water!" These kids are gaining an appreciation for science because they are seeing that science is fun and can even be "magical." Although it was not the intended result, one teacher said, "You have renewed something in me. I have gotten away from hands-on teaching because using paper is so much easier, but this has inspired me and reminded me that these kids need hands-on teaching. There were so engrossed in what you were teaching them!"

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #8

1. Outcome Measures

of youth demonstrate a capacity for science process skills

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3677

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
To build STEM skills in our youth, Purdue University partnered with the National Fluid Power Association and Center for Compact and Efficient Fluid Power to provide teams of Indiana youth in 6-8th grades with an opportunity to learn about hydraulics, engineering design, and other STEM (Science, Technology, Engineering, and Math) skills. This inaugural 4-H NFPA Fluid Power Challenge created an opportunity for youth to learn and experience STEM through hands-on, experiential activities.

What has been done
The challenge was a daylong workshop on Purdue's campus to introduce concepts of fluid power and engineering design to teams of 30 youth from across Indiana. Students learned skills to create their fluid-powered robots from a standard kit of resources, and were accompanied by graduate and undergraduate Purdue students from Agriculture and Biological Engineering and the Purdue Polytechnic Institute. Youth teams returned home to work on the design of a robotic manipulator and document the creation of their prototype with a design portfolio. Their challenge was to design a robot that could pick up an object, move it a certain distance, and climb a stair-stepped landing area. Teams used only syringes with air or water to actuate the mechanisms moving the robot. Five weeks after the workshop, the teams re-assembled at Purdue for the first 4-H NFPA Fluid Power Challenge Competition. Teams were judged by industry professionals from Caterpillar, Wabash National, and professors from Purdue University and Universidad Tecnológica de Queretaro, Mexico. Teams were awarded points on their portfolio, teamwork, design, and challenge completion.

Results
Only 25% of youth in this challenge understood what fluid power was prior to participating. At the end of the challenge, youth completed the 4-H Science Common Measures survey. 96% reported that they liked to see how things are made or invented. 86% liked science, while 75% would like

to have a job related to science. 96% said they felt they could explain why things happen in an experiment. Two teams were later selected to demonstrate their designs and communicate their experience at the Indiana Legislature Rural Caucus held at the Indiana State Fair. This was an opportunity to not only promote the Fluid Power Challenge, but also connect 4-H, STEM education, and fluid power with youth voice for policy makers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #9

1. Outcome Measures

# of youth demonstrate leadership efficacy

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3109

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Similarly, to other living things, youth need nourishing, supportive, and protective environments where they can grow to be healthy and contributing adults. Each young person needs to: 1) know others care about them: that they Belong; 2) feel and believe they are capable and successful: that they have Mastery; 3) know they are able to influence people and events: that they have Independence; and 4) practice helping others: that they can demonstrate Generosity. While many youth struggle in social environments (e.g., home, school, clubs, teams, community) that lack the necessary elements for growth, most youth grow up in environments rich in the essential elements that support healthy development. Adults, such as teachers, coaches, leaders, mentors, and parents, are the primary "caretakers" of those environments. Those same adults must be intentional and skilled about enriching settings with elements that lead to positive youth development.

What has been done
In over 40 counties across the state of Indiana, 4-H programs provide leadership training to teens to prepare them to be camp counselors. Training occurs in the spring and addresses leadership, communication, personalities, learning styles, youth development, team building, and safety. 4-H

camps are scheduled in June and are three to four day or overnight events for elementary age youth. Trained teens in the role of camp counselors help plan the camps, lead in activities, teach, and provide positive role models to the camp attendees.

Results
As just one example for Indiana, for a southeast region of counties, 45% of camp counselors reported their ability to provide direction increased during training and camp and 45% reported they increased their ability to work in a team or group. 73% ranked their ability to consider and pursue future goals as good or excellent. 73% indicated the most important thing they learned from this experience was a combination of leadership skills and teamwork. When asked how they will use what they have learned as a camp counselor, 71% responded they would use their leadership experience. Comments included "I will be a better leader in all situations."

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #10

1. Outcome Measures

# of key stakeholders engaged and active in community and economic development locally, countywide and regionally

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	944

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Members of the community often desire pursuing a goal or vision, yet struggle to effectively work together to accomplish the desired outcomes. Likewise, it is common for a few individuals to be the driving force behind changes within a community, thus hindering an opportunity for inclusive community-wide buy-in for a ?big idea?.

What has been done
The Hometown Collaboration Initiative (HCI) works with communities to build their collaborative efforts while producing a capstone project that represents the ability of the group to make positive changes within their community. Purdue Extension, Ball State University, and the Indiana Office

of Community and Rural Affairs come together to provide the expertise to conduct the program. Six communities dispersed throughout Indiana were selected to participate in the HCI pilot in 2015. Each community completed the foundation phase, including learning more about their county via data snapshots, asset mapping, collecting survey responses, conducting a community forum and choosing the building block ? leadership (developing a new generation of leaders), economy (growing small businesses and entrepreneurs) or placemaking (enhancing community design, public spaces, and local foods) ? as their focus. Each community operates at its own pace, some are just beginning while others are nearing the capstone phase. The process generally takes a year or two.

Results
In the pilot year, HCI engaged a total of 125 individuals in bettering their community. These communities gathered 4,900 survey responses from community members and hosted over 300 individuals for community forums. Five communities selected placemaking as their focus, and the sixth selected their economy. Early byproducts from the HCI process included creation of a young professionals networking group, selection into the Stronger Economies Together program via USDA Rural Development, and collaboration to the extent of bringing leaders together to commit $2.3 million toward a community trails project. HCI is expanding local leadership pipelines, enhancing economic assets, and providing strategies to improve hometown attractiveness and quality of life. For 2016, five more communities have been selected to begin the program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #11

1. Outcome Measures

NC - # of participants reporting new leadership roles and opportunities undertaken

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	187

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Confident, skilled and knowledgeable leaders are needed to guide organizations and communities through the challenges they face in today's changing environment. More leaders are needed to step up to the plate, get involved and create communities that are more vibrant.

What has been done

Daviess County piloted the Community Leadership Certificate Program, newly developed by a team of Extension faculty, specialists and educators, with 44 hours of interactive educational opportunities to enable people to learn about themselves, their community and their leadership role within it. Goals were to: 1) Expand the leadership base of people who will assume active roles in the community, 2) Establish strong community networks among participants & community leaders, 3) Encourage community volunteerism & service, and 4) Create a network of people to share creative ideas & promote community action. Topics included leadership styles, interpersonal communication, economic development, managing conflict, exploring diversity, and learning about county government. Participants completed enrichment activities, homework & group project work, and contributed over 100 hours each to the program. The 19 individuals in the pilot program came from diverse sectors of the community including business, healthcare, agriculture, education, local government & non-profit organizations. They shared common goals including learning more about the community in which they live & becoming more actively engaged. "I am so glad I have been given the opportunity to participate in this program, to increase my knowledge of my home community & become more in tune with what our community needs to thrive." Support from the community was extraordinary, including monetary & in-kind contributions totaling $13,700.

Results

At the end of the nine-month program, 100% of participants reported increased knowledge in topics presented. 100% of participants reported both an increase in their confidence to volunteer in the community and to take on leadership roles in community organizations. 81% of participants plan to use what they learned immediately, with the remainder planning to use it in 3 to 12 months. Strong community networks were established, as revealed in these comments and results: "I feel like we have created a family of leaders in our community that have a common goal. I have learned so much about this place that I have grown up in and now I have a team of people that I know I can count on. It has been one of the most exciting opportunities in my life." 100% of participants reported that the program expanded their connections with others in the community. In a letter written to the program graduates, Lt. Governor Sue Ellspermann shared, "A successful community and state depend on a continued supply of leaders who have the passion to serve and lead. Your program is helping create a benchmark of women and men who will lead Daviess County and the State of Indiana into a successful future." Based on the experience and success of this pilot in Daviess County, three additional counties across Indiana are now presenting the Community Leadership Certificate Program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #12

1. Outcome Measures

NC - $ value of grants and resources leveraged/generated by communities

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	40000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Public spaces are essential to the social, economic, and environmental sustainability of communities. They are the shared resources such as parks and town centers that define a sense of place and where residents experience social interactions, explore nature, and purchase goods and services. The management decisions of these public spaces - made by public policy makers, private business owners, and residents - affect the wellbeing and livelihood of the community as a whole. In many cases, Indiana communities underestimate and inefficiently leverage the value of public space to the detriment of their quality of place. Quality of place, in turn, is a significant factor that plays a critical role in community and economic development outcomes that seek to enhance community vitality and sustainability. Decision makers and local leaders with oversight and management of community public spaces (e.g., parks boards, plan commission members, non-profit organizations) design the Indiana-based curriculum for use. The program combines data collection and analysis with inclusive public deliberation to guide the design of a high-quality action plan that can result in sustainable and impactful improvements for public spaces and, ultimately, an enhanced quality of life.

What has been done
Efforts by an interdisciplinary team were to publish the Enhancing the Value of Public Spaces curriculum and facilitation guide including community capitals framework and the appreciative inquiry process to demonstrate how high quality public spaces improve a community?s quality of place and create a comprehensive action plan. The Enhancing program has three components: the Indiana-based curriculum, community workshop forums to bring together key stakeholders and decision makers to provide input into crafting the high quality action plan, and working group meetings facilitated by Purdue Extension to provide technical assistance needed to complete a high quality action plan. The facilitation process can take about 15-20 hours over the course of three to six months. The program was conducted in five pilot communities and is now being executed in seven communities (Corydon, Elkhart, Frankfort, Kokomo, Lebanon, Perry County

and West Lafayette). Deployment continues to be a team-oriented effort with a minimum of three Purdue facilitators and two or three local hosts collaborating with stakeholder groups to develop a public spaces action plan.

Results
Participating communities completed public spaces action plans for use with parks and recreation master plan updates, comprehensive planning efforts and downtown revitalization projects. Feedback survey results indicate the program is useful in providing new knowledge to assist with making decisions and taking actions to help develop new or enhance existing public spaces. Participants in the Frankfort program used the data, tools and resources to write an action plan and grant proposal focusing on downtown redevelopment that resulted in a $40,000 award from the Indiana Office of Community and Rural Affairs. The City of Kokomo used the tools and resources as part of the city Comprehensive Plan update, which the Purdue Extension Enhancing team will continue to support as part of a $13,000 grant award. Current programs in West Lafayette are focusing on the citywide Parks and Recreation Master Plan update with support from the Enhancing team through running public forums, survey development and implementation and stakeholder interviews. Success of the Enhancing program also prompted its inclusion as one of the key program offerings of the new Hometown Collaboration Initiative (HCI). This effort provided a conduit for Enhancing to support three HCI communities in completing their related action plans. As part of the HCI program, the city of Corydon used the Enhancing action planning process to successfully complete an action plan to acquire property and subsequently launch a fund raising campaign to develop and build Bicentennial Park. To date Corydon has raised $750,000 to create the first park in city limits.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #13

1. Outcome Measures

GF 3.5. - # of food councils and institutes created to promote practical food systems policies

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Local food summits bring together a broader community of stakeholders to network, collaborate and learn about local food topics together. As a result, communities increase awareness, create food systems linkages and synergies and foster leadership within the local food system. Local foods is a topic that engages many sectors of a community for reasons of health, community development, economic development, environmental concern, and quality of life. Summits include diverse groups to connect and learn about evidence-based approaches to strengthening the local system.

What has been done

Two local food summits were planned, coordinated, implemented and evaluated by a team of Purdue Extension educators and specialists, and took place in Fort Wayne and Valparaiso in March and April 2015. In each location, an agenda was created to reflect the community needs and interests. In both locations, the educational part of the program consisted of defining a local food system, food hubs, food councils, and panelists - farmers, chefs, and retailers collaborating on topics. After a lunch, prepare by local chefs, the program turned to facilitated round table discussions on a broader range of topics, relevant to local need. Summit participants engaged in facilitated discussion and action planning around topics of food security, community gardens, food waste, food hubs, food councils, and farm-to-school. In a multistate research project relating to food insecurity issues in communities, a team of Purdue researchers has been conducting initial steps to measure food insecurity related to Voices for Food, a program to develop food policy councils in 24 communities across six states, by determining the nutritional status of low income pregnant women and also the status of community food pantries.

Results

In Fort Wayne, 97 individuals attended from numerous organizations. Post program surveys indicated that 96% of attendees became more aware of local foods in Northeast Indiana and felt their presence at the Summit will improve their business. The following actions have been taken by Extension because of the Summit discussions and plans for action: Website development to improve communication, hosted regular meetings for the food hub task force, hosted meetings to foster food council development. In addition, Wells County Economic Development Corporation with a nine county team, gathered internal, regional and federal funds to create a strategic plan for local food for northeast Indiana in partnership with Extension and other community organizations. In Valparaiso, 87 people attended the summit and a core group of individuals spent the next six months meeting bi-weekly to launch the Northwest Indiana Food Council. Purdue Extension and Valparaiso Law are two of the partners, but the group is diverse and motivated to tackle some of the challenging social issues for northwest Indiana using local food solutions. Interest in Local Food Summits has sparked five new summit locations for 2016 including Columbus, Seymour, Lafayette, Terre Haute and Gibson County, with two more yet to be named. In the research study, baseline data have been collected and led to a novel analytical method identifying diet patterns and efficacy.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #14

1. Outcome Measures

ANR-S-DivAg - # of farmers/food producers who learn about available assistance

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	4145

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 2014, the Agriculture Marketing Service (AMS) of USDA did not award all the money available for the Local Food and Farmers' Market Promotion Program Grants due to poor quality applications. The North East Center for Regional Development (NECRD) worked with AMS to establish the Agricultural Marketing Service Technical Assistance (AMSTA) program to enable Extension in each state to deliver a universal grant training program to increase the quantity and quality of grant applications for these programs. Farmers' Market Promotion Program grants support direct producer-to-consumer marketing projects, such as farmers' markets, community-supported agriculture programs, roadside stands, and agri-tourism. Local Food Promotion Program funding supports projects that develop, improve, and expand local and regional food business intermediary supply chain activities, including processing, distribution, aggregation, and storage of locally or regionally produced food products.

What has been done
Purdue Extension identified a lead and team to attend a train the trainer event in Chicago in February. This team then delivered 5 grant training workshops in 5 locations across Indiana in March and April. Sixty-nine people attended the workshops. Further support for grant completion was given by all the team and other Educators.

Results
Workshop evaluations by the national AMSTA team at NECRD showed: In FY 2015, Indiana received a total of $606,415, funding 4 Farmers Market Promotion Program and 5 Local Foods Promotion Program grants, a 120% increase in overall funding from the prior year. 22% of survey respondents (n=29) had applied for a federal grant in the past, but only 10% had applied for an AMS grant. 33% had never applied for a grant before, with 50% having no idea how to register. After workshops, attendees increased their understanding of grant programs from 'not at all' to 'considerably' or 'a great deal' on topics: 1) objectives and funding limits (55%), 2) program

eligibility (58%), 3) application components (42%), 4) allowable expenditures (27%), 5) evaluation standards (27%), 6) obtaining and DUNS number (35%), 7) registering with grants.gov (15%), and 8) communication requirements (15%). Working with nascent and experienced grant writers together in these educational settings is challenging to have equal impact on all attendees. This is a multi-year process that will see results over time. This novel Extension program will continue each year, to support the individuals, groups and businesses working in local food system development for Indiana.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #15

1. Outcome Measures

# of participants adopted one or more practices to improve food choices and/or activity levels

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	477

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Diabetes adversely affects the lives of over 785,000 adults in Indiana dealing with this chronic condition. People with diabetes may experience a shorter life expectancy, financial struggles due to higher healthcare costs, and are at increased risk for developing long-term health problems associated with diabetes such as heart disease, stroke, high blood pressure, blindness, kidney disease, and loss of limbs. In 2012, diabetes was the seventh leading cause of death in Indiana. The estimated cost incurred by the State of Indiana for annual health care costs specifically attributed to diabetes approaches $4 billion. In 2013, 11% of adults (18 years of age or older) in Indiana reported they had been diagnosed with type 1 or type 2 diabetes. Modifiable risk factors associated with diabetes include obesity, physical inactivity, and dietary habits. About 67% of Indiana adults were overweight or obese based on Body Mass Index (BMI) in 2013.

What has been done
Purdue Extension is working throughout the state to educate individuals on the need to prevent diabetes and to help those with diabetes lessen their risk of long-term complications. Dining with

Diabetes helps people learn how to prepare foods they enjoy in a way that reduces calories, fat and sodium, and increases dietary fiber. Altering these dietary components in the diet may help reduce the risk of diabetic complications by helping lower blood glucose, maintain body weight and lower blood pressure. The program has four 2-hour sessions and a follow-up session presented by educators with help from healthcare professionals. Educators demonstrate how to prepare healthier options for main dishes, side dishes, beverages, snacks, and desserts, which participants are able to sample during the sessions. Weekly goal-setting activities help participants apply information learned. Of those who participated between 2013 and 2015, 492 completed a pre- and post-evaluation. In addition, 117 completed a follow-up evaluation. 358 were female and 116 male. 21% were 51-60 years, 34% were 61-70 years, and 28% were over 70 years. 58% reported they had diabetes, 36% did not have diabetes, and 2% did not know if they had diabetes.

Results

Participants were asked knowledge, self-efficacy, and behavior questions related to nutrition and diabetes management. There was a significant improvement in responses to the knowledge questions, and a significant improvement in behavior related to increasing physical activity, self-care behaviors, and decreasing intake of sugary drinks from pre to post-evaluation. A significant improvement was noted for practicing healthful cooking and food preparation behaviors 'frequently' or 'always' after the program compared with before. Participants in the follow-up for dietary change reported the ability to maintain or improve dietary changes. Dining with Diabetes is well received by participants, as one stated, "This program is well done. [It] underscores the need for knowledge to avoid diabetes. I heartily recommend it to anyone.?"

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #16

1. Outcome Measures

# of childcare providers who reported adoption of recommended practices for math, science and vocabulary development in children

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	56

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There are over a half-million children under the age of six in Indiana and over one-third of Indiana families have children ages 0-5 years. School-readiness has been a key issue identified by the stakeholders in Indiana, and school systems need children to come prepared and ready to succeed. How well a child does at the beginning of formal schooling is a predictor to high school completion. Children, through block play while having engaging adult interactions, can learn a wide variety of school readiness skills, such as math, science, language and vocabulary words, and problem solving.

What has been done

Purdue Extension offers two programs: 1) Block party events for parents with young children, with engaging activities for parents to learn skills children gain through blocks, and 2) Block play training for childcare providers to learn the research behind block play and the stages of block play development. Block party events were held in 52 Indiana counties with 1,183 evaluations collected. Block party event participants were parents (91%), grandparents (5%), childcare providers (2%), and other family members. 594 (87%) indicated they had blocks at home, and for those who didn't, 77% said they planned to purchase or make blocks for their child in the next three months. In the three-month follow-up with parents, 63 evaluations were collected from 13 counties. Block party training was provided to childcare providers in 37 Indiana counties and 442 evaluations were collected. For the three-month follow-up for childcare providers, 62 evaluations were collected from 9 counties.

Results

Changes in parent understanding were found for: 1) child skill development in science, math, language, and problem solving (22% before, 76% after), 2) use of observation and demonstration to guide children?s block play (20% before, 70% after), and 3) importance of describing to a child what is occurring for the child to associate words with actions, increasing the child's vocabulary and language skills (36% before, 79% after). Parents reported their child enjoyed playing with blocks 'a lot' (85%) during the event, but had only played with blocks 'a lot' (35%) prior to the event. Adults reported they would get down on the floor and play blocks with their child (77% before, 92% after). Some parent responses included: 1) "Spending more time utilizing block play. You don't realize how much they enjoy it and learn from it until someone points it out and you actually pay attention." 2) "I learned there are many different ways for my son to play with different kinds of blocks. This was awesome." In follow-up with parents, 73% reported making blocks more available, 84% reported using more words to increase the child's vocabulary, 71% were using more open-ended questions with their child, 84% had read the booklet provided. Parent comments included: 1) "I have been more involved in teaching different skills through block play and other play. I had a good time and was thankful we went. Thanks!" 2) "Bought a variety of blocks. Play with them pretty regularly." For childcare providers, 94% indicated they had blocks available for children and for those who did not, 88% indicated they planned to make or purchase blocks within the next three months. Significant changes in knowledge of childcare providers were: 1) playing with blocks increases a child's development in science, math, language and problem-solving, (29% before, 90% after), 2) research supporting block play (11% before, 71% after), 3) using observation and demonstration to guide children's block play to the next stage of development (22% before, 80% after), 4) importance of describing to a child what s/he is doing (39% before, 88% after). A new idea childcare providers planned on trying was: 1) "I want to have kids draw out on paper what they want to build before they use the blocks to build." 2) "Using blocks as a form of math and science." For follow-up with childcare providers, about 90% were: 1) making blocks more available to children, 2) supporting children's learning through block play, 3) using more open-ended questions with children. Childcare providers were using what they learned in many ways: 1) "We have made the number of week towers, then putting all together.

Then the children said it was a city with tall buildings. We have taught addition and subtraction with blocks. Also, learning the values of numbers while playing with blocks." 2) "I have been using a variety of words to describe things we see in the block areas - sizes, shapes, etc. I have added paper and pencils for children to draw what they built or make signs." Block party events for families and training for childcare providers have made a difference in motivating adults to be engaged with children in block play. Through knowledge gained, parents and childcare providers are able to encourage children?s learning in math, science, language and vocabulary words, problem solving, and creativity, thus, children in Indiana will have more school-readiness skills.

4. Associated Knowledge Areas

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

Outcome #17

1. Outcome Measures

# of childcare providers who reported intention to adopt best practices for nutrition education activities with children, parents, families

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	136

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In Indiana over 20,000 children are served meals and snacks each day through the USDA's Child and Adult Care Food Program (CACFP). Many childcare foodservice staff have minimal training in nutrition or food preparation. CACFP sponsors report a need for increased variety of fruits and vegetables, leaner and more varied entrée choices, more appealing food presentation, more varied snacks, and less reliance on ready-to-serve foods high in fat, sugar, and sodium.

What has been done
Educators provide "RECIPE for Growing Healthy Children" to inspire childcare staff to create a total environment that promotes quality meals and snacks, nutrition education, and positive role modeling, resulting in lifelong healthy beliefs and behaviors. RECIPE for Growing Healthy Children introduces childcare providers to six practices that redefine the purpose of nutrition programs from "feeding children" to "growing healthy children." Each section is devoted to one practice that forms the acronym RECIPE: Role Model what we want children to be, say, and do;

set up a mealtime Environment that encourages healthy behaviors and promotes well-being; Create nutritious meals and snacks; Involve children in food and fun; Partner with parents; and Enjoy eating together. Educators presented to 161 childcare staff who were teachers/staff (70%), center directors/assistant directors (8%), childcare program owners (7%), or cooks/food coordinators (7%). Licensed centers (67%), unlicensed registered childcare ministries (21%), and home childcare providers (8%) were the main types of childcare programs that participated. 151 participants completed the post-evaluation.

Results
After the program, participants reported an intention to role model healthy choices and positive behaviors during meals and snacks. Participants reported a significant interest in the frequency of allowing children to serve themselves - fully or in part (family style) at meal and snack times. There was a significant increase in the frequency in which participants reported their facilities plan to have adults engage in positive conversation about food with children at meals or snack times using one of the ideas from the training workshops. Almost 90% of participants are 'likely' or 'very likely' to offer a nutrition education activity with the children enrolled in their facility using one of the ideas they learned from the training workshop. About 90% are 'likely' or 'very likely' to share information they had learned from the training with parents/caregivers. Almost 80% are 'likely' or 'very likely' to promote family meals to the families they are serving using one of the ideas shared in the program. Examples of recipes participants tried during the program they plan to incorporate in their facility menus include the baked oatmeal, pizza pasta bake, baked French toast, and fruity coleslaw.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #18

1. Outcome Measures

# of childcare providers reported ability to apply strategies to improve quality of early childhood classrooms

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	458

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
More than a third of Indiana?s children, between the ages of 0-5, receive care from a non-relative for 10 or more hours each week. Research shows that children who attend high quality, early childcare and education programs are more likely to pursue higher education as adults, earn higher wages, and rely less on government assistance. Thus, there is a great need to have well-trained adults who provide care and education to young children.

What has been done
Five counties in Indiana received Better Kid Care training modules, from a national Child Care and Youth Training and Technical Assistance Project (CYTTAP) grant, to deliver training to childcare providers to increase the quality of care and education of young children. Each topic module delivers two hours of training through video clips, group discussions, activities, and handouts for participants. Lake County submitted 214 evaluations for Better Kid Care training for the time of June 1, 2014 - August 25, 2014 that were forwarded to University of Nebraska - Lincoln Extension to be included in the national CYTTAP grant report. Beginning September 1, 2014, Indiana moved to the "Sustainability Model" of the CYTTAP grant and no longer had to submit evaluations to the University of Nebraska - Lincoln Extension. Since then, 373 additional evaluations were collected in Lake County for Better Kid Care training. This is almost six hundred lessons provided to child educators in Lake County in the past year to help improve the quality of care and education to young children. 72% of participants worked in facility based programs, 17% were home-based care providers, and 11% worked in a ministry setting, worked for Child Care Resource and Referral, or a preschool program in an elementary school setting. 90% had worked in the field for 10 years or less, and 98% had been in their current position for 10 years or less. 96% were female.

Results
209 (56%) participants note they learned 'very much' on the day of the lesson. All participants indicated they were satisfied with the professional development program and instructor. Participants were 'very confident' applying the strategies (42% before, 78% after). Participants stated the information, ideas, and approaches they founds most useful for their work were: 1) "I enjoyed knowing that you can use a book repeatedly and start with the cover and have children discuss it even before you read it." 2) "Different circle time strategies including songs" 3) "To ask open-ended questions to keep their curiosity going." 4) "How to make a frustrating situation less stressful." Overall, the Better Kid Care lessons have been successful in educating childcare providers to improve the quality of early childhood classrooms and programs. This benefits both the children's environment and the responsive interactions with the adults that care for them.

4. Associated Knowledge Areas

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

Outcome #19

1. Outcome Measures

# of participants reported plans to apply money management strategies to their personal finances

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	318

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Financial issues affect millions of Americans. Nineteen percent of American households age 55-64 have saved NOTHING for retirement according to a recent survey (Sep-Oct, 2013) of 4,100 randomly selected household by the Federal Reserve. According to a study by the Brookings Institution (a leading authority on household economics), roughly 38 million households live paycheck to paycheck. Sixty-six percent of those households are considered to have middle class incomes. Only 49% of Americans have any amount of money in emergency savings according to a CNN Money article from 2012 and two-thirds of Americans do not have a monthly spending plan according to a recent Gallup poll. In a comparison study of the national Survey of Consumer Finances it was found the number of households that report saving any money at all slightly increased from 2010 to 2013 from 52% to 53% of all U.S. households. These numbers are still lower than those recorded in 2007 however, when over 56% of households reported saving money. When broken down by income levels, 82% of those in the highest 10% of income saved while only 40% of households in the lowest income group reported saving money in 2013.

What has been done
484 Indiana adults were taught basic financial literacy concepts and budgeting skills (aka spending plans) through the program, Where Does Your Money Go? The most popular version of the program lasts one hour and is usually taught in community environments such as schools and public libraries. An innovative approach to creating a spending plan known as "The Revolving Savings Account" helps participants realize the benefits of planning for unexpected or occasional expenses that occur throughout the year. With money set aside for these potential "spending leaks" participants are better prepared to avoid the pitfalls of unexpected expenses. Participants come away with a toolbox full of practical methods for developing their own spending plan.

Results
86% agreed that they are thinking differently about how they manage their money after attending the program. 88% realized that they could have more spending money if they made different spending choices. 66% said they plan to track expenses differently. 73% agreed to focus on reducing spending leaks in the future.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #20

1. Outcome Measures

youth made changes in knowledge and behavior about financial literacy

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1016

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Technology and convenience in the world of personal finance mask the underlying skills necessary to manage one's money. Without proper training on how and where to save money, today's children may grow up without a firm understanding of how basic financial systems work. Recent legislation made credit card usage safer for young adults in order to curb the misuse of easy credit. Dozens of states have adopted mandatory financial education for K-12 students to teach safe money practices before it is too late. Parents, educators, researchers and politicians on both sides of the aisle collectively believe that if personal financial management is taught at a young age, good money habits will form, leading to better decisions and financial independence for the next generation. While there is a scientific debate regarding the usefulness of financial education at any age, some studies suggest promising results from interactive financial education programs.

What has been done
The Captain Cash program covers four major financial literacy topics (earning, saving, spending and borrowing) in four separate, highly interactive lessons. Students are 8 or 9 year olds and enrolled in 3rd grade at their local elementary school. Each lesson is taught by Extension Educators in a school classroom environment with a few exceptions where Educators work with home school groups and summer camps.

Results
2,635 student evaluation forms were completed and recorded. Based on the results of the pre- and post-evaluations, students made changes in their knowledge and behavior about financial literacy. 36% knew they could earn money as a young entrepreneur (e.g. lemonade stand) before the intervention. That number increased to 49% after the program. For behavior change, before the program, 33% of students reported the use of a bank account as one of their preferred ways to save money. After the program, that number increased to 39%. This change in behavior is

supported by an increase in knowledge about safe places to keep ones earnings. Before the program, only 58% thought banks were safe places for earnings. After the program, 70% said they felt safe keeping their money in a bank. 69% of participants turn to parents for information about managing money. No other information source is as important to the student as their parents (other relatives: 42%, teachers: 51%, media: 14%, books: 30%, friends: 19%, church 14%). These findings suggest that with a strong, interactive, financial education program young consumers will not only change the way they think about banking, but will, in a short period of time (i.e. about one month) act on that knowledge.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #21

1. Outcome Measures

# of participants evaluating new business ventures

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	400

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research on hazards has found that disaster assistance focuses on individuals, but not on businesses. A North Central Region project (NC1030) was established to explore disaster assistance and family businesses. The focus of NC1030 has been on family firms and policy. Committee members from eleven states in the Midwest have broken new ground in business research by demonstrating the role of interactions and exchanges of resources between firm, family and community. The team has conducted a panel study that enabled the tracking of businesses over a 10-year period.

What has been done
Focus of research was to: 1) determine factors that contributed to sustainability of small businesses, 2) assess effects of management of change, risk and uncertainty by families and firms on family business sustainability, and 3) determine factors that contributed to sustainability

of small businesses after disruptions. This research used comprehensive data on business owners and their families to assess the extent to which family considerations and owner patterns of adjustment to change impact business recovery or non-recovery. This research examined disaster aid practices, policy, and the role of community in business owner decisions post-disaster. The research used a theoretical systems framework to examine the interaction and relative importance of factors such as business and owner characteristics, challenges faced by families and businesses, family resiliency and adjustment strategies, owner risk-taking, spatial characteristics of the disaster, and infrastructure changes created by a disaster on the post-event recovery or demise of small and medium sized businesses.

Results
Results have led to important understandings about the interactions of family and family firm, new insights into the survival and demise of firms, and the development of the Sustainable Family Business Theory, based on systems theory. Results showed how business characteristics affect operating status after a natural disaster, and demonstrated that social capital has a positive impact on disaster resilience, and that owner characteristics affected the approval of Small Business Administration (SBA) loans and the amount provided by the SBA.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #22

1. Outcome Measures

# of discoveries that relate to human nutrition and chronic conditions

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research has shown that poor diet is one of the key factors that can increase a person's cancer risk. Certain dietary patterns such as the Mediterranean diet are known to be effective in health maintenance and lowering risk of cancer however, active compounds and the mechanisms underlying these effects are yet to be determined.

What has been done
Research focuses on two polyphenols that are active components of grapes and blueberries. Every healthy tissue has a precise DNA methylation pattern that is part of a group of modifications called epigenetics. Using state-of-the-art technology and cellular and animal models, this research establishes the role of polyphenols in grapes and blueberries in health maintenance. Research focused on delivering evidence for beneficial effects of active compounds present in foods and elaborating on their mechanisms of action.

Results
Results show polyphenols exert anti-cancer effects through epigenetic mechanisms. Findings are beneficial to human nutrition and will increase understanding of complex regulation of the epigenome by dietary polyphenols. This will increase awareness about beneficial effects of plant-derived bioactives and have an impact on introducing changes in public health policies and daily dietary recommendations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food

Outcome #23

1. Outcome Measures

# of discoveries that relate to human health

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Estimates from the National Health and Nutrition Examination Survey list 32.2% of U.S. adults are obese, and 17.1% of children and adolescents are overweight. Because obesity costs more than $100 billion annually, it is critical to identify strategies for prevention. Further, there is strong evidence that obesity is associated with increased risk for breast cancer. Breast cancer is currently the most commonly diagnosed cancer in women, with an estimated 232,670 new breast cancer cases expected in 2014. Incidence of breast cancer is slowly declining, but there is great

promise in preventing incidence and deaths from breast cancer if effective strategies can be designed. Vitamin D status is inversely related to obesity, and one of the most promising potential preventive agents for breast cancer is vitamin D.

What has been done
Lab research was completed to determine the impact of vitamin D on fat cell differentiation status, the mechanisms of vitamin D regulation of energy metabolism in breast cancer, and the mechanisms of vitamin D regulation of cell growth, death and metastasis in breast cancer cells.

Results
Findings identified the active form of vitamin D reduces neutral lipid accumulation in differentiated adipocytes. Results identified that glutamine uptake is reduced by the active form of vitamin D through reducing the expression of the specific transporter for glutamine. In addition, findings show that the active from of vitamin D reduces lipid accumulation, and metastasis of breast cancer cells. Results contribute to important scientific foundation allowing design of public health recommendations to promote attainment of optimal fat mass and weight, achievement of optimal energy utilization in normal growth and development and to prevent breast cancer progression, preventing devastating consequences of obesity and breast cancer, as well as promoting optimal health.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food

Outcome #24

1. Outcome Measures

# of discoveries that relate to human nutrition and well-being

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Calcium is needed for building bone mass, especially at peak times for women, during adolescence and postmenopausal. Diet can affect the availability and retention of calcium.

Understanding how to build and then maintain calcium is important for health.

What has been done
This lab research uses aims to determine the bioavailability (absorption, distribution, metabolism, elimination) of nutrients and other food components, and evaluate the bioactivity of nutrients and other food components in order to clarify their underlying protective mechanisms. The research uses a novel method of isotopic tracer techniques of urinary excretion of the rare isotope 41-Calcium to intrinsically label foods or salts of interest in order to study factors which enhance or inhibit absorption. Previous findings about soluble corn fiber enhancing calcium absorption in adolescents were used to extend the study of bone calcium retention in postmenopausal women.

Results
Findings showed that soluble corn fiber improved bone calcium retention with increased doses. As a result, prebiotics, natural substances in some foods that encourage growth of healthy bacteria in the gut, enhance mineral absorption in animal models and humans, and bone parameters in animal models. Dietary bioactive ingredients like prebiotics are beneficial to bone and help protect against shortfall minerals in the diet, especially calcium. Work continues to understand the role of gut microbiota in this health benefit.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food

Outcome #25

1. Outcome Measures

# of technologies that relate to human nutrition and well-being

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Infants are exceptionally sensitive to adverse long-term health effects from exposure to environmental toxicants. Exposure to methylmercury, a developmental toxicant found primarily in fish, has been predicted to negatively impact 400,000 newborns every year in the U.S., with adverse health effects (abnormal memory, attention and language skills) possibly lasting past childhood. Pregnant or nursing women need to consume seafood because it is nutritionally important and provides lipids promoting healthy brains and eyes during perinatal development. Since maternal transfer of mercury and omega-3 fatty acids occurs for fetal (placental transfer) or infant (maternal milk) exposure/nourishment, there is a critical need to communicate specific advice to childbearing-aged women. Dietary Guidelines for adults are to consume 8 ounces of fish every week. Unfortunately, there are very few fish species (herring, mackerel, sablefish, salmon, shad and whitefish) that provide the desired amount of long-chain omega-3 fatty acids (EPA and DHA) at the recommended consumption rate. From those species, king mackerel and sablefish are both higher in mercury. Based on the top ten most frequently consumed seafood, it is more likely that consumers, attempting to follow dietary recommendation to 'eat fish', will increase their intake of mercury without increasing their intake of long-chain omega-3 fatty acids.

What has been done

Research analyzed 300 commercial fish samples for trace elements (Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Li, Mg, Mn, Mo, Ni, Pb, Se, Sn, Sr, Tl, V, Zn, Hg), and fatty acids. Fish samples were from seafood vendors in 6 regions of the U.S. (northeast, mid-Atlantic, southeast, southwest, northwest, and Great Lakes). Human clinical trials research determined rate of clearance of mercury and the effects of fish consumption on nutritional status of fatty acids. The research group surveyed 721 low-income women (of which 35% were pregnant and 5% were nursing), from across Indiana. 39% reported they had not eaten commercial fish within the past month and 10% of fish eaters had consumed fish that contains moderate to high levels of mercury (tuna steak, shark, swordfish or king mackerel). Only 33% understood that omega-3 fatty acids in fish are nutritionally important for the health of the unborn child and nursing infant. The team completed an educational intervention involving pregnant or nursing women to measure impact of a seafood safety wallet card on knowledge and beliefs about seafood risks and benefits, attitudes toward seafood consumption, and behaviors regarding purchase and consumption of different seafood species. The research group's Fish4Health wallet card is being distributed across Indiana and Florida by their Health Departments. In addition, two Fish4Health apps were developed for mobile devices to provide advice relating to commercial seafood consumption and allow women to track their intake of seafood, intake of healthy fats, and exposure to mercury in commercial fish.

Results

Improving understanding about bioavailability of mercury will help clarify human exposure and the toxicological consequences following exposure. Results of the research contribute to the development of national dietary recommendations aimed at optimizing nutritional benefits from consuming fish while minimizing relative risks to sensitive populations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
703	Nutrition Education and Behavior
723	Hazards to Human Health and Safety

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Lab research projects monitor progress and completion of goals and tasks to determine effectiveness and accomplishment. Evaluation examples: monitoring availability of nutrients in food, evaluation of impact of active form of vitamin D on cellular processes and intracellular signals; assessment of quality of parental care and its impact on children's behavioral organization and knowledge about relationships; number of protein-based materials successfully characterized in lab with difference mechanical, physical stability or digestibility properties.
4-H programs are beginning to administer the Common Measures surveys on programs with a minimum of 6 hours of instruction for science, healthy living, universal, and teen leadership. Community development efforts are surveying participants to determine their actions and leadership roles taken since program activities, also, monitoring of community plans and actions, and grant funds received. Health and human sciences programs assess participants post/pre, pre/post, and in follow-up surveys to identify changes in knowledge, intentions to take action, and changes in behaviors and practices. Evaluation examples: 4-H common measures science for teen teachers with collection of number of hours they taught in community; online survey distribute to all e-forum participants; youth camp counselors surveyed at conclusion of camp leadership experience; and pre/post and follow-up surveys to parents, teachers and staff on what they learned and which activities/actions they are using after the training.

Key Items of Evaluation

Teens learn leadership in context of Science and provide workshops for their communities, teaching others about bio-technology and bio-security. Communities collaborate, assess assets, develop plans and track actions in leadership, economy or placemaking. Communities collaborate to enhance public spaces through stakeholder involvement, surveying, and securing funds including $40,000 to $750,000 raised for downtown redevelopment and for creating a park in city limits. Local food and farmers markets that received training on available Agriculture Marketing Service grants brought in $606,415. Parents, teachers and staff now use block play to help children develop in math, vocabulary

and science to improve school readiness. Adults and 3rd grades trained in financial literacy showed immediate and medium-term increase in knowledge and plans for saving.
Research projects identified protective and preventive qualities of polyphenols in grapes, blueberries; and developed recommendations at optimizing nutrition benefits from eating fish.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Natural Resources and 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
101	Appraisal of Soil Resources	1%		1%	
102	Soil, Plant, Water, Nutrient Relationships	18%		18%	
104	Protect Soil from Harmful Effects of Natural Elements	5%		5%	
111	Conservation and Efficient Use of Water	2%		2%	
112	Watershed Protection and Management	6%		6%	
121	Management of Range Resources	1%		1%	
123	Management and Sustainability of Forest Resources	18%		18%	
125	Agroforestry	1%		1%	
131	Alternative Uses of Land	10%		10%	
132	Weather and Climate	4%		4%	
133	Pollution Prevention and Mitigation	24%		24%	
135	Aquatic and Terrestrial Wildlife	10%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	1.4	0.0	6.7	0.0
Actual Paid	5.4	0.0	19.2	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**
1065005	0	615886	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2632275	0	3088290	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
333865	0	895841	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Workshops
- Extension publications
- Public service announcements
- Research projects
- Web site development
- Home and farm visits
- Displays
- IP video programs
- Demonstrations and field days
- One-on-one consultations
- Collaboration with other agencies

2. Brief description of the target audience

Agricultural producers,rural and urban residents, elected officials and other decision-makers, owners of private and public forestlands and wildlands, natural resource professionals, technical service providers, tree care providers, right of way managers, urban planners, youth

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	67444	2818650	32134	123167

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

Patent Applications Submitted

Year:	2015
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	254	176	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops conducted

Year	Actual
2015	1559

Output #2

Output Measure

- Number of research projects

Year	Actual
2015	176

Output #3

Output Measure

- Number of Extension publications written, new or revised
  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of consultations

Year	Actual
2015	15166

Output #5

Output Measure

- Number of volunteers

Year	Actual
2015	2285

Output #6

Output Measure

- Number of research publications
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of participants who increase knowledge of practices to protect water resources
2	Number of participants who improve decision making for use of water resources
3	Number of participants who increase knowledge of proper application of fertilizer, manure and waste products to soil and potential for environmental consequences of misapplication
4	Number of participants who increased adoption of proper application of fertilizer, manure and waste products to soil
5	Number of participants who increase knowledge of best management practices for optimal manure nutrient utilization with on- and off-site agricultural lands
6	Number of participants who adopt best management practices for optimal manure nutrient utilization with on- and off-site agricultural lands
7	Number of participants who increase knowledge of the value of ponds in landscapes and methods for installing and managing ponds
8	Number of participants who increase value of landscapes through better installation and management of ponds
9	Number of participants who increase knowledge of on-site wastewater treatment siting and maintenance needs
10	Number of participants who make more informed decisions for on-site wastewater treatment siting and maintenance
11	Number of water quality violations related to animal production and land application in the state of Indiana
12	Number of tree care providers in Indiana who become certified arborists.
13	Number of professional natural resource advisors who have the skills necessary to assess the health of the wildlands
14	Number of wildlands owners who have a relationship with knowledgeable professional natural resource advisors and have developed and implemented a management plan
15	Number of natural resource professionals and wildland owners who have worked with landowners to develop and implement management plans
16	Number of owners of wildlands who will have assessed the health of their lands and developed and implemented management plans
17	Number of landowners with knowledge of proper tree planting and management techniques

18	Number of participants who increased their knowledge of natural resource management
19	Number of participants who increased their knowledge of proper application of pesticides
20	Number of participants who increased their knowledge of topsoil importance
21	Number of participants who increased their knowledge of Indiana's diverse wildlife
22	Number of woodlot owners who improved their management skills
23	NRE 1.1 # new assessment, management and decision tools developed, including models and measurements.
24	NRE 1.11 - # New production/logistic practices developed and tested
25	NRE 1.8 - # Relevant social media products, web-based products and communication tools
26	NRE 1.2 - # New relevant databases, monitoring systems, and inventories managed or under development
27	NRE 1.3 - # Viable technologies developed or modified for detection and characterization
28	NRE 1.4 - # Viable prevention, control and intervention strategies
29	NRE 1.15 - # Projects characterizing social, economic, and/or cultural practices
30	NRE 1.6 - # New diagnostic technologies
31	# new discoveries of species/cultivars for sustainable systems

Outcome #1

1. **Outcome Measures**

   Number of participants who increase knowledge of practices to protect water resources

   Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Number of participants who improve decision making for use of water resources

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Number of participants who increase knowledge of proper application of fertilizer, manure and waste products to soil and potential for environmental consequences of misapplication

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Number of participants who increased adoption of proper application of fertilizer, manure and waste products to soil

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

Number of participants who increase knowledge of best management practices for optimal manure nutrient utilization with on- and off-site agricultural lands

Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

Number of participants who adopt best management practices for optimal manure nutrient utilization with on- and off-site agricultural lands

Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

Number of participants who increase knowledge of the value of ponds in landscapes and methods for installing and managing ponds

Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

Number of participants who increase value of landscapes through better installation and management of ponds

Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

Number of participants who increase knowledge of on-site wastewater treatment siting and maintenance needs

Not Reporting on this Outcome Measure

Outcome #10

1. **Outcome Measures**

Number of participants who make more informed decisions for on-site wastewater treatment siting and maintenance

Not Reporting on this Outcome Measure

Outcome #11

1. **Outcome Measures**

Number of water quality violations related to animal production and land application in the state of Indiana

Not Reporting on this Outcome Measure

Outcome #12

1. **Outcome Measures**

Number of tree care providers in Indiana who become certified arborists.

Not Reporting on this Outcome Measure

Outcome #13

1. **Outcome Measures**

Number of professional natural resource advisors who have the skills necessary to assess the health of the wildlands

Not Reporting on this Outcome Measure

Outcome #14

1. **Outcome Measures**

Number of wildlands owners who have a relationship with knowledgeable professional natural resource advisors and have developed and implemented a management plan

Not Reporting on this Outcome Measure

Outcome #15

1. **Outcome Measures**

Number of natural resource professionals and wildland owners who have worked with landowners to develop and implement management plans

Not Reporting on this Outcome Measure

Outcome #16

1. **Outcome Measures**

Number of owners of wildlands who will have assessed the health of their lands and developed and implemented management plans

Not Reporting on this Outcome Measure

Outcome #17

1. **Outcome Measures**

Number of landowners with knowledge of proper tree planting and management techniques

Not Reporting on this Outcome Measure

Outcome #18

1. **Outcome Measures**

Number of participants who increased their knowledge of natural resource management

Not Reporting on this Outcome Measure

Outcome #19

1. **Outcome Measures**

Number of participants who increased their knowledge of proper application of pesticides

Not Reporting on this Outcome Measure

Outcome #20

1. **Outcome Measures**

Number of participants who increased their knowledge of topsoil importance

Not Reporting on this Outcome Measure

Outcome #21

1. **Outcome Measures**

Number of participants who increased their knowledge of Indiana's diverse wildlife

Not Reporting on this Outcome Measure

Outcome #22

1. Outcome Measures

Number of woodlot owners who improved their management skills

Not Reporting on this Outcome Measure

Outcome #23

1. Outcome Measures

NRE 1.1 # new assessment, management and decision tools developed, including models and measurements.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	47

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Billions of dollars are being spent for the design and implementation of agricultural conservation practices with the primary goal of reducing nonpoint source pollution from agriculture. Subsurface drainage is an important component of modern agriculture, and is used extensively within agricultural fields in Indiana and other regions of the Midwest. Nitrate that leaches through the root zone of drained fields flows through the tiles and directly enters the surface water. It is critical to design computer-based models to help farmers and landowners control water in their fields while minimizing the leaching of fertilizers.

What has been done
The overall goal is to quantify potential water quality improvements due to conservation practices used in subsurface-drained agricultural watersheds. To do this effectively, farmers and researchers need to be able to measure water at the field level and then convert this information to watershed knowledge. The team created a smaller Hydrologic Response Unit (HRU) that allowed measurements using field boundaries in addition to watershed scale. Using the Soil and Water Assessment Tool (SWAT), predictions of nitrogen, phosphorus and sediment losses at the watershed level were compared against losses measured at the field level. Several conservation practices were tested in the model and the results allowed improvements to be made to the

SWAT model.

Results
The watershed scale results were found to be reasonable and similar for both methods. Using watershed HRUs, users must choose a majority field type, which masked extremely high soil erosion predicted for a few soils. This was only uncovered when testing the model against field based HRUs. This new approach is flexible such that any land use and soil data prepared for SWAT can be used and any shapefile boundary can divide the HRUs. The team demonstrated an innovative method to target agricultural conservation practices to the most effective locations in a watershed, to promote wise use of conservation funds to protect surface waters from agricultural nonpoint source pollution.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management

Outcome #24

1. Outcome Measures

NRE 1.11 - # New production/logistic practices developed and tested

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Precision water management and resource efficiency were rated at the top of the issue/need/concern list developed at the joint USDA, ARS, NASA and NSF workshop "Engineering Solutions for Specialty Crop Challenges". The U.S. Environmental Protection Agency is enforcing federal legislation requiring states to implement Total Maximum Daily Load (TMDL) programs for watersheds. Most field producers of nursery stock use irrigation at some point during the growing season. While supplemental irrigation is essential for container production. Container substrates need to be well drained and container volume limits the amount

of available water, resulting in frequent irrigation and high water use. Almost all greenhouse crops are produced in containers. Over 75% of nursery crops in 17 of the major nursery producing states were grown in containers requiring irrigation. Frequent irrigation along with high fertilizer and pesticide use can lead to significant losses of agricultural chemicals in runoff water that transports them to containment ponds and/or off-site into groundwater or surface water. Irrigation water management is a key component in the nutrient management of ornamental crop production and in reducing the impact of runoff water on local water. Recycling water includes another set of issues for growers, primarily in the form of disease and salinity management. Emerging constraints on water use and quality means that the ornamental industry needs to find ways to manage water without detracting from production schedules and crop quality.

What has been done
Parboiled rice hulls (PRH) have been proposed as a viable alternative growing media for greenhouse and nursery industry. PRH can be used as an alternative to peat moss, but there is limited mixing information. Physical and chemical properties of PRH were evaluated when amended to a peat moss-based commercial potting mix (CPM) to determine the proper ratio of PRH to CPM. The tests were conducted using ground PRH (GRH) and whole PRH (WRH) to replace up to 70% of the peat moss.

Results
Substrate amendments with either 40% WRH or 40% GRH are viable options to substitute peat moss in commercial potting mixes. Follow-up research was conducted to evaluate the effects of PRH amendment on plant growth and to compare the amount of water consumed by plants grown in different formulations of the potting mixes. Petunia and zinnia were grown in commercial potting mix (CPM, 70% peat moss), 40% GRH or 40% WRH and fertigated to provide two different levels (high and low) of volumetric water content throughout production periods. In both species, GRH produced quality crops with the least amount of water. It is concluded that peat-based medium amended with 40% ground rice hulls is a sustainable option for both petunia and zinnia.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management

Outcome #25

1. Outcome Measures

NRE 1.8 - # Relevant social media products, web-based products and communication tools

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	37

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Maps have become an indispensable part of our lives. Once large, unwieldy pieces of paper that one could never get folded back correctly, informative, easy-to-use digital maps now reside on our smartphones, tablets, and desktop computers. Maps can convey an incredible amount of information about the world we live in, and they allow us to make sense of a space that is too large and too complex for us to comprehend in any other way. Soil scientists have been making maps of soil distributions for over 100 years. For almost all that time, soil maps were used only to provide information for farm and land use planning. Soil maps, however, contain incredibly detailed information about the upper 5 feet of the Earth's surface that impacts people's lives in ways most people do not even realize. Soils occur across landscapes in complex, repeating patterns, but teaching this concept to students has been difficult and time consuming, and thus it was taught poorly, if at all. However, the better our students understand the complex relationships between soils and landscapes and how they impact people and the environment in which we live, the better they will be able to understand and address the complex problems that society will face in the future. In this project, we will build on "a teaching soil science with maps" approach originally developed in Indiana and expand it to soil science education in six additional states.

What has been done

The objectives of this project are to develop the ability of our students to use digital maps (1) to learn how and why soils and landscapes vary spatially at scales ranging from individual fields, to counties, states, and, ultimately, globally; and (2) to learn how the spatial distribution of soils and landscapes impacts the distributions of land use, and environmental and ecosystem services across various scales. Work during the spring semester of 2015 focused on setting up the server for online maps of soil properties, and in continued development of the Isee app to display the online maps. Using the massive database of soils data collected over the past 100+ years of soil survey to create very detailed and informative digital maps of various soil properties for the states of Indiana, Wisconsin, Illinois, Kentucky, Ohio, West Virginia, and Texas, we created a web site and an app for tablet computers that will display these maps along with other information about soils. Guided by their instructors, students will study the digital soil maps while they observe the actual landscapes in the field. They will develop a deep understanding of how and why soils occur as they do, and how this affects both global and local problems. This project is aimed at undergraduate and graduate students in soil, crop, natural resource, and environmental science curricula in colleges and universities, but we also anticipate impact in non-agricultural disciplines in colleges and universities, in extension education, in middle school and high school science and vocational agriculture curricula, and in the public.

Results

The publication of the Isee app in the Apple App Store on May 30, 2015, was a significant milestone since anyone with an iPad can now access detailed maps of soil properties for the

partner states on their iPad. By the end of August, the app had been downloaded to 67 unique Apple IDs and maps were available for 4 states (Indiana, Illinois, Wisconsin, and Ohio). At The Ohio State University, maps were developed for Ohio and students in Soil Science Laboratory and Soil Landscapes classes used web-based Isee maps and iPad maps in the classroom, field, and laboratory to learn interactively about soil parent materials. Particularly during field trips, students were able to gain a much better understanding of the spatial distribution of diverse parent materials in the landscape and to observe the impact of this diversity in terms of soil characteristics and land use and land management implications. At Texas A&M University, maps for the Isee app were developed specifically for a field trip in Burleson County, TX for the SCSC 310 class, Soil Morphology and Interpretations. A soil parent material map was developed for the entire State of Texas and maps of interpretations such as shrink-swell potential, wetness class, and soil diagnostic horizons were developed to illustrate the effect of climate on soil formation. Training for use of the Isee app was incorporated into classes and a student received honors credit for developing coursework exercises using the Isee maps. At the University of Wisconsin, students used the digital soil maps in their studies from field to state level. They could understand soil and landscape diversity on the go by using the iPads to explore the links between soil types and soil forming factors. At the University of Illinois, the map layers necessary to convey the soils, geology, and geomorphology information pertinent to Illinois were developed in collaboration with USDA-NRCS soil scientists. West Virginia University (WVU) collaborators worked with colleagues at the USDA-NRCS National Soil Survey Center- Geospatial Research Unit (GRU) and with local NRCS soil scientists to developed three iterations of the Dominant Soil Parent Materials (DSMP) map for West Virginia. Proposals were submitted to both the WVU Davis College Faculty Development Grant Program and the WVU Academic Innovation Technology Integration Grant program for the purchase of iPads in support of Isee activities. Both applications were successful, garnering $7,000 to purchase iPads and a field-based WiFi hotspot that will allow students to explore Isee maps not only while sitting in the classroom but also while out in field.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements

Outcome #26

1. Outcome Measures

NRE 1.2 - # New relevant databases, monitoring systems, and inventories managed or under development

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	59

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Diseases and pests of agronomic and horticultural crops negatively affect farms, greenhouse and nursery operations, orchards, turf and landscapes. Growers need to know what problems they face and how to mitigate and prevent them. Purdue has responsibility for managing the National Plant Diagnostic Network (NPDN) National Repository. The national project addresses the continuation of the collection and dissemination of diagnostic information from land grant universities, state departments of agriculture, and industry in a standardized manner allowing for earlier recognition of new pest/pathogen outbreaks or unusual occurrences. Support from the NPDN grant allows the lab to provide molecular detection methods as a part of the routine diagnostics portfolio, a key part of species identification and determination of risk.

What has been done
Summary reports, maps, and charts are provided via a web interface to those with designated access for improved determination of anomalies. Email alerts indicating a first in state occurrence, are sent to the designated parties in a pro-active manner for review and notification resulting in earlier review verification of anomalies and recognition of new outbreaks. There are two main objectives of disseminating diagnostic clinic records - 1. The collection or transfer of the information from the diagnostic labs to the NPDN National Repository and two. The availability of useful reports in a secure manner. NPDN incorporated the naming convention of fungi under the International Code of Nomenclature (ICN) for algae, fungi and plants. Enhancements continued with the Pest Threshold report, which displays a listing of pest records based on sample date and threshold levels. The line chart feature using a scatter graph was implemented into production, which included criteria of sample date range, pest, and pest confidence level and line color.

Results
Researchers, epidemiologists, federal and state regulatory personnel, University extension staff, and USDA program leaders received rapid and accurate diagnosis for 2210 samples in 2015, 36% of which were from commercial growers or consultants. Over 170 diagnostic labs have uploaded to the repository since its inception with over 11,000 unique pests or pathogens, 3,800 unique hosts, and over 3,100 unique locations (counties). A major milestone has been reached in this cooperative agreement period with the National Repository now containing over 1 million diagnoses. A user can now search on synonym names allowing familiarity with historically correct names and easily incorporating the standard scientific name in the output providing a means for the diagnosticians to master the new naming convention with little inconvenience. This change in the database design and software interface will allow for the use of synonyms as pest or pathogen names are reviewed by the NPDN Database Committee in the future.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements

Outcome #27

1. Outcome Measures

NRE 1.3 - # Viable technologies developed or modified for detection and characterization

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Association of State Floodplain Managers (ASFPM) developed the No Adverse Impact approach to floodplain management in 2001. This managing principal was the product of a realization; that despite the progress made nation-wide because of the National Flood Insurance Program?s minimum standards and billions of dollars spent on structural flood control projects, flood damages have continued to increase. Since 1990 flood damage losses have increased fivefold, costing the nation $10 billion annually on average. The No Adverse Impact (NAI) approach to floodplain management was designed to help reverse this trend by providing communities with the tools to reduce the frequency and severity of flood events, and to protect their citizens now and in the future. In general, these tools prevent the actions of one property owner or even a community from adversely affecting other property owners or neighboring communities. When applied at the watershed or regional level, this approach creates a network of resilient communities.

What has been done
This workshop provided participants an opportunity to: 1. Learn from regionally-renowned experts and boots-on-the ground managers about the legal constructs that are central to floodplain management, planning, and hazard mitigation, 2. Build relationships with practitioners who represent a variety of different professions: floodplain, storm water, and coastal resource managers, land use and hazard mitigation planners, attorneys, health department staff, and local decision makers, and 3. Discover how flooding has impacted Indiana's municipalities and novel solutions individuals and organizations across the state are implementing to increase their resilience. Over the course of the day, seven 30-45 minute presentations were given. The planning committee offered continuing education credits for the following organizations and certification programs: Indiana Commission for Continuing Legal Education, Continuing Legal Education Credits; ASFPM, Certified Floodplain Manager credits; and Indiana Professional Licensing Agency, Professional Engineers and Professional Surveyor credits. The beginning of

the day focused heavily on No Adverse Impact, while the second half of the day highlighted flooding case studies and other special topics. The workshop was organized in this way to ensure that all participants had a strong understanding of No Adverse Impact and common legal concerns associated with floodplain management, prior to exploring specific applicable examples and topics in further detail.

Results
The Indiana Coastal No Adverse Impact Workshop provided participants (41 workshop participants included certified floodplain managers, planners, attorneys, coastal resource managers, health department staff, storm water managers, and local officials) with information about the core tenants of ASFPM's No Adverse Impact approach to floodplain management, common legal issues faced by floodplain managers and planners in the region, specific actions that have been taken in Indiana to enhance flood resilience, the value of green infrastructure, and benefit of wetlands and how they are regulated in the United States. All of the evaluation respondents felt that they could apply the information presented at this workshop to their work and that presenters had given them the tools to implement the knowledge that was shared. In addition, all respondents noted that they would recommend this workshop to others. These results are reinforced by comments that were collected in response to an open-ended question regarding how participants planned to use what they learned at the workshop. Respondents noted that they would use/incorporate the information presented at the workshop into various on-going projects and initiatives, and that they planned to pass it along to others who were not able to attend through technical assistance programs or interpersonal communications.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management

Outcome #28

1. Outcome Measures

NRE 1.4 - # Viable prevention, control and intervention strategies

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	22

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Adjuvants are substances added to vaccines to stimulate the immune response. Without them, many vaccines would be poorly effective or ineffective. The most widely used adjuvants in human and veterinary vaccines are aluminum adjuvants. They have been used for many years, but the mechanisms by which they work are not well understood. Aluminum adjuvants have some disadvantages - they cause inflammation at the injection site that is necessary to induce an immune response, but also persists for months and this may diminish the quality of the carcass for food animals. In addition, they are not biodegradable and do not stimulate all aspects of the immune response effectively.

What has been done
The team has been looking at another adjuvant, alpha-D-glucan nanoparticles derived from a variety of sweet corn. They chemically modified the surface of these nanoparticles to give them a positive surface charge (and named them Nano-11)

Results
The team found that the new Nano-11 adjuvant does stimulate the immune response, in other words, act as adjuvants. Like aluminum adjuvants, they induce inflammation at the site of injection, but the inflammation is transient, i.e. it disappears after a few weeks. Furthermore, the Nano-11 nanoparticles are biodegradable and inexpensive, and there is real potential for their use in vaccines for food animals. The team is now investigating how Nano-11 stimulates the immune response and how the response can be maximized.

4. Associated Knowledge Areas

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

Outcome #29

1. Outcome Measures

NRE 1.15 - # Projects characterizing social, economic, and/or cultural practices

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	24

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There are many household products that while considered "safe" to use are environmental hazards when they have finished their useful life including paints in liquid form, electronics, and medicines. Many waste collection sites, public and private, do not have a mechanism for collecting these products or the policies have changed regarding how to dispose of them and the public is not aware of these changes. For example, people were trained to flush unused medicines but the residues are showing up in the drinking water.

What has been done
In several counties of Indiana, drop off sites were established for the public to drop off these materials.

Results
Hancock County Solid Waste Management District collaborated with Hancock County DARE, Purdue Extension and Hancock Regional Hospital to hold quarterly drug toss events. In 2015, there were 3 events (data for 2 of them). 127 participants turned in 980 pounds of medicine. Hancock County Solid Waste Management District collaborated with Purdue and Covance. 185 people turned over more than 18,000 pounds of electronic waste. Hancock County Solid Waste Management District parented with Purdue and Habitat for Humanity and collected 39 gallons of paint that were donated to Habitat. Another 256 gallons were collected that could not be reused and were disposed of properly.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

Outcome #30

1. Outcome Measures

NRE 1.6 - # New diagnostic technologies

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A need exists to design and develop machines and procedures that will reduce agricultural labor requirements, improve food security and livelihoods, increase agricultural efficiency and productivity, automate common tasks, minimize the impact of machines on the environment, and produce a globally qualified STEM workforce. New machine system technologies, higher production efficiencies, growing more food with fewer inputs, and a qualified workforce are all critical components to a sustainable future. Although the U.S. has a remarkable history of increasing food production using fewer inputs, we are still dependent on many petroleum-based inputs, and require a non-sustainable use of domestic water resources. As a nation, we import energy to grow food, export water when we export food, and crop (inputs and markets) prices are influenced by international events. To move towards a sustainable future requires investment in science and technology, education, and international engagement.

What has been done
The proposed research involves undergraduate and graduate students in the development of new machine and sensor technologies based on state-of-art modeling and simulation tools. Intersecting the research, learning, and engagement activities produces new technologies that improve the efficiency of agricultural systems, domestically and internationally, while producing globally competent graduates looking forward to a career that addresses the grand challenges of this century.

Results
1) A multidisciplinary working group has been formed around ag robotics. Several grants have been written to solicit funding to support a concentrated research effort in this area. 2) New simulation tools have been developed and are being applied towards the design of new hydraulic systems. 3) A new mechanical method of controlling the displacement on a digital pump/motor has been developed and is being designed. A prototype will be constructed for testing, and a preliminary patent has been applied for.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

Outcome #31

1. Outcome Measures

new discoveries of species/cultivars for sustainable systems

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Turfgrass is the preferred ground cover for lawns, parks, cemeteries, recreational areas and utility areas like roadsides. The turfgrass seed industry is the second largest seed industry in the US, and much of the nation's sod production is incorporated as part of a crop rotation system with food crops in order to reduce pest issues. Turf industry stakeholders indicate a need to identify and address environmental issues related to turfgrass production and management, including water, chemicals, greenhouse gas emissions, and sustainability. The work is important due to the vast acreage (> 50 million acres) and economic impact (>$40 million annually) and employs greater than 500,000 persons in the care and maintenance of turf. Environmental degradation and reduced economic impact, including jobs and manufacturing, could occur if environmental issues are not addressed through collaborative research and outreach.

What has been done
Joint research and extension efforts of this multi-state group seek to enhance sustainability of managed turfgrass systems by reducing the environmental footprint from inputs, and developing novel strategies to maintain persistent turf that provide functional, social, and aesthetic benefits. Several dozen engaged scientists in the North Central region collaborate on environmental issues of turfgrass. Projects evaluate novel turfgrass species/cultivars, individual cultural inputs and holistic management systems to meet the goal of sustainable management through the use of reduced or alternative management requirements including underutilized renewable resources like composts. At the core, these studies assess the effect of reduced water, nutrients, mowing and pesticide inputs. This project evaluated multiple cultivars of turf grass species with known adaption to low-input environments in the North Central Region. 25 turf grass cultivars and selections, representing 10 grass species, were evaluated at 8 locations. Plots were established and maintained at 7.6 cm without inputs of pesticides, fertilizer, or supplemental irrigation. Tall fescue, Chewings fescue, hard fescue, and colonial bent grass performed well at most locations. Sheep fescue, tufted hairgrass, and prairie junegrass all performed adequately at some locations, and poorly at others. Texas bluegrass hybrids and the single Idaho bent grass entry were not well adapted to most of the region. A turfgrass website was created and outreach materials were developed on insect management to help turf managers better identify insect concerns. A growing degree day model was created and is accessible to those in MI, OH, IN, and IL to better time pesticide applications in order to reduce pesticide use.

Results
Turfgrass managers can refer to updated list of recommended species and cultivars for low maintenance use areas identified by NCERA-221 which is helpful to state highway departments. Research demonstrated: 1) that fungicides can be reduced through accurate diagnosis of pathogen and potential effects, 2) importance of water quality characteristics and influence of efficacy of spray application of herbicide use, and 3) feasibility of grass-legume systems that

reduce nutrient inputs. Work continues on molecular and applied research to help turf manages efficiently use water in landscape, and evaluating germplasm species and cultivars for turn that may adapt and persist in cool-humid/transitional climate.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Field and lab research projects monitor progress and completion of tasks to determine effectiveness and accomplishment. Extension programs monitor participation or conduct evaluation surveys to measure change in knowledge and intentions of participants, and follow-up surveys to assess change in behavior or practice, and results of actions. Evaluation examples: tracking changes in number or species of wild animals; simulation modeling trends; nutrient load reduction due to improved drainage management practices and ability of models to predict load reductions; insects collected in traps at forest locations; assessing by RNA sequencing analysis genes under water sufficient and deficit conditions; evaluation of factors affecting success of hardwood plantation establishment; surveys of growers and post workshop surveys.

Key Items of Evaluation

Developed hydrologic response unit (HRU) for targeting agriculture conservation practices to the most effective locations in a watershed. Developed parboiled rice hulls as viable alternative growing media for greenhouse and nursery industry, shown effective with petunia and zinnia. Training participants indicated they could apply the No Adverse Impact approach to floodplain management.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
13087	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)	
86	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
5	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.