2017 University of Wisconsin Combined Research and Extension Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 06/18/2018

I. Report Overview

1. Executive Summary

Operating Philosophy/ Program Overview:
The Wisconsin Agricultural Experiment Station (WAES) and University of Wisconsin-Extension Cooperative Extension are partners who work together to generate new research-based knowledge and apply that knowledge to help Wisconsin's citizens and communities address needs, leverage assets, and take advantage of new opportunities.

Priorities are aligned with input from stakeholders with interests in traditional and non-traditional agriculture, natural resources, human health and communities. We receive input through conversations and correspondence with individuals and groups, as well as at public meetings such as field days at Agricultural Research Stations and other Extension events. We also ask issue-based teams, comprised of UW-Extension faculty and county-based educators, to determine the priorities in their areas.

These priorities inform decisions about what research to conduct, and about the development of educational initiatives conducted by Cooperative Extension in partnership with local, state, tribal and regional organizations, farmers, consumers, business owners and entrepreneurs, support services, coalitions, decision makers, and public and tribal government agencies.

How we allocate capacity funds
The success of our statewide educational efforts is founded on new, relevant knowledge through peer-reviewed, investigator-driven research supported by capacity grant funding. We seek to allocate these funds in a manner that best addresses the needs of our stakeholders.

The WAES's general approach is to allocate capacity funds to support specific, peer-reviewed projects rather than to distribute block grants to departments. We use capacity funds to support approximately 130 projects each year, covering the cost of personnel (mainly graduate students), supplies, student hourly help and travel. We use a different approach to distribute funds for capital equipment. In this case, departments set the priorities and where practical, several projects may share capital equipment. We cover the costs of travel to multistate research meetings (for two representatives per project) out of a central pool of funds.

We continually re-examine our research portfolio in order to address short-term, intermediate term and long-term issues. We may fund a small number of new projects at mid-year as new faculty members are hired or to address emerging problems that require immediate attention. These mid-year projects are funded at the discretion of the associate dean for research and chief financial officer of WAES in the College of Agricultural and Life Sciences (CALS), of which WAES is a part. This ongoing portfolio review ensures that we invest in projects that are relevant to the REE and NIFA national goals and emphasis areas and focus on current state research needs.

Cooperative Extension's interdisciplinary and cross-program area statewide teams are co-chaired by campus-based specialists and community-based educators. Structuring team leadership in this manner is

intentional, building relationships and linkages among communities of research interest, communities of practice, and communities of locale. Teams develop plans focused on interests that cut across these communities. They do so from the point of issue identification and priority-setting, to resource commitment, plan implementation and evaluation. This same approach applies to multi-state and joint research and extension activities.

How we measure success
WAES uses several indicators to assess the impact and outcomes of a research project. We consider peer-reviewed publications, efforts to share results with client groups, patent disclosures and graduate students trained. The list may be expanded in the future to include other criteria that will enable us not only to assess the effectiveness of current programs, but also to help us set future capacity grant funding priorities. CALS published research has been ranked first among peer institutions in terms of the Scientific Impact Factor. Formula funding plays a major role in this achievement, not just because of the success of our capacity-funded projects, but also because formula grants help our researchers attract significant funding from other sources. CALS also ranks very high in extramural funding awarded to land-grant universities and public institutions, as well as private universities.

Cooperative Extension's approach to measuring success is grounded in an overarching program development framework. This framework begins with understanding the need and context for a particular program and its intended change. Program plans, which includes measuring program outcomes and impact, are developed by statewide teams. As teams implement and evaluate their efforts, they determine effects of programming and make changes to address emerging trends and improve programming.

Publications in refereed journals, books and extension bulletins have been reported on projects using the annual reports in the REEport system. Extension peer-reviewed publications are entered and tracked in a project database by our central Publishing Unit.

Cooperative Extension's direct contacts include only those participants that were asked for race, ethnicity and gender demographic data. If an educator did not ask for this information, their contacts were not included per our civil rights guidance from NIFA. We have implemented that definition since 2016. Please see the External Factors sections for additional context on organizational changes that affected our direct contacts in 2017. More information can be provided on how we collect and calculate direct contacts, and how we've changed collector systems over the last several years, upon request.

In 2017, we did not consistently collect indirect contacts but could do so in the future if it's important to NIFA. Our contact numbers would certainly increase if we reported these systematically. For example, one of our evaluation studies published in 2016 found that indirect contacts of just one Extension program (the Wisconsin Crop Manager newsletter - a collaboration across several agricultural faculty and staff) could total 120,000 annually. (Details on this statistic: On average, readers of the newsletter share information about once a month with anywhere from 1 to 2,500 people each time. Information is distributed orally, by email, and by printed copy to an average of 7-14 people each time and via social media, newsletters, websites, and publications to about 225-1,500 people.)

What follows are a few brief summaries which describe impact across our research and extension portfolio.

Title: Winter Grain Series: Grain Management in Low-Margin Years
Shawn Conley, Extension Soybean and Small Grains Specialist; Bryan Jensen, Extension Integrated Pest Management Coordinator and Damon Smith, Assistant Professor, CALS-Plant Pathology; and Extension Plant Pathologist

Issue:
Many factors contribute to year-over-year changes in crop production. In previous years, research-based solutions to a variety of issues affecting farmers, crop consultants and technical service providers statewide were presented in Wisconsin's Annual Agriculture Winter Meeting series. Using research from previous years' events and participant feedback, coupled with observed volatility in the grain market, colleagues from multiple University of Wisconsin departments and Extension county educators collaborated in 2017 to produce a new series of events and materials focused on increasing producer profitability and reducing debt load in the current economic environment. The goal of this new series was to address factors that make growers more efficient with their selection of inputs and ultimately increase profit during the 2017 growing season, a year in which profit margins were expected to be low.

What has been done:
The new Winter Grain Series created more than 65 hours of new programming delivered at 13 locations throughout Wisconsin. This series built upon previous research and applied participant survey feedback to better understand the emerging needs and crucial topics affecting participants. Presentation topics included:

- Grain Management in Low-Margin Years,
- Using Economic Principles To Make Pest Management Decisions,
- Selecting Hybrids and Variety Traits to Increase Efficiency and Profit,
- Other topics.

Colleagues from multiple departments with varied expertise contributed to the creation of a robust leave-behind document for participants to reference. This document addressed topics related to cropping, pest management and economic issues, mirroring the presentation topics. Materials can be found at: https://learningstore.uwex.edu/Assets/pdfs/A4137.pdf
In addition, colleagues produced 10 videos for social media distribution on a dedicated YouTube channel. This multi-format approach (in person, paper and electronic materials, video production) was intended to diversify opportunities for various audiences to consume the material in the most accessible format.

Impacts:
The new Winter Grain Series was delivered in person to 455 participants in 13 locations statewide. Each presentation included 4-6 hours of content and individualized question-and-answer time. Participants represented multiple sectors including producers (79%), bankers (12%) and technical service providers. These participants returned evaluation surveys at a rate of 54%, resulting in a robust data set for evaluation of the multi-pronged approach to content delivery.

Among respondents, 99% of attendees found the new series content relevant to their current operations and 79% intended to change their crop inputs based on the new information they gained through participation in this series. Ninety-four percent of respondents felt the information would help them increase profitability during economically challenging times and 56% reported alleviated stress pertaining to farm operations due to the new information.

More than 500 copies of the supporting information were distributed to participants. The document continues to be available online for free download and printing by any interested parties.

The 10 supporting videos uploaded to the dedicated UWIPM YouTube channel create a series entitled, "Grain Management in Low-Margin Years." As of the reporting date, this channel lists 3,400 subscribers and 1,168 views of these 10 videos.

Wisconsin colleagues who developed this series and unique, multi-layered approach to content delivery shared information and materials regarding the Winter Grain Series with surrounding states (Illinois, Iowa,

Minnesota, Ohio) similarly affected by volatility in the grain market.

States: IA, IL, MN, OH, WI

Title: Genomic Investigation of the Saccharomyces eubayanus-Specific Traits Responsible for Brewing Lager, a Major Value-Added Barley Product
Chris Hittinger, Associate Professor, CALS-Genetics

Issue:
Most types of fermented beverages, including ale, are brewed with Saccharomyces cerevisiae, a species of yeast that has been used by humans for thousands of years. Most modern beer is cold-fermented using hybrids of S. cerevisiae and S. eubayanus. S. eubayanus was discovered in 2011 (with collaborator Diego Libkind of Argentina) and found to be the "missing ancestor" of lager yeasts. Since the discovery, researchers have wanted to understand the genetic properties of S. eubayanus that allowed it to hybridize with ale-brewing strains of S. cerevisiae to form the interspecies lager-brewing hybrids used to brew approximately 95 percent of beer. In particular, researchers wanted to understand which traits were conferred to the hybrids by the S. cerevisiae genome, which traits were conferred by the S. eubayanus genome, and what the genetic basis of each was.

What has been done:
To address these questions, a number of techniques were used, including whole-genome sequencing, computational analyses, interspecies hybridization, directed evolution, and genetic engineering. Hybridization of S. eubayanus and S. cerevisiae showed that cold-tolerance was conferred by the S. eubayanus parent, while aggressive fermentation of the wort, or the malt extract used to brew beer, was conferred by the S. cerevisiae parent. When researchers sequenced and annotated the genome of S. eubayanus and several lager strains, they focused their analyses on genes responsible for consuming the two most prevalent sugars in wort. The analyses showed that the ancestries and likely the functions of these genes were more complex than assumed. These findings and other emerging results in the field further suggested candidate genes that impact both cold-tolerance and fermentation, which are two of the most important traits for lager brewing. Work from this study experimentally verified genes that control a portion of both of these traits.

Impacts:
It is now clear that pure strains of S. eubayanus can be used to make beer, a practice Heineken has successfully commercialized. It is also clear that synthetic hybrids of S. eubayanus and S. cerevisiae can be used, but no one has yet commercialized this practice.
Additional funding from the Robert Draper Technology Innovation Fund has been secured to continue this work, and researchers on this project are seeking industrial research partners. This research contributes to the robust and forward-thinking education and research programs in the fermentation sciences at UW-Madison. Two graduate students and several undergraduate students participated in basic research on yeast biodiversity and brewing applications. During the research, talks covering the subject were given to the Biotechnology Center and the Food Research Institute of UW-Madison.

Title: Boosting dairy feed efficiency -- Interdisciplinary collaboration - Career Highlights
Randy Shaver, Professor, CALS-Dairy Science; Cooperative Extension Dairy Nutrition Specialist

Issue:
Throughout the top cheese-producing state, the average Wisconsin dairy cow contributes around $30,000 to local communities--but at what cost? With feed cost about half of total cost of producing milk, an integrated research and extension dairy science leader has devoted 3 decades collaborating with extension agronomy, nutrition and agricultural engineering colleagues to understand and improve feed

efficiency (milk per unit of intake). Randy D. Shaver, professor and extension dairy nutritionist, holds a joint 75% extension and 25% research appointment at the University of Wisconsin-Madison--examining applied nutrition of lactating dairy cattle with emphasis on carbohydrates and forages--conducting and distilling innovative research results into practical, understandable recommendations for the forage, seed corn and dairy industries since 1988.

Tracing the arc of his public service career demonstrates the value of long-term local, state and federal investment in his research, extension and teaching by contributing to dairy production industries and the public thus fostering professionalism among dairy nutritionists and others worldwide. Students, educators, farm business professionals, dairy farmers, crop producers, their advisors and others better understand feed quality and efficiencies--feed provides more energy so dairy cows are healthier with better body condition for optimum reproduction--maintaining productivity, profitability and affordability of dairy products for consumers with less waste to the environment.

What has been done
Improving dairy guidelines and practices: As a scientific leader in the field of applied dairy cattle nutrition, Randy Shaver seeks to solve costly problems of the dairy production industry. He collaborates with interdisciplinary colleagues to provide timely research, education and assistance on feeding strategies, cropping, harvesting and processing systems, and feed storage management. This information is especially critical in times of high feed costs, low milk prices, low-quality forage harvests and extreme weather conditions such as drought. To optimize feed use by dairy cows' complex ruminant digestive systems, his Hatch and other research examines forage quality, factors affecting storage and use of grains and corn silage, generating major career contributions to Wisconsin's $43.4 billion dairy industry--to which farming and processing contribute 78,900 jobs (Deller 2014). Results shared through education and assistance locally, nationally and around the world include:

Balancing rations with proper phosphorous levels: Early on, Randy Shaver's interdisciplinary collaboration responded to the need for better balancing Total Mixed Rations (TMR). Dairy rations originally contained more phosphorous (P) than was necessary for herd health and milk production. Wisconsin research and extension results gave the National Research Council (NRC) confidence to lower P in feed, thus giving veterinarians and dairy nutritionists confidence to feed less P as a mineral supplement. Since the revised NRC Nutrition Requirements of Dairy Cattle reduced P in rations in 2001, extension soil scientists began tracking P levels from manure as well as monitoring total P levels in TMR rations. At the same time, extension put major effort into getting dairy farmers and their advisors information on proper levels of total dietary P in rations. As a result, dairy ration research by extension state specialists, county educators and the USDA Dairy Forage Research Center found P excretion by dairy cows decreased by 25-30%, land required for P application dropped by 0.6 acres per cow, and feed costs were cut by $10-$15 per cow per year--producing the same dairy cow performance while reducing P cost and harm to the environment (Peters et al. 2013).

Improving starch digestibility to enhance milk yield: Focusing ideas from three disciplines on the hard flinty corn kernel developed to withstand global shipping, Shaver's group demonstrated how physical and chemical properties affect total starch digestibility in dairy cows. These factors include hybrid type, plant density, maturity at harvest, particle length, kernel hardness and processing, corn silage moisture content, bacterial protein flow and storage. With the NRC guidelines, Shaver identified for extension agronomists two sources of energy important for dairy cows--energy from stover (corn stalk and leaves) and energy from grain. "That in my mind was the big step. Once we had that target to shoot for in the way we bred corn and the way we manage corn," recalls corn agronomist Joe Lauer, affirming he can now identify the best yield and digestibility from stover and grain for dairy, "because Randy gave us that target."

Shaver created awareness of the importance of forage particle size and the use of particle separators by exploring the juncture between plant structure and function, and its influence on nutrient concentration and

availability. He led groundbreaking research in the area of novel-processed corn silage where whole-plant corn is harvested as forage with longer fiber length and greater kernel processing (more tearing than crushing), to improve starch digestibility and increase milk produced. This longer cut can help keep cows healthier and prevent costly milk fat depression common when feeding diets with 70% or more of the forage dry matter as corn silage.

A convergence of technologies including TMR evaluation encouraged producers to improve hay quality and increase corn silage. Microbes break down fibrous matter enabling cows to digest feeds indigestible by humans. As expanding herds required more feed, tower silos were too costly to erect and too slow to operate for the intermediate to larger dairy farms. University of Wisconsin emeritus agricultural engineer Brian Holmes reports collaborating with campus and county colleagues and the USDA Dairy Forage Research Center studying the storage and feedout losses from three less expensive and simpler to operate horizontal silos: concrete pads, walled bunkers and plastic bags. To start, covering silage piles with plastic greatly reduced spoilage and financial losses for intermediate to large size farms. Next, compacting silage with heavy tractors and other filling management practices improved forage density. Extension state specialists and county educators also studied how farmers packed silage. Four chest-high samples of both corn and hay, were collected from 168 on-farm bunker silos. The results determined what factors farmers can control to achieve a certain density. An equation was developed to predict those densities, incorporated into spreadsheets, and posted on the UW-Extension Team Forage web site. Nutrition consultants and other advisors have used the spreadsheets to help producers and custom harvesters improve their forage packing in bunker and pile silos. Another spreadsheet was developed to help producers determine the value of feed saved based on changed practices.

Establishing professionalism and best practices: Randy Shaver shares expert guidance with graduate students, educators and professionals, farmers and their advisors through conferences, field days, the Midwest Forage Association and Wisconsin forage councils. To reach the Upper Midwest with timely research updates, in 1989 he quickly combined his Wisconsin outreach with that of neighboring states to foster professionalism through the Four-State Applied Dairy Nutrition and Management Conference (IA, IL, MN, WI). An industry partner whose extension career parallels his observes that the "nutrition consultant" was in its infancy then. Through this new conference and many others, "Randy helped develop high-level educational programs for that audience of nutrition consultants, veterinarians etc." Emeritus agricultural engineer Brian Holmes notes that as crop producers, custom harvesters, feed suppliers and others see the value in dealing with the growing amount of silage producers now make, this education and technical assistance extends to many other regional agricultural professionals in the four states and beyond.

Shaver both founded and now serves on the organizing committee for annual 4-state conferences with University of Iowa Extension, University of Illinois Extension, University of Minnesota Extension and University of Wisconsin-Extension colleagues. This nationally recognized conference provides advanced nutrition education and professional development for dairy nutritionists, ration advisors, feed dealers, dairy farmers, herd managers, veterinarians, technical service providers, researchers, county extension advisors and others. Shaver estimates that of around 600 participating in 2017, about a third (mainly nutritionists) received Continuing Education Unit credits from the American Registry of Professional Animal Scientists (ARPAS) or their state nutrition and veterinary certifying agencies (also described in the multistate module of this report).

States: IA, IL, KS, MD, MN, NE, NY, OH, PA, WI

Outcomes and impacts
Boosting dairy feed efficiency through interdisciplinary collaboration: As a Professional Animal Scientist Diplomate, Randy Shaver opens doors for improving feed efficiency, known among peers for his commitment to improving corn silage digestibility and encouraging adoption. The legacy of his interdisciplinary collaboration is a sea change from mainly higher cost alfalfa to transforming corn hybrid

type, cropping, harvesting and processing systems, feeding strategies, bunker and pile silo storage and management practices--and the rural landscape. Breakthrough research has led to global adoption of increasingly improved fermented forages including corn silage, earlage, Shaver's signature shredlage, and snaplage (described below). Application of Shaver's starch digestibility outreach has likely touched every dairy cow in the country through changes in dairy rations, impacting the entire U.S. dairy industry. He has presented hundreds of papers integrating his research with other published work yielding valuable technical information to the feed and dairy industries regionally, nationally, in 38 U.S. states and throughout the world including Argentina, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, England, Germany, Italy, Japan, Mexico and Turkey.

Interdisciplinary research and extension outreach flipped dairy feeding from mostly alfalfa to dramatically more lower-cost corn silage. While corn grain is 75% starch, corn silage at 30 to 35% starch is more digestible than dry corn, thus providing more energy to transition cows. Dairy cows in good condition breed back better. Improving starch digestion by dairy cows reduces the amount of supplemental corn grain in dairy cattle rations, reducing ration costs, and increasing milk production which lowers the cost of milk production and the cost of dairy products to consumers. Shaver estimates the cumulative effect of his combined interdisciplinary effort has increased milk yield on average 2 pounds more milk per cow per day. His many contributions to the U.S. and world feed industries have clearly advanced many facets of the forage and dairy industries. His innovative, highly integrated approaches have led to widespread improvements in dairy feed efficiencies and production, fostering collaboration, innovation, economic and workforce development, improving both farm management practices as well as scientific understanding of agriculture. For example:

Evaluating forage and feed grain value: Throughout his career, Shaver has been developing decision tools farmers and their advisors use to maximize returns to dairy feed. His earliest assays are still standard among commercial forage testing laboratories. Most recently, as a member of software development teams (University of Wisconsin MILK2006 Corn Silage, Feed Grain v2.0, and FeedVal v6.0), he has contributed to widely used and highly integrated platforms to evaluate and quantify the nutritional and economic values of forages and feed grains. Based on Wisconsin-fed NRC guidelines, the MILK2006 Excel spreadsheet estimates the energy content of corn silage, milk per acre, and a milk per ton quality index. This index has become a focal point for corn silage hybrid performance trials and hybrid breeding programs throughout academia and the seed-corn industry. Extension specialist in dairy farm management, Victor Cabrera has shared this suite of tools for the past decade. He reports the 3,000 FeedVal subscribers can shop for and locate supplies of the most economical top-quality feed. Cabrera notes improved efficiencies also result in better quality, more affordable and nutritious dairy products for consumers, and less nitrogen to the environment per unit of product. See updates on Shaver's web site: https://shaverlab.dysci.wisc.edu/spreadsheets.

Fostering industry partner improvements: Machinery manufacturers made faster harvesters based on extension recommendations of harvesting quickly to reduce oxygen degradation of forage, also reducing labor. Shaver's recommendation of longer corn plant chop length by a third for best digestibility resulted in the harvester knives missing many of the hard, nearly indigestible corn kernels. This pressed equipment manufacturers to improve processing, adding processing rollers behind the knives and doubling the speed differential from 20% to 40 or 50%, sufficiently shredding corn kernels for best digestibility. Developing near infrared reflectance spectroscopy calibrations for analyzing grain and whole-plant corn silage, Shaver's early work has helped identify the potential for future germplasm to be exploited for developing highly nutritive corn hybrids for silage and grain feeding. As a result, an industry partner developed a completely new softer corn seed variety recently released for on-farm testing. At proper processing speed these "floury" kernels turn to powder for optimum digestibility and energy for the cow.

Training the next generation: Shaver has mentored 28 graduate students who have taken faculty research, extension and teaching positions at Land Grant and other institutions and within the feed industry. They

report cooperating on feeding trials, sharing the load and sharing ideas. Inspired by Shaver's fermentation studies, UW Marshfield Agricultural Research Station dairy extension specialist Matt Akins looked at different forages, different fermentation temperatures and length of time fermenting, finding "the longer the corn silage fermentation, the better the use by the animal." As part of a 2017 survey project, Akins and UW-Madison intern Morgan Cavitt, UW-Extension county educators and their interns, University of Minnesota extension dairy educator James Salfer and Emily Wilmes, University of Minnesota Extension gathered farm-level data from both states to evaluate costs of raising dairy calves using automated feeding systems. They will share results at the Four-State Applied Dairy Nutrition and Management Conference in Dubuque, Iowa.

Shaver influenced students to look at different forages and techniques, teaching quality analysis of different treatment diets with different forages. University of Florida livestock nutrition specialist Luiz Ferraretto now analyzes two seasons of corn and sorghum silage harvests, improving quality of high-moisture silage. "Collaboration is the key that gets you further--interacting with other faculty and different perspectives," Ferraretto observes. As Shaver's student, he also published with UW corn agronomist Joe Lauer and recalls joining the first controlled study harvesting and feeding snaplage (chopped whole ear of corn with kernels, husk and part of the stalk) compared with high-moisture corn grain. They measured more parameters such as consumption, milk production and cow body weight for a more complete trial than previously conducted. They recommended adding dry corn to snaplage to reduce costly rumen acidosis, producing more butterfat for premium price.

Shaver continues to write and share articles on subjects such as rumen acidosis, bunk management, forage quality, transition cow management and nutrition, and corn silage hybrids: http://shaverlab.dysci.wisc.edu/publications

Meeting NIFA Priorities:
The 2017 combined Research and Cooperative Extension federal annual report describes how statewide interdisciplinary campus and county faculty, staff and colleagues provide research-based education and assistance to sustain and grow the state's vital agricultural economy across NIFA priorities:

1. Global Food Security Food Availability: Crops and Agronomic Plants
The WAES and Cooperative Extension collaboration among campus, county and regional colleagues, partners and trained volunteers, provides research-based education and assistance to improve food security by strengthening local food markets and systems, responding to growing consumer demand for sustainably produced local foods, building community capacity to increase access to healthy foods for vulnerable populations, increasing household access to healthy foods for those in need, and providing education to assist with the succession of farm businesses and retaining on-farm jobs.

2. Global Food Security Food Availability: Livestock and Poultry
The WAES research and Extension colleagues, partners, and trained volunteers provide timely research-based education and assistance to producers to develop food production systems that enhance animal health, while increasing the production capacity, efficiency and nutritional value of food. Research and professional education of such topics as grass-fed beef, pasture-raised poultry, and managing pastures for water quality continue to be just a few areas of focus.

3. Global Food Security and Hunger: Food Accessibility
Cooperative Extension colleagues collaborate among campus, county and regional colleagues, partners and trained volunteers, providing research-based education and assistance to improve food security by strengthening local food markets and systems, responding to growing consumer demand for sustainably produced local foods, building community capacity to increase access to healthy foods for vulnerable populations, and increasing household access to healthy foods for those in need.

4. Climate Change and Energy Needs
Climate change and energy needs have a variety of impacts on communities, agriculture, natural resources, local economies and human health. In addition, the WAES and Cooperative Extension educators in both agriculture and community development program areas are being called upon to respond to questions about bioenergy and sustainable renewable energy. Professionals and community leaders need locally relevant, science-based climate change and energy needs information and methods to incorporate into economic development and resource management planning processes.

5. Sustainable Use of Natural Resources
Communities are interested in developing renewable energy industries for energy independence, job creation, and economic development. The Wisconsin Agricultural Experiment Station incorporates research to benefit forest production, weed management, surface water quality, and promote new farm based practices. Cooperative Extension campus and county faculty and staff are conducting integrated research and extension programs, and building capacity for scalable, sustainable energy among extension colleagues and communities.

6. Nutrition
The WAES and Cooperative Extension research projects explore basic human nutrition, and identify effective measures that guide individuals and families to make informed, science-based decisions to promote health and reduce malnutrition in high-risk populations. Effective research-based interventions that are practical to implement and sustain are needed to support parents and others to help young children develop healthy behaviors.

7. Food Safety
As the U.S. becomes more urban, youth and adults are becoming disconnected from a basic understanding of the science behind agricultural production and the technology it takes to make sure their food supply is safe and readily available. The WAES and Cooperative Extension plan collaboration among campus and county faculty and staff, colleagues, partners and trained volunteers to provide research-based training and support to reduce the incidence of food-borne illnesses and to improve the safety of the food supply by educating consumers and food safety professionals, and developing food processing technologies to improve food safety.

8. Education and Science Literacy
Education and science literacy reach beyond local communities to impact regional, national and global communities. The WAES and Cooperative Extension campus and county faculty and staff, colleagues, partners and trained volunteers work with Wisconsin youth in educational events using curriculum such as STEM and the Master Gardener and Master Naturalist programs.

9. Rural Prosperity
Rural Prosperity not only depends on attracting, retaining and informing young people through community development efforts that build upon a community's assets, while improving agricultural development and marketing, rural prosperity also means supporting established and possibly aging rural property owners through education and outreach. Cooperative Extension campus and county faculty and staff, colleagues, partners and trained volunteers work with rural property owners across the state to help them stay current regarding ownership and leasing decision-making. In addition, while half of Wisconsin farmers are nearing retirement, most do not discuss farm succession plans with anyone. Cooperative Extension county agriculture agents and campus specialists will continue to deliver comprehensive regional farm succession trainings.

10. Wisconsin Competitive Program
Capacity funds are being used to address a number of state priority research activities that cannot be

classified in the nine priority areas. We have grouped these ongoing projects under the rubric of the "Wisconsin Competitive Research Program," but funds supporting these projects will be redirected to the new national priorities in the future. These projects do contribute to a variety of important state needs and are focused in several areas, including water resource issues, applied statistics in support of agricultural research, policy analysis for use in land use planning and commodity programs, management of invasive exotic organisms, and bio-waste management.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	102.0	{No Data Entered}	133.0	{No Data Entered}
Actual	100.0	0.0	145.4	0.0

II. Merit Review Process

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

- Internal University Panel
- External University Panel
- External Non-University Panel
- Combined External and Internal University Panel
- Combined External and Internal University External Non-University Panel
- Expert Peer Review

2. Brief Explanation

A 10--person faculty Research Advisory Committee (RAC), appointed by the CALS Associate Director of the Agricultural Experiment Station, reviews proposals for capacity grant funding on the UW-Madison campus. Each proposal is reviewed by two RAC members (designated primary and secondary reviewers) and by two, non-committee members--drawn from the Madison campus, other UW campuses, state agencies, non-governmental organizations and other states--who are established experts in the field. The reviewers are asked to consider a proposal's merit in terms of its relevance to program guidelines and to national goals and emphases areas, pertinence to state problems and priorities, relationship to multistate projects and inclusion of integrated activity. Some Wisconsin faculty members are cooperators in multistate committees in the North Central, North East, Southern, and Western Region as well as a few National (NRSP) projects. Each region has a review process with slight modifications.

Cooperative Extension educators and WAES faculty with extension appointments are organized into self-directed teams that develop specifics for implementing and evaluating planned programs. At the state level, program area administrators review and oversee team programming. Teams co-chaired by campus and county faculty set the direction for their initiatives, complete a statewide team plan of work, develop research-based educational resources, and evaluate and report progress toward planned outcomes.

Team leaders and program directors conduct merit reviews jointly in Cooperative Extension. Teams use reviewers' recommendations to improve program quality and relevance for the intended audience, and

include review comments in annual accomplishment reports and plans of work. Cooperative Extension curricula and publications are peer reviewed by research and extension faculty, government or industry colleagues and professionals as appropriate to the content, purpose and intended audience. Translations are reviewed for cultural appropriateness. Scholarly peer review and cultural review assure the quality and relevance of educational materials and outreach scholarship.

III. Stakeholder Input

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

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of the general public
- Other (meeting specifically with non-traditional groups)

Brief explanation.

Methods of collecting stakeholder input vary depending on the type of meeting or activity around which the input process is organized. Most generally, this involves personal contact with someone from the UW-Madison WAES/CALS and Cooperative Extension administrative leadership group meeting with a traditional or non-traditional stakeholder group or individual, or meetings that are open to the general public or selected individuals. For example, this year the UW system hosted a dairy summit to encourage dialog among legislators, researchers and farmers. Together, they discussed emerging issues and research needs for the future of the state's dairy industry. County educators routinely conduct local needs assessments that identify critical issues. These issues inform local educational programs and are transmitted to campus-based staff to inform research priorities.

In 2017, educators and specialists within Extension continued assessing needs and engaging stakeholders in their communities as part of program planning, delivery and evaluation. Also in 2017, county Extension committee survey results on needs were analyzed and shared: https://blogs.ces.uwex.edu/nextgeneration/files/2016/03/Needs-Assessment-Survey-Results.pdf

In 2017, the 4-H Youth Development Expanding Access Task Force sought stakeholder input via four focus groups focused on parents of African American and other underserved youth to identify barriers and opportunities for youth programs. Locations included Green Bay, Superior and Madison Wisconsin. The task force also reviewed a lot of secondary information including the recent Latino Family Study and previous listening sessions.

University of Wisconsin Native Nations Task Force conducted listening sessions at all Wisconsin tribal communities and in urban Indian communities in 2016 were made public in 2017. This resulted in Extension priorities being established in the plan around language and culture revitalization, environmental issues, and native student access to UW campuses (post-secondary education). More detail can be found in the report here: https://blogs.ces.uwex.edu/natf/files/2014/08/Native-Nations_UW-Strategic-Plan-5.30.17-1-14.pdf

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
- Use Surveys

Brief explanation.

The CALS Administrative Leadership group maintains a close relationship with leaders of the industries and advocacy groups that have an interest in disciplines we study. In addition to advisory groups, the CALS Administrative Leadership Group attends field days, hosted at our 12 agricultural research stations located throughout the state. These field days and other public events allow college leaders regular interaction with a variety of producers and growers representing the breadth of Wisconsin agriculture.

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About 30 parents and caregivers were engaged for the 4-H Youth Development Expanding Access Task Force focus groups. They were involved in after-school programs with organizations that Extension partners with. For the Native Nations work, tribal leadership (councils and tribal organizational leaders) were invited to name participants and Extension also helped to recruit.

Examples of face-to face meetings with stakeholders:

UW System hosted a free dairy summit in June 2017 to foster dialog among legislators, researchers, farmers and producers and work towards a more prosperous future for Wisconsin's dairy industry. Experts discussed the status of Wisconsin's dairy industry, industry trends, production advances, research innovations, the future of the state's dairy industry and key priorities for moving forward. Several CALS and Cooperative Extension faculty and staff served on the planning committee and lead discussions during the event. More than 235 people attended.

Wisconsin hosted the 2017 North American Manure Expo on August 22 and 23, showcasing the latest equipment and technology for professional manure management. The program featured farm tours, field demonstrations, hands-on product and safety education, exhibitor booths and commercial vendor displays. More than two dozen educational sessions focused on Manure Safety and Manure Management Tools, Manure as a Fertilizer Resource, Manure Application Techniques and Technology, and Manure and Environmental Protection.

A CALS researcher served on the National Academies of Sciences and Medicine international

committee that issued a human genome-editing technology report laying out principles and recommendations for the U.S. government and governments around the globe.

CALS and UW Extension specialists hosted a field day featuring the organic vegetables grown at the UW Arlington Agricultural Research Station. UW--Madison/Extension plant breeders were joined by representatives of seed companies, including High Mowing Organic Seeds, Johnny's Selected Seeds, PanAmerican Seeds, Seed Savers Exchange and Vitalis Organic Seeds. The field day was followed by a dinner, open to the public, featuring dishes prepared by area chefs using the new varieties of spinach, sweet corn, bell peppers, acorn and delicata squash, cabbage and tomatoes developed in collaboration with UW plant breeders, the chefs and local farmers.

Cooperative Extension expanded their efforts at the 10-day Wisconsin State Fair in Milwaukee. The new location in Exploratory Park featured different educational programs each day. Highlights included: fossils of Wisconsin's past, a Master Gardener demonstration garden, grocery shopping games, and 4-H archery, kite-making and robotics.

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

Brief explanation.

Stakeholders' input for the development and conduct of research relating to state needs are accomplished in a tiered system. Many departments, centers, and institutes maintain advisory committees that meet periodically with researchers in the units. Departments convey this input to the CALS Administrative Leadership Group.

A Board of Visitors advises CALS and meets with the Administrative Leadership Group twice a year. That board includes accomplished and influential individuals representing a number of interest groups, including agriculture producers, industries, consumers, environmentalists, and state agencies. In addition to advising CALS on research and outreach needs, the board also provides a source of contacts of various constituencies.

College leaders are also frequently invited guests at a monthly meeting of commodity groups, organized by representatives of those groups to better collaborate on emerging issues. These public events and organizational meetings provide periodic opportunities for leaders of user groups to

interact informally with CALS Administration and faculty.

Input has been gathered from diverse and under-represented audiences statewide through focus groups, interviews, listening sessions and case studies. Statewide team efforts accord with the local context, where all 72 Wisconsin county extension offices have civil rights plans designed to increase access to educational programs among traditionally under-served audiences.

3. A statement of how the input will be considered

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

Brief explanation.

Results from stakeholder input identify priority issues. Planning is ongoing and continues to set direction for research and extension to address priority issues, for incorporation into budget and staffing decisions through statewide self-directed teams, and shape team implementation and evaluation plans as well as statewide federal plans of work.

Brief Explanation of what you learned from your Stakeholders

In meeting with stakeholders, we continue to learn of their interests in many areas related to agriculture, natural resources and environment, food, energy, rural life and health issues and rural economic development. The consistent theme being presented to us is the growing demands for food and new food markets, community food systems and health issues.

2016-2017 specific findings:

• Our 2016 survey of county Extension committees showed that all areas of our programming are needed, and positive youth development ranked as the number one identified need: https://blogs.ces.uwex.edu/nextgeneration/files/2016/03/Needs-Assessment-Survey-Results.pdf

• Listening sessions with tribal communities resulted in Extension priorities being established in the plan around language and culture revitalization, environmental issues, and native student access to UW campuses (post-secondary education). More detail can be found in the report here: https://blogs.ces.uwex.edu/natf/files/2014/08/Native-Nations_UW-Strategic-Plan-5.30.17-1-14.pdf

• Engaging diverse parents and caregivers taught us ways that our 4-H Youth Development clubs, policies and procedures need to be structured in order to adequately expand access.

IV. Expenditure Summary

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

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	4969506	0	8430992	0
Actual Matching	4969506	0	8430992	0
Actual All Other	0	0	0	0
Total Actual Expended	9939012	0	16861984	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	4969506	0	1360721	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security Food Availability: Crops and Agronomic Plants

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	20%		4%	
133	Pollution Prevention and Mitigation	15%		1%	
135	Aquatic and Terrestrial Wildlife	0%		2%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		15%	
202	Plant Genetic Resources	5%		8%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	10%		8%	
204	Plant Product Quality and Utility (Preharvest)	0%		6%	
205	Plant Management Systems	10%		6%	
206	Basic Plant Biology	0%		4%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		11%	
212	Pathogens and Nematodes Affecting Plants	0%		11%	
215	Biological Control of Pests Affecting Plants	0%		6%	
216	Integrated Pest Management Systems	20%		5%	
302	Nutrient Utilization in Animals	0%		5%	
307	Animal Management Systems	0%		2%	
402	Engineering Systems and Equipment	0%		2%	
403	Waste Disposal, Recycling, and Reuse	0%		1%	
601	Economics of Agricultural Production and Farm Management	10%		2%	
608	Community Resource Planning and Development	10%		0%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%		1%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	28.0	0.0	21.7	0.0
Actual Paid	15.3	0.0	66.2	0.0
Actual Volunteer	8377.0	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
825379	0	2980830	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
825379	0	2980830	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Faculty working on food availability issues transcend discipline lines and use a variety of biological, physical and social science approaches in working on these issues. The majority of our work involves improvements in the management of important crop food sources in the upper Midwestern U.S. However, many projects have broad national and international applications, including herbicide resistance, identification and application of genes of economic significance, practices for maintaining soil fertility, conservation and management of crop genetic resources, and management of a variety of globally important microorganisms. Work is also occurring in the areas of urban poverty and food security, especially in metropolitan areas and among recent immigrants, and in social network analysis and socio-ecological systems.

In 2017, educators with the Extension Program for Crops and Soils primarily delivered educational events and resources, such as seminars, workshops, and summits. For example, educators participated or led efforts as varied as chairing the 2017 Midwest Manure Summit; preparing farmers for marketing their goods to consumers and industry buyers; providing information on techniques for managing crop growth inputs; forming community-based coalitions to interpret and educate about new safety regulations; and others. Major programs focused on general production, environmental sustainability, and social sustainability. This Extension Program also houses the Plant Disease Diagnostics Clinic. This clinic, hosted on the UW-Madison campus, serves audiences from indoor gardeners and commercial growers to plant health professionals and governmental agencies. The clinic provides not only a diagnosis but also information on managing the disease, including additional, collaborative assistance with managing diseases with widespread environmental health implications. Educators whose work fits this Extension Program also often led or contributed to research efforts. These educators have been involved primarily with researching the benefits of cover crops, particularly the effects of certain varieties/strains of potential cover crops, as well as how to balance nutrient (especially nitrogen) management to maximize the health

of both crop-growing soil, surface water, and groundwater. A few educators aided audiences in strategic planning and/or in bringing about systemic change in an organization or business to help modernize farm equipment and buildings or involve growers with water conservation conversations.

2. Brief description of the target audience

Integrated activity for our capacity grant programs targets three broad groups of stakeholder audiences in agriculture, natural resources, and the public. The audience includes North Central Region colleagues, agricultural professionals and other educational partners, grains, commercial vegetable, fruit and specialty crop growers and workers, 4-H and FFA youth, grower associations, food processors and entrepreneurs, food coalitions and cooperatives, agricultural service providers, agronomic retail and wholesale suppliers, local and regional economic development initiatives, local and tribal officials, planning commissions, state and federal rural development and regulatory agencies, and others.
The vast majority of the audience for programming in the Crops & Soils Extension Program towards Global Food Security, Food Availability, Crops/Agronomic Plants were businesses and professionals, particularly farms and farmers. Educators working in this area identified the following as their top three audiences:
1. all types of farmers (crop, fruit & vegetable, grazers, forage, home gardeners, dairy and livestock),
2. agricultural professionals (e.g. crop consultants, fertilizer dealers), and
3. agricultural service providers (e.g. lenders, buyers, and food processors).
Other audiences were community residents; nonprofits; and government agents/officials at the county, state, and federal levels. Other researchers and Extension professionals also benefited from research work, presentations, and trainings described in our data.

3. How was eXtension used?

University of Wisconsin-Extension campus and county faculty and staff participate in various communities of practice, engaging with colleagues around the country to improve the educational content of research-based programs and assistance delivered to residents across the state and region. 289 Cooperative Extension colleagues have created accounts with eXtension. They are connected by email ListServ, blogs and online newsletters, and shared resources such as teleconferences and webinars, eXtension Communities of Practice, and the national Extension Disaster Education Network (EDEN) to quickly address critical and emerging issues such as responding to extreme weather. In 2017, two Cooperative Extension colleagues were trained by eXtension to be Designathon/Innovation facilitators and we prepared to host a Designathon event with eXtension in early 2018. We organized teams representing food systems, opioids, nutrition and educational technology to attend. Interdisciplinary colleagues and other professionals in this network include University of Wisconsin researchers on the Madison, Platteville, River Falls and Stevens Point campuses, working with 3 tribes, and at 12 agricultural research stations.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4815	0	8068	0

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

Year:	2017
Actual:	1

Patents listed
Title: Methods and Compositions for Resistance to Cyst Nematode in Plants
Investigator: Andrew Bent
Patent Application 62/544824 (filed 8/13/2017)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	12	122	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension self-directed teams on the relevance, importance and impact of our research program. The output measures listed will also serve as outcome measures in that patents, graduate degrees and publications all include an element of critical review and assessment of uniqueness, originality, contribution to the science and knowledge base, or other performance criteria.

Year	Actual
2017	172

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Manage and minimize the loss due to plant pests and/or diseases.
2	Enhance the economic and environmental sustainability of agribusiness.
3	Build the capacity of the agriculture service and support industry.
4	Implement and improve forest production.
5	Innovations and increased efficiencies in production

Outcome #1

1. Outcome Measures

Manage and minimize the loss due to plant pests and/or diseases.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Enhance the economic and environmental sustainability of agribusiness.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	455

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Winter Grain Series: Grain Management in Low-Margin Years

Many factors contribute to year-over-year changes in crop production. In previous years, research-based solutions to a variety of issues affecting farmers, crop consultants and technical service providers statewide were presented in Wisconsin's Annual Agriculture Winter Meeting series. Using research from previous years' events and participant feedback, coupled with observed volatility in the grain market, colleagues from multiple University of Wisconsin departments and Extension county educators collaborated in 2017 to produce a new series of events and materials focused on increasing producer profitability and reducing debt load in the current economic environment. The goal of this new series was to address factors that make growers more efficient with their selection of inputs and ultimately increase profit during the 2017 growing season, a year in which profit margins were expected to be low.

What has been done
The new Winter Grain Series created more than 65 hours of new programming delivered at 13 locations throughout Wisconsin. This series built upon previous research and applied participant

survey feedback to better understand the emerging needs and crucial topics affecting participants. Presentation topics included:

- Grain Management in Low-Margin Years,

- Using Economic Principles To Make Pest Management Decisions,

- Selecting Hybrids and Variety Traits to Increase Efficiency and Profit,

- Other topics.

Colleagues from multiple departments with varied expertise contributed to the creation of a robust leave-behind document for participants to reference. This document addressed topics related to cropping, pest management and economic issues, mirroring the presentation topics. Materials can be found at: https://learningstore.uwex.edu/Assets/pdfs/A4137.pdf

In addition, colleagues produced 10 videos for social media distribution on a dedicated YouTube channel. This multi-format approach (in person, paper and electronic materials, video production) was intended to diversify opportunities for various audiences to consume the material in the most accessible format.

Results
The new Winter Grain Series was delivered in person to 455 participants in 13 locations statewide. Each presentation included 4-6 hours of content and individualized question-and-answer time. Participants represented multiple sectors including producers (79%), bankers (12%) and technical service providers. These participants returned evaluation surveys at a rate of 54%, resulting in a robust data set for evaluation of the multi-pronged approach to content delivery.

Among respondents, 99% of attendees found the new series content relevant to their current operations and 79% intended to change their crop inputs based on the new information they gained through participation in this series. Ninety-four percent of respondents felt the information would help them increase profitability during economically challenging times and 56% reported alleviated stress pertaining to farm operations due to the new information.

More than 500 copies of the supporting information were distributed to participants. The document continues to be available online for free download and printing by any interested parties.

The 10 supporting videos uploaded to the dedicated UWIPM YouTube channel create a series entitled, "Grain Management in Low-Margin Years." As of the reporting date, this channel lists 3,400 subscribers and 1,168 views of these 10 videos.

Wisconsin colleagues who developed this series and unique, multi-layered approach to content delivery shared information and materials regarding the Winter Grain Series with surrounding states (Illinois, Iowa, Minnesota, Ohio) similarly affected by volatility in the grain market.

In addition, this project garnered the following awards:

- 2017 American Society of Agronomy (ASA) Educational Awards Program Certificate of Excellence for a publication less than sixteen pages; and

- 2017 American Society of Agronomy (ASA) Educational Awards Program Certificate of

Excellence for audio visual presentation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
601	Economics of Agricultural Production and Farm Management
608	Community Resource Planning and Development
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #3

1. Outcome Measures

Build the capacity of the agriculture service and support industry.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Implement and improve forest production.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Innovations and increased efficiencies in production

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Genome-wide Association Analysis and Breeding in Potato

In potato breeding, the use of molecular biology tools such as genetic modification and selection (i.e., molecular breeding) has lagged behind other major crops. Recognizing that genetic improvement is a powerful approach to improving yield, processing quality, disease resistance, and other traits affecting the sustainability of potato production, the overarching goal of this project was to enable the use of molecular markers (fragments of DNA that can be used to identify novel plant traits) for potato breeding. One issue this project could help address is the presence of acrylamide, a likely human carcinogen, in French fries and potato chips, which account for nearly half of the 43 billion pounds of potatoes sold in in the United States in 2012. One promising strategy for reducing acrylamide in the American diet is the development of new potato varieties with low potential for forming acrylamide.

What has been done
To improve the efficiency of potato breeding and aid in the development of new potato varieties, researchers at the University of Wisconsin-Madison designed two open-source software packages, GWASpoly and ClusterCall. These programs offer enhanced tools for genome-wide association studies (GWAS), a common approach in genomics that rapidly analyzes complete sets or subsets of DNA from a population of organisms to see if any of their genetic variants are associated with specific traits. The use of GWAS has the potential to inform and enhance plant breeding. GWASpoly is novel because it is tailored to autopolyploids, organisms with more than two sets of chromosomes. Many plants, including potatoes, are autopolyploids. Other software packages are designed for diploid species, or those containing only two sets of chromosomes, so their use for GWAS of autopolyploids is limited. GWASpoly also has the unique ability to model the different ways in which certain genes influence the observable traits of an organism. The statistical accuracy and power of the software, as well as the assumptions of its models, were

validated when applied to simulated data and to actual data from a large sample of potatoes that were already genotyped (classified based on genetic makeup) and phenotyped (classified based on observable traits). ClusterCall serves as a complement to GWASpoly by providing a more accurate way to assign genotypes to the plant samples included in a GWAS.

Results

Both software packages are freely available online (potatobreeding.cals.wisc.edu/software/) under a general public license and are being used by UW-Madison's potato breeding program and other research groups around the world. To illustrate the use of the software, the research team has published peer-reviewed articles in The Plant Genome and Theoretical Applied Genetics and presented at two annual meetings of the Potato Association of America, at the Fifth International Conference of Quantitative Genetics, and at Plant and Animal Genome XXIII.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)

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

Brief Explanation

2017 was a time of transition for Cooperative Extension. As part of that transition, we experienced reduced numbers of employees and some losses of institutional knowledge. We are moving forward with the efficiency and effectiveness of our programs at the forefront. Continuing to meet our mission is possible largely because of consistent NIFA funding. In late 2017 and into 2018 we entered a significant hiring phase rebuilding our human capitol around program development and delivery.

• In the 2015-2017 Wisconsin State biennial budget, Cooperative Extension saw a reduction of $3.6 million per year in ongoing state funding. The portion of this reduction that impacted the county/tribal arm of Cooperative Extension was $1.2 million.

• Between January 1, 2017 and January 1, 2018, Cooperative Extension saw a total of 59 retirements and resignations of county-based educators.

• There were 34 resignations by county-based educators/coordinators.

- There were 25 retirements by county-based educators/coordinators.

- Cooperative Extension reorganized its 72 single-county administrative structure into 22 Areas overseen by 22 full-time Area Extension Directors. In June of 2017, regional/county based administration of cooperative extension educators was consolidated into these 22 Area Extension Director positions. These are full-time administrative positions that oversee county-based educators in groups of counties across the state. Twenty-two county based educators/coordinators transitioned into these fully administrative roles.

- A major change in federal policy or appropriation affecting the Capacity Grant program could affect CALS's ability to produce our desired outcomes. Training graduate students is a priority of our program. Since these funds do not allow tuition remissions, we continue to discuss alternatives to meeting our capacity grant mission, while continuing to train graduate students for the next generation of agricultural science.

A variety of factors could affect the outputs and outcomes of this planned program including those listed above. However, the breadth of the program ensures that there is still a sustainable base of work being done that can grow and evolve in 2018 and beyond.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Please refer to summaries under planned program activity and outcomes number 2 and 5.

Key Items of Evaluation

In 2017, we started redesigning the Cooperative Extension Program Development and Evaluation unit, which will result in more evaluation being done on high priority planned programs and an increased ability for us to provide concise summaries here in the years to come. For now, please reference the Results section of the Qualitative Outcome or Impact Statement sections above.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Global Food Security Food Availability: Livestock and Poultry

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
111	Conservation and Efficient Use of Water	0%		4%	
204	Plant Product Quality and Utility (Preharvest)	0%		3%	
205	Plant Management Systems	0%		4%	
301	Reproductive Performance of Animals	10%		13%	
302	Nutrient Utilization in Animals	0%		21%	
304	Animal Genome	0%		13%	
305	Animal Physiological Processes	0%		21%	
307	Animal Management Systems	15%		4%	
308	Improved Animal Products (Before Harvest)	10%		0%	
311	Animal Diseases	5%		13%	
315	Animal Welfare/Well-Being and Protection	5%		0%	
601	Economics of Agricultural Production and Farm Management	20%		0%	
602	Business Management, Finance, and Taxation	15%		0%	
702	Requirements and Function of Nutrients and Other Food Components	0%		4%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	10%		0%	
806	Youth Development	10%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	35.0	0.0	21.0	0.0

Actual Paid	21.1	0.0	13.0	0.0
Actual Volunteer	26980.0	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**
1089777	0	900163	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1089777	0	900163	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension provides timely research-based education and assistance to producers to develop food production systems that enhance animal health, while increasing the production capacity, efficiency and nutritional value of food. In 2017, Extension colleagues identified economies and efficiencies of livestock production, animal health - biosecurity, and manure management as the top three animal agriculture programs. Research and Extension faculty projects have broad national and international applications, including technologies to improve fertility in livestock and management of a variety of globally important microorganisms. Research and professional education of such topics as dairy profitability, milk quality, livestock production systems (including grass-fed beef and pasture-raised poultry), animal care and well-being, farm safety, farm management, sustainable production and managing pastures for water quality continue to be just a few areas of focus.

In preparation for today's specialized careers in agriculture, youth must understand their many options for gaining experience and obtaining the education needed to attain their chosen career. Wisconsin Cooperative Extension 4-H Youth Development outreach staff coordinates the annual National 4-H Dairy Conference in collaboration with a national committee of dairy specialists, industry leaders, recent alumni youth, and 4-H dairy project volunteers. All youth delegates explore careers while attending seminars on the UW-Madison College of Agricultural and Life Sciences campus, sparking an interest in attending this or another college to pursue a specialized educational degree for a career in agriculture.

2. Brief description of the target audience

Integrated activity for our livestock and poultry capacity grant programs targets a broad group of stakeholder audiences in agriculture, natural resources, and the public. The audience includes: scientists, health professionals, animal nutritionists, livestock producers including producer associations, veterinarians, dairy herd management, dairy farmers and consumers. In 2017, Extension colleagues identified farmers/producers, agribusiness/agricultural service providers, and farm employees as the top three audiences for animal agriculture outreach. These audiences include rural farmers, women, youth, and Spanish-speaking farm workers.

3. How was eXtension used?

University of Wisconsin-Extension campus and county faculty and staff participate in various communities of practice, engaging with colleagues around the country to improve the educational content of research-based programs and assistance delivered to residents across the state and region. 289 Cooperative Extension colleagues have created accounts with eXtension. They are connected by email ListServ, blogs and online newsletters, and shared resources such as teleconferences and webinars, eXtension Communities of Practice, and the national Extension Disaster Education Network (EDEN) to quickly address critical and emerging issues such as responding to extreme weather. In 2017, two Cooperative Extension colleagues were trained by eXtension to be Designathon/Innovation facilitators and we prepared to host a Designathon event with eXtension in early 2018. We organized teams representing food systems, opioids, nutrition and educational technology to attend. Interdisciplinary colleagues and other professionals in this network include University of Wisconsin researchers on the Madison, Platteville, River Falls and Stevens Point campuses, working with 3 tribes, and at 12 agricultural research stations.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2632	0	24412	0

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	3	66	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension self-directed teams on the relevance, importance and impact of our research program. The output measures listed will also serve as outcome measures in that patents, graduate degrees and publications all include an element of critical review and assessment of uniqueness, originality, contribution to the science and knowledge base, or other performance criteria.

Year	Actual
2017	82

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Manage and minimize the loss due to animal disease.
2	Enhance the economic and environmental sustainability of agribusinesses.
3	Build the capacity of the agriculture service and support industry.
4	Innovations and increased efficiencies in production.

Outcome #1

1. Outcome Measures

Manage and minimize the loss due to animal disease.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Correlating Calf Health and Development to their Associated Microbial Communities While Differing Feeds

Wisconsin dairy calves are fed a calf starter to support health and growth during the transition from their mother's milk to the dry feeding period. Calf starter can be expensive, so many Wisconsin farmers are beginning to feed their calves corn silage, which is both cheap and easily produced on-site. It was unknown, however, how silage consumption by calves impacts their health and their milk production efficiency later in life.

What has been done
To study this issue, researchers from UW-Madison conducted a trial on three cohorts of calves: one fed calf starter, a second fed corn silage, and a third fed a 50:50 mix of the two feeds. Various health metrics, such as daily grain and feed intake, were assessed during development, and each cow's milk production efficiency was determined into their first lactation cycle. Simultaneously, samples were collected and sequenced to determine the microbiota-the population of microbes-in the rumen throughout calf development.

Results
Researchers determined that feed type did not impact calf development metrics measured nor milk production efficiency. They found that each cohort developed a rumen microbiota over time, but that those calves fed a diet containing corn silage acquired an adult-like rumen microbiota faster than those animals fed calf starter. The calf microbiota was fluid and dynamic, fluctuating widely during development before stabilizing during weaning.

Another key finding of the work was a window around weaning that researchers believe represents a transitionary period where the rumen microbiota could be altered. The adult rumen microbiota proved to be highly resilient and can resist whole-scale changes. Therefore, researchers believe that establishing a specific, optimized rumen microbiota in the dairy calf would lead to improvements in milk production efficiency that would last across lactation cycles. In the future, the researchers aim to further develop this approach and discover products to improve milk production efficiency by altering the rumen microbiota. Given the findings of the study, the researchers believe this work will have substantial economic impacts for farmers seeking to shift from calf starter to more cost-effective feeds like corn silage.

The study has provided training and professional development opportunities for a graduate student; this student has subsequently been published in three well-known journals.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

Outcome #2

1. Outcome Measures

Enhance the economic and environmental sustainability of agribusinesses.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Boosting dairy feed efficiency - Interdisciplinary collaboration

Throughout the top cheese-producing state, the average Wisconsin dairy cow contributes around $30,000 to local communities?but at what cost? With feed cost about half of total cost of producing milk, an integrated research and extension dairy science leader has devoted 3 decades collaborating with extension agronomy, nutrition and agricultural engineering colleagues to understand and improve feed efficiency (milk per unit of intake). Randy D. Shaver, professor and extension dairy nutritionist, holds a joint 75% extension and 25% research appointment at the University of Wisconsin-Madison "examining applied nutrition of lactating dairy cattle with emphasis on carbohydrates and forages" conducting and distilling innovative research results into practical, understandable recommendations for the forage, seed corn and dairy industries since 1988.

Tracing the arc of his public service career demonstrates the value of long-term local, state and federal investment in his research, extension and teaching by contributing to dairy production industries and the public thus fostering professionalism among dairy nutritionists and others worldwide. Students, educators, farm business professionals, dairy farmers, crop producers, their advisors and others better understand feed quality and efficiencies'feed provides more energy so dairy cows are healthier with better body condition for optimum reproduction' maintaining productivity, profitability and affordability of dairy products for consumers with less waste to the environment.

What has been done

Improving dairy guidelines and practices: As a scientific leader in the field of applied dairy cattle nutrition, Randy Shaver seeks to solve costly problems of the dairy production industry. He collaborates with interdisciplinary colleagues to provide timely research, education and assistance on feeding strategies, cropping, harvesting and processing systems, and feed storage management. This information is especially critical in times of high feed costs, low milk prices, low-quality forage harvests and extreme weather conditions such as drought. To optimize feed use by dairy cows' complex ruminant digestive systems, his Hatch and other research examines forage quality, factors affecting storage and use of grains and corn silage, generating major career contributions to Wisconsin's $43.4 billion dairy industry?to which farming and processing contribute 78,900 jobs (Deller 2014). Results shared through education and assistance locally, nationally and around the world include:

Balancing rations with proper phosphorous levels: Early on, Randy Shaver's interdisciplinary collaboration responded to the need for better balancing Total Mixed Rations (TMR). Dairy rations originally contained more phosphorous (P) than was necessary for herd health and milk production. Wisconsin research and extension results gave the National Research Council (NRC) confidence to lower P in feed, thus giving veterinarians and dairy nutritionists confidence to feed less P as a mineral supplement. Since the revised NRC Nutrition Requirements of Dairy Cattle reduced P in rations in 2001, extension soil scientists began tracking P levels from manure as well as monitoring total P levels in TMR rations. At the same time, extension put major effort into getting dairy farmers and their advisors information on proper levels of total dietary P in rations. As a result, dairy ration research by extension state specialists, county educators and the USDA Dairy Forage Research Center found P excretion by dairy cows decreased by 25-30%, land required for P application dropped by 0.6 acres per cow, and feed costs were cut by $10-$15 per cow per year' producing the same dairy cow performance while reducing P cost and harm to the environment (Peters et al. 2013).

Improving starch digestibility to enhance milk yield: Focusing ideas from three disciplines on the hard flinty corn kernel developed to withstand global shipping, Shaver's group demonstrated how

physical and chemical properties affect total starch digestibility in dairy cows. These factors include hybrid type, plant density, maturity at harvest, particle length, kernel hardness and processing, corn silage moisture content, bacterial protein flow, feed storage and management. For a complete account of interdisciplinary collaboration, see the full text of Randy Shaver's career highlights in the report Overview Executive Summary and his Four-State Applied Dairy Nutrition and Management Conference in the multistate module.

Results

Boosting dairy feed efficiency through interdisciplinary collaboration: As a Professional Animal Scientist Diplomate, Randy Shaver opens doors for improving feed efficiency, known among peers for his commitment to improving corn silage digestibility and encouraging adoption. The legacy of his interdisciplinary collaboration is a sea change from mainly higher cost alfalfa to transforming corn hybrid type, cropping, harvesting and processing systems, feeding strategies, bunker and pile silo storage and management practices and the rural landscape. Breakthrough research has led to global adoption of increasingly improved fermented forages including corn silage, earlage, Shaver's signature shredlage, and snaplage (described below). Application of Shaver's starch digestibility outreach has likely touched every dairy cow in the country through changes in dairy rations, impacting the entire U.S. dairy industry. He has presented hundreds of papers integrating his research with other published work yielding valuable technical information to the feed and dairy industries regionally, nationally, in 38 U.S. states and throughout the world including Argentina, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, England, Germany, Italy, Japan, Mexico and Turkey.

Interdisciplinary research and extension outreach flipped dairy feeding from mostly alfalfa to dramatically more lower-cost corn silage. While corn grain is 75% starch, corn silage at 30 to 35% starch is more digestible than dry corn, thus providing more energy to transition cows. Dairy cows in good condition breed back better. Improving starch digestion by dairy cows reduces the amount of supplemental corn grain in dairy cattle rations, reducing ration costs, and increasing milk production which lowers the cost of milk production and the cost of dairy products to consumers. Shaver estimates the cumulative effect of his combined interdisciplinary effort has increased milk yield on average 2 pounds more milk per cow per day. His many contributions to the U.S. and world feed industries have clearly advanced many facets of the forage and dairy industries. His innovative, highly integrated approaches have led to widespread improvements in dairy feed efficiencies and production, fostering collaboration, innovation, economic and workforce development, improving both farm management practices as well as scientific understanding of agriculture. For example:

Evaluating forage and feed grain value: Throughout his career, Shaver has been developing decision tools farmers and their advisors use to maximize returns to dairy feed. His earliest assays are still standard among commercial forage testing laboratories. Most recently, as a member of software development teams (University of Wisconsin MILK2006 Corn Silage, Feed Grain v2.0, and FeedVal v6.0), he has contributed to widely used and highly integrated platforms to evaluate and quantify the nutritional and economic values of forages and feed grains. Based on Wisconsin-fed NRC guidelines, the MILK2006 Excel spreadsheet estimates the energy content of corn silage, milk per acre, and a milk per ton quality index. This index has become a focal point for corn silage hybrid performance trials and hybrid breeding programs throughout academia and the seed-corn industry. Extension specialist in dairy farm management, Victor Cabrera has shared this suite of tools for the past decade. He reports the 3,000 FeedVal subscribers

can shop for and locate supplies of the most economical top-quality feed. Cabrera notes improved efficiencies also result in better quality, more affordable and nutritious dairy products for

consumers, and less nitrogen to the environment per unit of product. See updates on Shaver?s web site: https://shaverlab.dysci.wisc.edu/spreadsheets.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
304	Animal Genome
305	Animal Physiological Processes
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
702	Requirements and Function of Nutrients and Other Food Components
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
806	Youth Development

Outcome #3

1. Outcome Measures

Build the capacity of the agriculture service and support industry.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Innovations and increased efficiencies in production.

Not Reporting on this Outcome Measure

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

Brief Explanation

2017 was a time of transition for Cooperative Extension. As part of that transition, we experienced reduced numbers of employees and some losses of institutional knowledge. We are moving forward with the efficiency and effectiveness of our programs at the forefront. Continuing to meet our mission is possible largely because of consistent NIFA funding. In late 2017 and into 2018 we entered a significant hiring phase rebuilding our human capitol around program development and delivery.

• In the 2015-2017 Wisconsin State biennial budget, Cooperative Extension saw a reduction of $3.6 million per year in ongoing state funding. The portion of this reduction that impacted the county/tribal arm of Cooperative Extension was $1.2 million.

• Between January 1, 2017 and January 1, 2018, Cooperative Extension saw a total of 59 retirements and resignations of county-based educators.

• There were 34 resignations by county-based educators/coordinators.

• There were 25 retirements by county-based educators/coordinators.

• Cooperative Extension reorganized its 72 single-county administrative structure into 22 Areas overseen by 22 full-time Area Extension Directors. In June of 2017, regional/county based administration of cooperative extension educators was consolidated into these 22 Area Extension Director positions. These are full-time administrative positions that oversee county-based educators in groups of counties across the state. Twenty-two county based educators/coordinators transitioned into these fully administrative roles.

• A major change in federal policy or appropriation affecting the Capacity Grant program could affect CALS's ability to produce our desired outcomes. Training graduate students is a priority of our program. Since these funds do not allow tuition remissions, we continue to discuss alternatives to meeting our capacity grant mission, while continuing to train graduate students for the next generation of agricultural science.

A variety of factors could affect the outputs and outcomes of this planned program including those listed above. However, the breadth of the program ensures that there is still a sustainable base of work being done that can grow and evolve in 2018 and beyond.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Please refer to summaries under planned program activity and outcome number 1 and outcome number 2.

Key Items of Evaluation

In 2017, we started redesigning the Cooperative Extension Program Development and Evaluation unit, which will result in more evaluation being done on high priority planned programs and an increased ability for us to provide concise summaries here in the years to come. For now, please reference the Results section of the Qualitative Outcome or Impact Statement sections above.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Global Food Security and Hunger: Food Accessibility

☑ 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	5%		0%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		11%	
202	Plant Genetic Resources	0%		11%	
204	Plant Product Quality and Utility (Preharvest)	0%		11%	
205	Plant Management Systems	10%		11%	
601	Economics of Agricultural Production and Farm Management	5%		0%	
602	Business Management, Finance, and Taxation	15%		0%	
604	Marketing and Distribution Practices	10%		11%	
607	Consumer Economics	25%		0%	
608	Community Resource Planning and Development	15%		0%	
703	Nutrition Education and Behavior	15%		11%	
704	Nutrition and Hunger in the Population	0%		11%	
802	Human Development and Family Well-Being	0%		12%	
806	Youth Development	0%		11%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	12.0	0.0	0.0	0.0
Actual Paid	10.6	0.0	1.0	0.0
Actual Volunteer	1186.0	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**
491187	0	98948	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
491187	0	98948	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Cooperative Extension and WAES colleagues collaborate among campus, county and regional colleagues, partners and trained volunteers, providing research-based education and assistance to improve food security by strengthening local food markets and systems, responding to growing consumer demand for sustainably produced local foods, building community capacity to increase access to healthy foods for vulnerable populations, and increasing household access to healthy foods for those in need.

Related horticulture work includes community programs (such as Master Gardener Volunteer community garden programming) and commercial programs (such as building farmer market vendor capacity, as well as diagnostic services at both the consumer and commercial levels.

2. Brief description of the target audience

The audience includes farmers' market managers, vendors and customers, small-scale producers, producer associations, food processors and entrepreneurs, amateur gardeners, food coalitions and cooperatives, hunger coalitions and task forces, food pantries and other community service providers, local and regional economic development initiatives, local and tribal governments, school boards, school food service directors, teachers and parents of school-age children, low-income women with infants and young children, Hmong and Spanish-speaking participants, state and federal agency personnel, and others.

Horticultural audiences also included county and state Extension colleagues, Master Gardener volunteers, urban farmers, the incarcerated, Wisconsin public radio, Wisconsin Public Television , social media, youth, younger adults, the elderly, community garden users, special needs clientele, veterans, homeowners, beekeepers, homeowners, hospitals and health care providers.

3. How was eXtension used?

University of Wisconsin-Extension campus and county faculty and staff participate in various communities of practice, engaging with colleagues around the country to improve the educational content of research-based programs and assistance delivered to residents across the state and region. 289 Cooperative Extension colleagues have created accounts with eXtension. They are connected by email ListServ, blogs and online newsletters, and shared resources such as teleconferences and webinars, eXtension Communities of Practice, and the national Extension Disaster Education Network (EDEN) to quickly address critical and emerging issues such as responding to extreme weather. In 2017, two Cooperative

Extension colleagues were trained by eXtension to be Designathon/Innovation facilitators and we prepared to host a Designathon event with eXtension in early 2018. We organized teams representing food systems, opioids, nutrition and educational technology to attend. Interdisciplinary colleagues and other professionals in this network include University of Wisconsin researchers on the Madison, Platteville, River Falls and Stevens Point campuses, working with 3 tribes, and at 12 agricultural research stations.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2312	0	1473	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	2	5	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension self-directed teams on the relevance, importance and impact of our research program. The output measures listed will also serve as outcome measures in that patents, graduate degrees and publications all include an element of critical review and assessment of uniqueness, originality, contribution to the science and knowledge base, or other performance criteria.

Year	Actual
2017	6

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Strengthen local food markets and systems.
2	Increase household access to healthy foods for vulnerable populations
3	Build capacity to strengthen local food markets and systems.

Outcome #1

1. Outcome Measures

Strengthen local food markets and systems.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Strategies for Effectively Using Genetic Resources in Cultivar Development for Local Food Systems

Local food systems are growing, often in conjunction with the expansion of organic agriculture. One of the defining characteristics of local produce is quality-particularly flavor. Heirloom vegetable varieties are often used because of their superior flavor, and there may be other characteristics in older varieties that are useful for organic systems. Genetic resource collections attempt to collect some of these traits in databases, but they are not well characterized and are underutilized by the plant breeding community. Plant breeders who wish to develop cultivars for organic agriculture or who wish to incorporate complex traits like flavor into breeding programs would benefit from tools for identifying interesting acquisitions from genetic resource collections and tools for improving evaluation of complex traits such as flavor.

What has been done
Researchers from UW-Madison used a two-pronged approach to address the question of how to improve use of genetic resource collections. First, they used carrot as a model crop to develop methods of more effectively evaluating genetic resources collections. They developed a two-year field study with about 250 older, open-pollinated varieties of carrot to characterize the diversity available for breeders. They also used genetic markers to predict the performance of related lines in collections that have not been field tested in organic systems. In this way, they hope to identify varieties with traits that are important to local growers. They also worked with a group of Madison-area chefs to evaluate flavor of a wide range of varieties. Using tomato as a model, they tested different methods of rapid sensory evaluation during two field seasons.

Results
Around 250 carrot cultivars were evaluated for morphological and agronomic traits of interest to plant breeders at the West Madison Agricultural Research Station for two years, then scored for traits like germination, early vigor, top size and disease resistance. The researchers confirmed their expectations that there is a wide range of diversity in carrot that could be useful for organic systems but is currently not being used in breeding programs. Strategies for using the varieties will depend on the trait of interest, for example weed competition, disease resistance and flavor.

The study also provided education and outreach related to plant breeding and variety selection for chefs, consumers, community gardeners and direct-market farmers. A winter workshop was held for farmers, breeders and chefs each year of the project. This meeting was used to discuss results from the previous year and refine methodology for farmer and chef involvement. A field day related to this project was held at the West Madison Agricultural Research Station each summer. The field days presented information about plant breeding activities for different vegetable species related to flavor and organic agriculture. Attendees included farmers, gardeners, chefs and interested members of the public. Two publications about this work are in the final stages of preparation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
604	Marketing and Distribution Practices

Outcome #2

1. Outcome Measures

Increase household access to healthy foods for vulnerable populations

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Build capacity to strengthen local food markets and systems.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2549

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: The Seed to Kitchen Collaborative

Statewide University of Wisconsin research, extension and teaching are addressing emerging needs of farmers serving local food systems.
Organic and urban growers consistently ask for peer-to-peer training opportunities and collaborative research and demonstration projects that involve growers and other food system stakeholders from the beginning phases. Production systems of market farms differ widely in management and environmental constraints, making decentralized trials and farmer participation critical to the relevance of plant breeding programs described in this year's report. Participatory research and extension that facilitates farmer-to-farmer learning strengthen relationships with organic and urban growers, providing resources and assistance relevant to their scale and methods of production. For these reasons, participatory research and extension that facilitates farmer-to-farmer learning is the most relevant approach for community food systems stakeholders.

What has been done
Building participatory collaboration: Since 2013, University of Wisconsin integrated urban and regional food systems specialist Julie Dawson supports farmers serving local food systems. The Seed to Kitchen and apprenticeship programs described here and in the multistate module involve urban and peri-urban growers as participants, and address issues common to farms in urban and more rural areas.

Seed to Kitchen Collaborative: Collaboration among chefs, farmers and breeders presents a unique opportunity to focus on vegetable variety characteristics important to local food systems. These include flavor, fresh-market quality, and agronomic performance on smaller-scale diversified farms. Participatory on-farm trials are completely managed by growers who provide input during planning and priority-setting phases, conduct collaborative research on farms, engage in data collection and evaluation, and share results. Dawson?s group participated in public outreach events at the West Madison, Hancock and Spooner Agricultural Research Stations, Master Gardeners events, the Garden Expo and food related events with local non-profits.

Quality is a key reason chefs are involved. Chefs involved are clear that their priority is to keep farmers in business, so they are interested in varieties that perform well on farms in the Upper Midwest. While many rely on heirloom varieties for quality, they recognize that these may not always be the best for farmers to grow, and are helping identify highly productive varieties that also have the quality characteristics they need in the kitchen.

Results
Julie Dawson's group is building grower capacity for participatory on-farm research and extension projects, facilitating farmer-to-farmer learning. As these partnerships develop into joint research and extension programming, they expand to the Upper Midwest and beyond.

Serving underrepresented communities and harsher climates: In expanding participatory on-farm trials to areas of the state that may serve the Twin Cities, Duluth and Wausau markets, Julie Dawson partnered with extension educators Kevin Schoessow at the Spooner Agricultural Research Station and Jane Anklam in Superior. They support applied, on the ground research and maintain close connections to participating farmers in a climate zone farther north, reaching out to growers and building trusting relationships with sovereign tribal communities.

Beginning farmer resources ? registered apprenticeship program: Small-scale diversified farms are a primary point of entry for beginning farmers. While farming used to be learned side-by-side with relatives while growing up on a farm, it is becoming a career choice for aspiring farmers with no experience who must piece together their own training. This shift necessitates a new training model that fits with the steps taken to learn a skilled trade. Julie Dawson, with extension educator Claire Strader and the FairShare CSA Coalition Grower Education Committee are leading development of a registered apprenticeship program for diversified organic vegetable farmers. This farmer-to-farmer curriculum will be the first of its kind in the nation and they are working closely with others who would like to use this model to develop an apprenticeship program for their states. See Cotter, Natalie and Julie C. Dawson 2016. Urban Agricultural Manual: www.urbanagriculture.horticulture.wisc.edu

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
604	Marketing and Distribution Practices
608	Community Resource Planning and 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

Brief Explanation

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• There were 34 resignations by county-based educators/coordinators.

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A variety of factors could affect the outputs and outcomes of this planned program including those listed above. However, the breadth of the program ensures that there is still a sustainable base of work being done that can grow and evolve in 2018 and beyond.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Please refer to summary under outcome number 1 and outcome number 3.

Key Items of Evaluation

In 2017, we started redesigning the Cooperative Extension Program Development and Evaluation unit, which will result in more evaluation being done on high priority planned programs and an increased ability for us to provide concise summaries here in the years to come. For now, please reference the Results section of the Qualitative Outcome or Impact Statement sections above.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Climate Change and Energy Needs

☑ 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%		4%	
104	Protect Soil from Harmful Effects of Natural Elements	0%		4%	
123	Management and Sustainability of Forest Resources	0%		8%	
132	Weather and Climate	0%		4%	
133	Pollution Prevention and Mitigation	15%		12%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	5%		4%	
205	Plant Management Systems	10%		0%	
206	Basic Plant Biology	0%		8%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		4%	
302	Nutrient Utilization in Animals	0%		8%	
306	Environmental Stress in Animals	0%		4%	
307	Animal Management Systems	0%		4%	
401	Structures, Facilities, and General Purpose Farm Supplies	0%		4%	
403	Waste Disposal, Recycling, and Reuse	5%		8%	
511	New and Improved Non-Food Products and Processes	0%		8%	
601	Economics of Agricultural Production and Farm Management	10%		8%	
605	Natural Resource and Environmental Economics	20%		0%	
608	Community Resource Planning and Development	25%		0%	
609	Economic Theory and Methods	0%		4%	
610	Domestic Policy Analysis	0%		4%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	17.0	0.0	30.0	0.0
Actual Paid	8.3	0.0	13.0	0.0
Actual Volunteer	4803.0	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
433478	0	847338	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
433478	0	847338	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The WAES and Cooperative plan collaboration among campus, county faculty and staff, tribal, regional and national colleagues, partners and trained volunteers to provide timely, science-based education and assistance for climate change adaptation and mitigation. Efforts will focus on developing, implementing, and evaluating outreach programs to reduce carbon, nitrogen, and energy and water footprints in local communities. One ongoing research project looks to advance the use of aspen for bioenergy, wood and fiber production.

The UW-Extension Climate Change Task Force is made up of several educators and specialists with expertise including community development, natural resources, land use, energy, sustainability, placed-based & culturally-responsive environmental education, communication and evaluation. In 2017, the task force wrote a proposal asking for funds to train internal Extension colleagues to deliver appropriate and needed climate change programming across the state. This capacity building effort is the top priority for the task force in the near future, as determined by an internal cross=program area survey of colleagues followed by brainstorming and voting on options by the task force.

2. Brief description of the target audience

Integrated activity for our capacity grant programs targets a broad group of stakeholder audiences in agricultural, natural resources, and the public. The audience includes colleagues and other professionals, growers and grower associations, certified crop advisors, agricultural service providers, coalitions and cooperatives, community leaders, business owners, local elected officials, town, city, county and tribal governments, state and federal agencies, local planning departments and regional planning commissions, utilities, school districts, economic development practitioners, the news media, and families.

The interdisciplinary WCE BioEnergy and the BioEconomy Team is addressing statewide emerging bioenergy education needs. Farmers and foresters are interested in supplying feedstocks to the bioenergy industry as a potential alternative market and source of revenue. Communities are interested in developing renewable energy industries for energy independence, job creation, and economic development. At the onset of the bioenergy industry, policy makers, as well as entrepreneurial businesses, encouraged the rapid development of new energy sources using biomass as a renewable feedstock.

3. How was eXtension used?

University of Wisconsin-Extension campus and county faculty and staff participate in various communities of practice, engaging with colleagues around the country to improve the educational content of research-based programs and assistance delivered to residents across the state and region. 289 Cooperative Extension colleagues have created accounts with eXtension. They are connected by email ListServ, blogs and online newsletters, and shared resources such as teleconferences and webinars, eXtension Communities of Practice, and the national Extension Disaster Education Network (EDEN) to quickly address critical and emerging issues such as responding to extreme weather. In 2017, two Cooperative Extension colleagues were trained by eXtension to be Designathon/Innovation facilitators and we prepared to host a Designathon event with eXtension in early 2018. We organized teams representing food systems, opioids, nutrition and educational technology to attend. Interdisciplinary colleagues and other professionals in this network include University of Wisconsin researchers on the Madison, Platteville, River Falls and Stevens Point campuses, working with 3 tribes, and at 12 agricultural research stations.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2030	0	4070	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	5	40	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension self-directed teams on the relevance, importance and impact of our research program. The output measures listed will also serve as outcome measures in that patents, graduate degrees and publications all include an element of critical review and assessment of uniqueness, originality, contribution to the science and knowledge base, or other performance criteria.

Year	Actual
2017	56

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Work to reduce atmospheric greenhouse gas emissions.
2	Develop biomass use for biofuels
3	Build capacity to create, refine and implement scalable conversion technologies
4	Increase the capacity of collaboratives to address complex water and climate priorities

Outcome #1

1. Outcome Measures

Work to reduce atmospheric greenhouse gas emissions.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Emissions Trading and Hotspots in Wisconsin

Emissions trading programs (or "cap-and-trade") mandate that individual polluters must have a permit for each ton of emissions, and regulated firms can trade the permits. These policies lead to a more economically efficient reduction in total emissions, but they also result in an uneven distribution of pollution reductions over space. A major concern, then, is that the programs could disproportionately harm poor communities.

What has been done
Researchers at UW-Madison wanted to empirically test the claim that poorer areas are harmed by cap-and-trade policies. Previous studies have assumed that the harm from pollution is distributed evenly in the area surrounding the polluting facility. In this study, however, researchers determined the treatment area for each polluter using a particle dispersion model to simulate the distribution of pollution from each source under regulation.

Originally, the research was intended to test whether cap-and-trade programs differentially affect rural and urban areas in Wisconsin, but in the absence of any meaningful local policy, researchers studied the impact of real-world policies in other parts of the country. Data from RECLAIM, a NOx emission trading program in the Los Angeles area, were used in the analysis. Researchers found that there were distributional consequences of emissions trading, which previous literature had not identified. The pollution reduction induced by emissions trading in the case of RECLAIM was correlated with income.

Results
Results of this study show that poorer areas of the Los Angeles area (either defined by median income or the poverty rate) saw a significantly smaller reduction in pollution than would have occurred under a command-and-control regulation-that which directly legislates how much pollution those in the industry can produce. These distributional consequences of emissions trading had not been identified by previous literature. Going forward, researchers aim to study cap-and-trade regulation in the Regional Greenhouse Gas Initiative (RGGI) in the Northeast. These studies will include a rural-urban component and will focus on the distribution of co-pollutants.

Beyond the research findings, this study also challenged the way that social scientists have thought about pollution dispersion in empirical work. Corbett Grainger was contacted by researchers and students at several universities who are interested in incorporating dispersion models into their work. The project also provided graduate student support that led to econometric training, simulation training, and experience writing and going through the publication process.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Develop biomass use for biofuels

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Build capacity to create, refine and implement scalable conversion technologies

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Increase the capacity of collaboratives to address complex water and climate priorities

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	48

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Building Collaboration between State Land Grant Universities and Tribal Colleges and Universities in the North Central Region

With 20 Tribal Land-grant colleges and universities (TCUs) across the North Central Region, there are ample opportunities for collaboration among TCUs and state land-grant universities on water-related issues.

Collaboration is essential on complex issues like water resource management, especially in the context of climate change. A recent First Americans Land-Grant College Organization and Network (FALCON) member survey showed there is a strong interest among these institutions to work on water-related projects. While there are ample opportunities for partnership, past collaboration between state land-grants and TCUs has been limited and highly localized.

What has been done
In May 2017, a team from state land-grants, tribal land-grants, and partners including the First Americans Land-grant Consortium (FALCON) hosted the Tribal Water Summit at Haskell Indian Nations University to bridge communication and connections between diverse institutions. Six different tribal institutions, a number of state universities, and partner organizations attended and combined their perspectives to identify priority issues surrounding overlapping water issues, share past collaboration successes and challenges, and determine future funding and collaboration opportunities.

Climate change was an important topic in the conversation especially as it relates to watershed management and food security. Several participants in this initiative are from Wisconsin, benefitting UWEX and TCU collaboration in the state as well as sharing ideas from other states and TCUs with Wisconsin.

Results
As a result of the group planning activities and the summit itself, 91% of respondents to an end-of project survey felt "somewhat well positioned" or "very well positioned" to apply for additional funding for research and outreach around water issues; 78% increased their understanding of examples of successful collaborations between tribal colleges and other land-grant universities to "a large or medium extent"; and 88% would be "likely or very likely? to attend a similar event

again.

All respondents reported that they increased their understanding of future opportunities for collaboration. In addition, the event increased awareness of out-of-state experts who could be consulted on water-related issues and increased understanding of various water-focused research and outreach happening across the region at TCUs and state land-grants.

The team is now hard at work building on the opportunities discussed at the summit, developing a working group of diverse stakeholders and building action plans for the identified priorities

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

2017 was a time of transition for Cooperative Extension. As part of that transition, we experienced reduced numbers of employees and some losses of institutional knowledge. We are moving forward with the efficiency and effectiveness of our programs at the forefront. Continuing to meet our mission is possible largely because of consistent NIFA funding. In late 2017 and into 2018 we entered a significant hiring phase rebuilding our human capitol around program development and delivery.

• In the 2015-2017 Wisconsin State biennial budget, Cooperative Extension saw a reduction of $3.6 million per year in ongoing state funding. The portion of this reduction that impacted the county/tribal arm of Cooperative Extension was $1.2 million.

• Between January 1, 2017 and January 1, 2018, Cooperative Extension saw a total of 59 retirements and resignations of county-based educators.

• There were 34 resignations by county-based educators/coordinators.

• There were 25 retirements by county-based educators/coordinators.

- Cooperative Extension reorganized its 72 single-county administrative structure into 22 Areas overseen by 22 full-time Area Extension Directors. In June of 2017, regional/county based administration of cooperative extension educators was consolidated into these 22 Area Extension Director positions. These are full-time administrative positions that oversee county-based educators in groups of counties across the state. Twenty-two county based educators/coordinators transitioned into these fully administrative roles.

- A major change in federal policy or appropriation affecting the Capacity Grant program could affect CALS's ability to produce our desired outcomes. Training graduate students is a priority of our program. Since these funds do not allow tuition remissions, we continue to discuss alternatives to meeting our capacity grant mission, while continuing to train graduate students for the next generation of agricultural science.

A variety of factors could affect the outputs and outcomes of this planned program including those listed above. However, the breadth of the program ensures that there is still a sustainable base of work being done that can grow and evolve in 2018 and beyond.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Please refer to summary under outcome number 1 and outcome number 4.

Key Items of Evaluation

In 2017, we started redesigning the Cooperative Extension Program Development and Evaluation unit, which will result in more evaluation being done on high priority planned programs and an increased ability for us to provide concise summaries here in the years to come. For now, please reference the Results section of the Qualitative Outcome or Impact Statement sections above.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Sustainable Use of Natural Resources

☑ 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	0%		5%	
102	Soil, Plant, Water, Nutrient Relationships	0%		12%	
103	Management of Saline and Sodic Soils and Salinity	0%		3%	
111	Conservation and Efficient Use of Water	0%		5%	
112	Watershed Protection and Management	0%		8%	
123	Management and Sustainability of Forest Resources	0%		5%	
131	Alternative Uses of Land	0%		3%	
132	Weather and Climate	0%		8%	
133	Pollution Prevention and Mitigation	0%		8%	
135	Aquatic and Terrestrial Wildlife	0%		8%	
136	Conservation of Biological Diversity	0%		8%	
141	Air Resource Protection and Management	0%		3%	
213	Weeds Affecting Plants	0%		5%	
216	Integrated Pest Management Systems	0%		3%	
301	Reproductive Performance of Animals	0%		3%	
307	Animal Management Systems	0%		3%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	0%		5%	
723	Hazards to Human Health and Safety	0%		5%	
806	Youth Development	60%		0%	
903	Communication, Education, and Information Delivery	40%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	2.0	0.0	22.0	0.0
Actual Paid	10.0	0.0	12.0	0.0
Actual Volunteer	1656.0	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**
464990	0	872554	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
464990	0	872554	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The WAES encourages research to benefit forest production, weed management, surface water quality, and promoting new farm-based practices. An ongoing research project looks to provide input on nutrient recovery to reduce the environmental impacts on agricultural production and wastewater treatment.

Extension primarily does its natural resources work via the Environmental Resources Center (erc.cals.wisc.edu) and a number of campus-based integrated specialists (e.g. UW-Stevens Point Center for Land Use Education, Center for Watershed Science and Education, and UW-Extension Lakes). Outreach and applied research programs span citizen monitoring (e.g. Water Action Volunteers - volunteer stream monitoring), agricultural stewardship (e.g. Conservation Professional Training Program), sustainable forestry (e.g. Natural Resource Education Program), water resource management (e.g. North Central Region Water Network), community and climate resilience (e.g. G-WOW "Guiding for Tomorrow" approach - g-wow.org), drinking and groundwater management, lakeshore management, and wildlife management.

Extension land, forestry and water programming features a) applied research and b) citizen engagement for positive behavior change. Facilitating sustainable management decisions is key for land and forestry programs. Extension water programs utilize multidisciplinary problem-solving approaches to address complex water resource challenges at multiple scales. Upham Woods Outdoor Learning Center builds curriculum continuity between onsite programming and programming at partner organizations, conducts offsite programming and engages with community partners to reach new audiences, and provides informal science education.

2. Brief description of the target audience

Rural and private landowners are a major target audience for forestry, land and water Extension programs. Other audiences include resource professionals, industry and commercial entities, local governments,

agricultural producers, lake & watershed associations, college students, and the general public including diverse ethnicities.
At the onset of the bioenergy industry, policy makers, as well as entrepreneurial businesses, encouraged the rapid development of new energy sources using biomass as a renewable feedstock. Farmers and foresters are interested in improving land, farming and supplying feedstocks to the bioenergy industry as a potential alternative market and source of revenue. Communities are interested in developing renewable energy industries for energy independence, job creation, and economic development.

3. How was eXtension used?

University of Wisconsin-Extension campus and county faculty and staff participate in various communities of practice, engaging with colleagues around the country to improve the educational content of research-based programs and assistance delivered to residents across the state and region. 289 Cooperative Extension colleagues have created accounts with eXtension. They are connected by email ListServ, blogs and online newsletters, and shared resources such as teleconferences and webinars, eXtension Communities of Practice, and the national Extension Disaster Education Network (EDEN) to quickly address critical and emerging issues such as responding to extreme weather. In 2017, two Cooperative Extension colleagues were trained by eXtension to be Designathon/Innovation facilitators and we prepared to host a Designathon event with eXtension in early 2018. We organized teams representing food systems, opioids, nutrition and educational technology to attend. Interdisciplinary colleagues and other professionals in this network include University of Wisconsin researchers on the Madison, Platteville, River Falls and Stevens Point campuses, working with 3 tribes, and at 12 agricultural research stations.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3640	0	1628	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	2	25	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension self-directed teams on the relevance, importance and impact of our research program. The output measures listed will also serve as outcome measures in that patents, graduate degrees and publications all include an element of critical review and assessment of uniqueness, originality, contribution to the science and knowledge base, or other performance criteria.

Year	Actual
2017	40

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Build capacity to create, refine and implement scalable conversion technologies
2	Improve and encourage the use of and growth in the ThinkWater curricula
3	Implement and improve forest production, weed management, water quality, and promote new farming practices.

Outcome #1

1. Outcome Measures

Build capacity to create, refine and implement scalable conversion technologies

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Improve and encourage the use of and growth in the ThinkWater curricula

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	200

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Systems Thinking in Program Development and Evaluation: ThinkWater and Its Application within Extension

"Wicked" problems and everyday problems result from the mismatch between how real-world systems work and we think they work (Cabrera & Cabrera 2016). Systems thinking provides the structure and tools that are key to enhancing our thinking and build shared knowledge around complex issues. The systems thinking framework developed by Cabrera and Cabrera (2016) and utilized by ThinkWater, a national initiative funded by USDA-NIFA, identifies four underlying patterns of thinking. These patterns are making distinctions (D), identifying parts and wholes of systems (S), identifying relationships (R), and taking perspectives (P). DSRP provides the foundation for teaching thinking, enhancing our own thinking, improving education and outreach, more deeply understanding complex issues, and building shared knowledge of any topic or issue.

In Wisconsin, water research, education and Extension efforts do not always yield their desired outcomes. In part, this is because water issues are often complex and interconnected, and the ways we tend to design, deliver and evaluate our efforts do not address that complexity.

What has been done
ThinkWater employed several core strategies nationally to achieve its goals:

1. Develop a committed minority of water researchers, educators and Extension professionals prepared and committed to lead systems thinking in their state

2. Develop an evidence-based case for the value and impact of systems thinking applied to water work

3. Create a self-sustaining, accessible suite of technologies and resources to support water research, education and Extension and to scale capacity nationally

A sub-strategy relating to all of these was to implement a focused demonstration in one state for the purposes of enhancing water education and outreach outcomes in that state, and serving as a pilot, model and innovation space for other states. In 2017, we implemented two initiatives: The Wisconsin WaterThinkers Network (WWTN) and The Wisconsin ThinkWater School. Within these efforts, we cultivated the committed minority, built an evidence-based case, created and shared resources and lessons, and used Wisconsin as a demonstration for expansion nationally.

Wisconsin ThinkWater School taught systems thinking to water/natural resource educators, all of whom are either using it to design, deliver and evaluate their programs, and/or teaching systems thinking to other natural resource educators. Wisconsin ThinkWater School participants receive in-depth instruction in systems thinking, support in collaborative planning, feedback on program plans, and systems evaluation support. This was accomplished through the Systems Thinking Made Simple online course, in-person and virtual meetings, and consultation. The School included participants from organizations such as UW-Extension, UW-Campuses, DNR, other state or municipal agencies, non-profit organizations, and the private sector. The six Wisconsin ThinkWater School teams and their programs are:

- Milwaukee Water Commons Team - enhancing Milwaukee Water School, a community education program focused on building community water leadership

- Waukesha County Team - working on youth water education, and water-focused outreach to farmers

- Green Bay Team - planning a community engagement program focusing on water quality in Lake Michigan's Green Bay

- Pepin County Team - developing an interdepartmental effort to address groundwater quality issues in the county

- Lakes Team - developing an innovative model for watershed-level planning to address surface water quality issues through building community capacity

- City of Superior Team - creating a stream monitoring program to build awareness and generate action to protect urban streams

The WWTN was developed using a systems thinking organizational model (see this infographic) and shares that model with others to improve organizational effectiveness.

The WWTN hosts an annual in-person gathering and regional gatherings organized by WWTN

members in that region to build relationship and share effective strategies and resources. The WWTN hosts a monthly virtual community of practice session to build the capacity and share resources to increase integration of systems thinking in community engagement around water issues.

News articles and blogs related to this work:

https://www.wiscontext.org/wicked-problems-arise-when-people-misunderstand-water-issues
https://www.wisconsinacademy.org/blog/waters-wisconsin/water-education-cultivating-water-thinking

Results
In 2017, 200 individuals were engaged through the Wisconsin Water Thinkers Network and six Wisconsin ThinkWater School teams (20 people). Water School Teams have applied systems thinking to community-based water education, as well as formal K-16 classrooms. We are currently completing the year 3 (2016-17) evaluation, but early analysis suggests:

1. Increased ability of participants to systems think (metacognition)

2. Increased capacity to apply systems thinking to program development, including ability to understand and de/construct complex issues, frame interdisciplinary responses

3. Improved learning outcomes for their learners/audiences

4. Improved engagement from key stakeholders in programming and application of results

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
103	Management of Saline and Sodic Soils and Salinity
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
301	Reproductive Performance of Animals
723	Hazards to Human Health and Safety
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Implement and improve forest production, weed management, water quality, and promote new farming practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	183

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Woodland Owners Outreach Programming

Leading the nation in paper production and wood furniture manufacturing, Wisconsin's $24.7 billion forest products industry provides 64,000 jobs, and employee compensation adds another $6.4 billion to local economies. (http://dnr.wi.gov/topic/forestbusinesses/factsheets.html)

Many communities depend on a sustainable forest products industry. But who is managing this valuable forest resource, and how? As harvesting from industry-owned land decreased, to ensure a continuous timber supply the Wisconsin Department of Natural Resources (DNR) looked to private woodland owners who own nearly 70% of the 17 million acres of forested land. In 2013, the Legislature funded the Wisconsin Council on Forestry's Wisconsin Forest Practices Study (WFPS) to address knowledge gaps at the interface of forest policy and practice. Strong partnerships formed among the DNR, University of Wisconsin Cooperative Extension, neighboring Land Grant universities, federal, state, local, regional and tribal agencies, industry professionals, foresters, loggers and others who identified and are now implementing final study recommendations.

Traditionally, only a small percentage of woodland owners participate in learning events, and only about 25% have Managed Forest Law (MFL) plans covering 3,576,589 acres. Of these, 16% received forestry advice from Cooperative Extension. To further promote sustainable management by the state's 414,000 non-industrial private forest landowners, Cooperative Extension is aiming to identify and reach those who are seeking technical assistance. This assistance will help landowners manage their woodlands by adopting MFL plans, which will

encourage continued forest management by the next generation of landowners. There is a great need for this assistance, as more than 6 million acres of family-owned forests are yet to be covered by MFL plans (DNR 2013). An increase in acres enrolled in the Managed Forest Law program ensures a continuous supply of timber from private lands for the next 25 to 50 years. This work also fits with NIFA's Renewable Resources Extension Act (RREA) priorities.

What has been done

Learn About Your Land Woodland Owner Outreach: Area natural resource educators conducted 14 'Learn About Your Land' classes for woodland owners in four locations around the state. Class topics address landowner interests as well as the importance of actively engaging with one's woodland. Examples include wildlife habitat, forest health, assistance, and timber sales logistics. Additional support for 'Learn About Your Land' attendees includes monthly blog posts, bi-weekly Facebook posts, and a quarterly e-newsletter reaching 355 owners, providing landowner resources to make informed decisions for their woodland. These resources include relationships with professionals, access to publications and other credible, professional information sources, plus cost-share funding for management activities. Previous long-term surveys indicate that about 11% of attendees will have a new management plan within 2 years. Use of a forester was about 28% (consulting forester) to 42% (DNR forester).

2017 Wisconsin Woodland Owners Association Conference: Natural resource educators reports that 78 attendees learned about new statewide landowner issues, woodland insects and diseases, and DNR Forestry realignment plans. Participants discussed with local experts hardwood markets, control of invasive species, woodland vegetative management to enhance bird populations, how to prepare for woodland ownership succession to family members, adaptive woodland management activities to prepare for a changing climate, and water quality issues.

Driftless Forest Network: Since 2011, the Driftless Forest Network (DFN) in Southwest Wisconsin has conducted targeted social marketing campaigns to engage woodland owners to participate in conservation conversations with local professional conservation staff. In these campaigns, DFN has been very successful in establishing a campaign response rate of 5% to 7%. The response rate not using a targeted message is usually 1% to 3%. As a result of the DFN pilot, WI DNR decided to test their ability to replicate the response rate with their own campaigns in four other counties throughout Wisconsin. Four counties, Juneau, Langlade, Washburn and Waushara, were identified to experiment with targeted social marketing to engage woodland owners. DNR Foresters within these counties assisted in the technical service to woodland owners who responded to a written mailed invitation. This pilot project was successful in replicating the same DFN response rates with their campaigns (5% to 7%).

Extension state specialists supports area educators' outreach, promoting sustainable forestry practices among private woodland owners by teaching foresters how to communicate more effectively with their clients. Read more on the 'Helping You Promote Sustainable Forestry' website: http://forestryinsights.org

Results

Sustaining forestry resources: As a direct result of Cooperative Extension engagement, the Wisconsin Forest Practices Study (WFPS) generated new knowledge about the forestry sector and challenges faced in the economics of sustainable forestry. A small team representing forest industry, university extension faculty, other university and non-profit staff, and woodland owners prioritized 13 recommendations from the WFPS in three areas:

- Outreach programs to let landowners know the value of forest management to achieve wildlife, hunting, and forest health objectives.
- Continue and expand statewide public training, cooperating and consultant foresters on forestry economic issues.
- Improve forester training, especially related to tree quality assessment, order of retention, and northern hardwood management principles.

Of the 105 individuals representing 2,161 acres of woodlands attending the 2017 Learn About Your Land classes, 76% took on activities related to class topics such as removing invasive species or improving wildlife habitat, 5% submitted an MFL application, and 21% outlined activities for the next 2+ years. MFL is a landowner incentive program that encourages sustainable forestry on private woodlands in Wisconsin. Sustainable forest management benefits Wisconsin's economy, hunting, fishing, wildlife, recreation, soils, waterways, and air quality, and renews beautiful forests for everyone to enjoy. Since 2007, classes have been held in 141 locations reaching 4,906 households and over 325,000 acres of woodland. See supportive resources and events at, http://woodlandinfo.org.

The Wisconsin Council on Forestry will continue to monitor implementation over the next few years. Ultimately, implementation will result in greater alignment in expectations for forest management activities that allow greater flexibility for foresters and loggers to achieve sustainable forestry outcomes, increased recognition of economics in forestry decisions, and greater engagement of forest landowners toward active forestry.

Additionally, as a result of the Driftless Forest Network pilot, the American Forest Foundation has partnered with Cooperative Extension to establish another landscape level outreach effort in the Lake Superior Basin. First established in 2017, this work will continue into 2018, with Natural Resources Educators coordinating outreach efforts to woodland owners in a similar fashion.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
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112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
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133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
301	Reproductive Performance of Animals
723	Hazards to Human Health and Safety
806	Youth Development
903	Communication, Education, and Information Delivery

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

Brief Explanation

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• Between January 1, 2017 and January 1, 2018, Cooperative Extension saw a total of 59 retirements and resignations of county-based educators.

• There were 34 resignations by county-based educators/coordinators.

• There were 25 retirements by county-based educators/coordinators.

• Cooperative Extension reorganized its 72 single-county administrative structure into 22 Areas overseen by 22 full-time Area Extension Directors. In June of 2017, regional/county based administration of cooperative extension educators was consolidated into these 22 Area Extension Director positions. These are full-time administrative positions that oversee county-based educators in groups of counties across the state. Twenty-two county based educators/coordinators transitioned into these fully administrative roles.

• A major change in federal policy or appropriation affecting the Capacity Grant program could affect CALS's ability to produce our desired outcomes. Training graduate students is a priority of our program. Since these funds do not allow tuition remissions, we continue to discuss alternatives to meeting our capacity grant mission, while continuing to train graduate students for the next generation of agricultural science.

A variety of factors could affect the outputs and outcomes of this planned program including those listed above. However, the breadth of the program ensures that there is still a sustainable base of work being done that can grow and evolve in 2018 and beyond.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Please refer to summary under outcome number 2 and outcome number 3.

Key Items of Evaluation

In 2017, we started redesigning the Cooperative Extension Program Development and Evaluation unit, which will result in more evaluation being done on high priority planned programs and an increased ability for us to provide concise summaries here in the years to come. For now, please reference the Results section of the Qualitative Outcome or Impact Statement sections above.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Nutrition

☑ 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	0%		5%	
206	Basic Plant Biology	0%		5%	
302	Nutrient Utilization in Animals	0%		17%	
305	Animal Physiological Processes	0%		5%	
311	Animal Diseases	0%		5%	
501	New and Improved Food Processing Technologies	0%		5%	
502	New and Improved Food Products	0%		9%	
607	Consumer Economics	0%		5%	
701	Nutrient Composition of Food	0%		5%	
702	Requirements and Function of Nutrients and Other Food Components	0%		25%	
703	Nutrition Education and Behavior	75%		5%	
704	Nutrition and Hunger in the Population	10%		0%	
724	Healthy Lifestyle	15%		9%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	2.0	0.0	7.0	0.0
Actual Paid	2.8	0.0	9.0	0.0
Actual Volunteer	3195.0	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**
129123	0	690159	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
129123	0	690159	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Faculty in CALS and specialists in Extension have assessed the causes and consequences of childhood obesity and poor nutrition for families based on Nutritional Sciences, Bacteriology, Biochemistry, Food Science and Genetics aspects. Educational projects this year include introducing and emphasizing the importance of nutrition for children, promoting healthful eating campaigns, dietary markers of human health and nutrition, general obesity prevention and research on nutritional perspectives of diabetes.

2. Brief description of the target audience

The targeted audience for research and extension includes children and youth, caregivers, parents and family members, local and tribal officials, public and private collaborating and community agencies, public services providers, child care providers, educators, school districts, administrators, tribal, state and federal agencies and others in diverse educational settings to reach under-represented population including low-income individuals, Latino/a, African American, American Indian and Hmong community members, translating and interpreting as needed.

3. How was eXtension used?

University of Wisconsin-Extension campus and county faculty and staff participate in various communities of practice, engaging with colleagues around the country to improve the educational content of research-based programs and assistance delivered to residents across the state and region. 289 Cooperative Extension colleagues have created accounts with eXtension. They are connected by email ListServ, blogs and online newsletters, and shared resources such as teleconferences and webinars, eXtension Communities of Practice, and the national Extension Disaster Education Network (EDEN) to quickly address critical and emerging issues such as responding to extreme weather. In 2017, two Cooperative Extension colleagues were trained by eXtension to be Designathon/Innovation facilitators and we prepared to host a Designathon event with eXtension in early 2018. We organized teams representing food systems, opioids, nutrition and educational technology to attend. Interdisciplinary colleagues and other professionals in this network include University of Wisconsin researchers on the Madison, Platteville, River Falls and Stevens Point campuses, working with 3 tribes, and at 12 agricultural research stations.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	12	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension self-directed teams on the relevance, importance and impact of our research program. The output measures listed will also serve as outcome measures in that patents, graduate degrees and publications all include an element of critical review and assessment of uniqueness, originality, contribution to the science and knowledge base, or other performance criteria.

Year	Actual
2017	23

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Develop and implement behavioral interventions that improve nutrition and increase physical activity
2	Build capacity among community partners and schools to address issues related to nutrition and childhood obesity
3	Complete nutrition research implication for policy development (e.g. labeling and policy)

Outcome #1

1. Outcome Measures

Develop and implement behavioral interventions that improve nutrition and increase physical activity

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Build capacity among community partners and schools to address issues related to nutrition and childhood obesity

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Complete nutrition research implication for policy development (e.g. labeling and policy)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Trans-Vaccenate: An anti-inflammatory in dairy fat

Chronic inflammation is linked to conditions such as rheumatoid arthritis, inflammatory bowel diseases, cardiovascular diseases, cancer, psoriasis, Alzheimer's disease, diabetes and obesity. This malfunction of the human immune system affects the health and quality of life of millions of Americans. Strategies to reduce inflammation are continually sought by researchers and clinicians, and new studies of trans fats in food are providing promising results. While the general

public has become wary of manufactured trans fats in the foods they consume, research has shown that some natural fats, such as one called CLA (conjugated linoleic acid) found primarily in dairy fat, may have health benefits including reducing the severity of arthritis in mice.

What has been done

Researchers at UW-Madison are using mice to learn how diets higher in specific natural trans fats could prevent or reduce inflammation. Their study focused on TVA (trans vaccenic acid, a natural trans fat in dairy fat that is metabolized into CLA) to determine if it is also anti-inflammatory. Mice were fed diets containing purified TVA or butter from cows whose diets included additional grasses to maximize potential CLA and TVA levels (produced in partnership with the Department of Dairy Science).

Scientists found that the severity of inflammation in mice decreased when fed diets with TVA, either purified or from butter. Additional findings suggest that TVA could also prevent inflammation before it occurs. Researchers calculated minimum effective doses of TVA and translated it to human dairy consumption. If maximally enriched for TVA and CLA, a fourth-cup of cheese, one tablespoon of butter, and one cup of whole milk all consumed on a daily basis would meet the minimum effective dose for the average human. While this consumption level is similar to current Dietary Guidelines for Americans, researchers hope to test lower doses of TVA and CLA to determine if consumption required for health benefits could further be reduced.

Results

The Food and Drug Administration requires foods containing trans fats to label for it without any specification of type. This incentivizes reduction of all trans fats in foods. With additional research that continues this line of study, CLA and TVA could be determined to be beneficial to human health. This knowledge could raise consumer demand for CLA- and TVA-rich dairy products and more detailed food labels. Dairy producers may then have incentive to enrich their products for these potentially beneficial fats.

Three papers have been published about these findings, and more are in process. The work of two graduate students was supported through this grant. Researchers presented this work in posters and oral presentations at successive American Oil Chemists' Society conferences, and in a webinar.

4. Associated Knowledge Areas

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

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

Brief Explanation

2017 was a time of transition for Cooperative Extension. As part of that transition, we experienced reduced numbers of employees and some losses of institutional knowledge. We are moving forward with the efficiency and effectiveness of our programs at the forefront. Continuing to meet our mission is possible largely because of consistent NIFA funding. In late 2017 and into 2018 we entered a significant hiring phase rebuilding our human capitol around program development and delivery.

• In the 2015-2017 Wisconsin State biennial budget, Cooperative Extension saw a reduction of $3.6 million per year in ongoing state funding. The portion of this reduction that impacted the county/tribal arm of Cooperative Extension was $1.2 million.

• Between January 1, 2017 and January 1, 2018, Cooperative Extension saw a total of 59 retirements and resignations of county-based educators.

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• A major change in federal policy or appropriation affecting the Capacity Grant program could affect CALS's ability to produce our desired outcomes. Training graduate students is a priority of our program. Since these funds do not allow tuition remissions, we continue to discuss alternatives to meeting our capacity grant mission, while continuing to train graduate students for the next generation of agricultural science.

A variety of factors could affect the outputs and outcomes of this planned program including those listed above. However, the breadth of the program ensures that there is still a sustainable base of work being done that can grow and evolve in 2018 and beyond.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Please refer to summaries under outcome number 3.

Key Items of Evaluation

In 2017, we started redesigning the Cooperative Extension Program Development and Evaluation unit, which will result in more evaluation being done on high priority planned programs and an increased ability for us to provide concise summaries here in the years to come. For now, please reference the Results section of the Qualitative Outcome or Impact Statement sections above.

V(A). Planned Program (Summary)

Program # 7

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
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		4%	
212	Pathogens and Nematodes Affecting Plants	0%		4%	
311	Animal Diseases	0%		11%	
501	New and Improved Food Processing Technologies	0%		4%	
502	New and Improved Food Products	0%		11%	
701	Nutrient Composition of Food	0%		4%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	50%		0%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	50%		44%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%		7%	
723	Hazards to Human Health and Safety	0%		11%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	3.0	0.0	17.0	0.0
Actual Paid	6.3	0.0	13.0	0.0
Actual Volunteer	7817.0	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**
328592	0	803837	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
328592	0	803837	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The collaboration between the University of Wisconsin and UW-Extension has focused on developing and evaluating the improved technologies in food processing and several on-farm food safety practices. Faculty and staff, partners and trained volunteers are also involved in providing research based education and support to improve the safety of the food supply by helping youth and adult agricultural producers, meat, dairy and acidified canned food processors and entrepreneurs adopt best practices. Research has been done in several important aspects of food safety, including food toxins and their causal organisms, development of thermal food preservation technologies, residual pesticides in foods and several other areas.

The WAES and Wisconsin Cooperative Extension (WCE) plan collaboration among interdisciplinary campus and county faculty and staff, colleagues, partners and trained volunteers providing research-based training and support to improve the safety of the food supply by helping youth and adult agricultural producers, meat, dairy and acidified canned food processors and entrepreneurs adopt best practices and comply with government regulations. Twenty county Extension educators and state specialists are Beef Quality Assurance trainers, two Swine Team members are certified Transport Quality Assurance trainers, and all four are Pork Quality Assurance Plus Advisors. This group also helps train certified 4-H youth and volunteer leaders in Meat Animal Quality Assurance required for participation in county and state fair swine, beef and sheep projects and auctions.

2. Brief description of the target audience

Integrated activity for our capacity grant program targets a broad group of stakeholder audiences in agricultural, natural resources, and the public. The audience includes colleagues, community groups, veterinarians and other professionals, individuals, families, 4-H and FFA youth, school-age children and preschoolers, fresh market vegetable and fruit growers and sellers, small food processors and entrepreneurs, crop, dairy and livestock producers, producer associations, dairy food processors and artisan cheesemakers, natural, organic and conventional meat processors, local and regional economic development initiatives, local and tribal governments, state and federal regulatory agencies, and others preserving food safely and keeping the food supply safe and wholesome.

3. How was eXtension used?

University of Wisconsin-Extension campus and county faculty and staff participate in various communities of practice, engaging with colleagues around the country to improve the educational content of research-based programs and assistance delivered to residents across the state and region. 289 Cooperative Extension colleagues have created accounts with eXtension. They are connected by email ListServ, blogs

and online newsletters, and shared resources such as teleconferences and webinars, eXtension Communities of Practice, and the national Extension Disaster Education Network (EDEN) to quickly address critical and emerging issues such as responding to extreme weather. In 2017, two Cooperative Extension colleagues were trained by eXtension to be Designathon/Innovation facilitators and we prepared to host a Designathon event with eXtension in early 2018. We organized teams representing food systems, opioids, nutrition and educational technology to attend. Interdisciplinary colleagues and other professionals in this network include University of Wisconsin researchers on the Madison, Platteville, River Falls and Stevens Point campuses, working with 3 tribes, and at 12 agricultural research stations.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	4	23	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension self-directed teams on the relevance, importance and impact of our research program. The output measures listed will also serve as outcome measures in that patents, graduate degrees and publications all include an element of critical review and assessment of uniqueness, originality, contribution to the science and knowledge base, or other performance criteria.

Year	Actual
2017	39

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Improve the safety of the food supply.
2	Develop and implement behavioral interventions that improve consumer food safety practices.

Outcome #1

1. Outcome Measures

Improve the safety of the food supply.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Mycotoxins: Biosecurity, Food Safety and Biofuels Byproducts

While some fungi are used for beneficial purposes such as antibiotics and food fermentation, others, such as a species called Aspergillus flavus, are plants and human pathogens and can cause environmental damage, agricultural loss and adverse health effects. Many fungi can produce toxic compounds called mycotoxins, with aflatoxin being the most globally problematic. The most potent carcinogen found in nature, aflatoxins can contaminate crops such as corn and cereals, and high doses can cause human death. It is estimated that ~25% of the global food supply is contaminated by aflatoxins. Because of their toxicity, aflatoxins have been regulated by the U.S. Food and Drug Administration since 1965. Strategies for controlling fungal spread as well as aflatoxin production are important to avoid future economic losses and health risks.

What has been done
Researchers from UW-Madison, led by Jae-Hyuk Yu, want to reduce problems caused by aflatoxin contamination by better understanding how the fungi grow and produce the toxin. To better understand the biology of the fungi, graduate student Ming-yueh Wu focused on a key regulator that affects fungal spores, the structures that make fungi more infectious. That regulator, called WetA, is necessary for Aspergillus flavus to produce intact spores. Wu produced fungi missing the wetA gene and grew large quantities to collect materials that were then sent for analysis of genes and other characteristics.

This study provided a large amount of previously unknown information about WetA. The regulator not only affects the pathway of spore formation but also has evolved to control many other pathways, including aflatoxin production. Furthermore, the scientists showed that WetA is a

transcription factor, which binds to specific DNA sequences to control if and when genes are expressed. In fact, of the approximately 12,000 genes in Aspergillus flavus, about half of them are affected by the WetA regulator including genes related to production of aflatoxin.

Results

Current anti-fungal treatments concentrate on killing fungi. While this results in decreased fungal contamination, harsh treatments can be detrimental to crops and other hosts. Because WetA controls so many processes in fungi, it is a promising target for blocking fungal infection. A treatment could be developed that would interfere with WetA, and in this way, no intact spores will form and aflatoxins will not be produced. With WetA as a target, treatments could be developed that avoid harsh side effects. These treatments could be spread on farm fields or even applied to building structures to prevent fungal infestation, and reduce human exposure.

Jae-Hyuk Yu has given many talks to industry partners to explain the work of his lab and their progress. Graduate student Wu was supported by this grant and has graduated. This research has been presented at international conferences (such as Fungal Genetics Conference 2017), a journal article was published in PLOS ONE, and another article is soon to be published.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Develop and implement behavioral interventions that improve consumer food safety practices.

Not Reporting on this Outcome Measure

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

Brief Explanation

2017 was a time of transition for Cooperative Extension. As part of that transition, we experienced reduced numbers of employees and some losses of institutional knowledge.

We are moving forward with the efficiency and effectiveness of our programs at the forefront. Continuing to meet our mission is possible largely because of consistent NIFA funding. In late 2017 and into 2018 we entered a significant hiring phase rebuilding our human capitol around program development and delivery.

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- A major change in federal policy or appropriation affecting the Capacity Grant program could affect CALS's ability to produce our desired outcomes. Training graduate students is a priority of our program. Since these funds do not allow tuition remissions, we continue to discuss alternatives to meeting our capacity grant mission, while continuing to train graduate students for the next generation of agricultural science.

- Cooperative Extension reorganized its 72 single-county administrative structure into 22 Areas overseen by 22 full-time Area Extension Directors. In June of 2017, regional/county based administration of cooperative extension educators was consolidated into these 22 Area Extension Director positions. These are full-time administrative positions that oversee county-based educators in groups of counties across the state. Twenty-two county based educators/coordinators transitioned into these fully administrative roles.

- There were 25 retirements by county-based educators/coordinators.

- There were 34 resignations by county-based educators/coordinators.

- Between January 1, 2017 and January 1, 2018, Cooperative Extension saw a total of 59 retirements and resignations of county-based educators.

A variety of factors could affect the outputs and outcomes of this planned program including those listed above. However, the breadth of the program ensures that there is still a sustainable base of work being done that can grow and evolve in 2018 and beyond.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Please refer to summaries under outcome number 1.

Key Items of Evaluation

In 2017, we started redesigning the Cooperative Extension Program Development and Evaluation unit, which will result in more evaluation being done on high priority planned programs and an increased ability for us to provide concise summaries here in the years to come. For now, please reference the Results section of the Qualitative Outcome or Impact

Statement sections above.

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Education and Science Literacy

☑ 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
603	Market Economics	0%		25%	
604	Marketing and Distribution Practices	0%		25%	
608	Community Resource Planning and Development	0%		25%	
806	Youth Development	100%		0%	
903	Communication, Education, and Information Delivery	0%		25%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	1.0	0.0	2.0	0.0
Actual Paid	8.9	0.0	2.0	0.0
Actual Volunteer	8540.0	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**
376962	0	116620	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
376962	0	116620	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The WAES will incorporate research projects to address the needs of farmers and landowners and to educate them to improve agriculture, the land and use of natural resources. Cooperative Extension 4-H STEM specialists builds capacity in 4-H educators and volunteers to provide LEGO® Mindstorms® Robotics programs across Wisconsin. Extension's Wednesday Nite at the Lab (WN@TL) engages the general public with campus-based researchers around emerging research findings and trends. A variety of citizen science and volunteer programs work towards science literacy such as the Wisconsin Master Naturalist program featured below.

2. Brief description of the target audience

The audience includes farmers, landowners, 4-H youth, parents, staff, teachers, volunteers, organizations, community leaders, business owners, school districts, economic development practitioners, the news media, and families.

3. How was eXtension used?

University of Wisconsin-Extension campus and county faculty and staff participate in various communities of practice, engaging with colleagues around the country to improve the educational content of research-based programs and assistance delivered to residents across the state and region. 289 Cooperative Extension colleagues have created accounts with eXtension. They are connected by email ListServ, blogs and online newsletters, and shared resources such as teleconferences and webinars, eXtension Communities of Practice, and the national Extension Disaster Education Network (EDEN) to quickly address critical and emerging issues such as responding to extreme weather. In 2017, two Cooperative Extension colleagues were trained by eXtension to be Designathon/Innovation facilitators and we prepared to host a Designathon event with eXtension in early 2018. We organized teams representing food systems, opioids, nutrition and educational technology to attend. Interdisciplinary colleagues and other professionals in this network include University of Wisconsin researchers on the Madison, Platteville, River Falls and Stevens Point campuses, working with 3 tribes, and at 12 agricultural research stations.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1513	0	8123	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	1	5	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension self-directed teams on the relevance, importance and impact of our research program. The output measures listed will also serve as outcome measures in that patents, graduate degrees and publications all include an element of critical review and assessment of uniqueness, originality, contribution to the science and knowledge base, or other performance criteria.

Year	Actual
2017	7

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	To increase the knowledge and implement decision-making tools for farmers and landowners.
2	To increase the knowledge of youth and teachers in the 4-H STEM program.

Outcome #1

1. Outcome Measures

To increase the knowledge and implement decision-making tools for farmers and landowners.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	115

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Wisconsin Master Naturalist Program

Train-the-trainer models used in conjunction with volunteers can exponentially increase dissemination of educational information, citizen science efforts, and stewardship activities with limited resources. Wisconsin Master Naturalist, a program focused on educational conservation and public service, is one example of this model. Similar programs are currently in practice across the country and networked through the national non-profit Alliance of Natural Resources Outreach and Service Programs. Wisconsin Master Naturalist Program uses federal resources to develop training curriculum then partners with host organizations to train instructors and participants statewide in Wisconsin's diverse natural history and volunteer needs.

The Master Naturalist program then provides an on-going network for instructors, records volunteer data at a statewide level in three areas: environmental education, citizen science and stewardship, and recognizes volunteer achievements.

What has been done
The Wisconsin Master Naturalist Volunteer Training Course provides 40 hours of coursework in natural history, interpretation and conservation stewardship. Courses combine classroom instruction with field experiences and are taught by professional natural resources educators and scientists that provide a localized perspective to the statewide curriculum.

Training opportunities are located at host organizations, generally nonprofits like university and college campuses, environmental education centers, friends of state parks and natural history

museums throughout Wisconsin. After participating in 2017 trainings, 91% of volunteers reported feeling they had the knowledge to effectively provide natural resources related opportunities to others.

In addition to the initial coursework, volunteers perform a minimum of 40 hours of service work annually and receive 8 hours of continuing training annually to maintain their volunteer certification. Volunteers record their service hours through an on-line platform.

UW-Extension, Cooperative Extension staff hosted multiple events in 2017 including two instructor trainings, instructor retreat, and 10 volunteer trainings involving more than 200 individuals and nine new host organizations. Wisconsin Master Naturalist Program together with the Water Action Volunteer program fostered their commitment to underserved populations by bringing a professional development opportunity to staff, instructors, and local coordinators entitled, 'Connecting, Engaging and Strategizing' at their annual instructor retreat. This session discussed creating meaningful connections to ensure inclusive engagement across the programs' volunteers.

Results

The Wisconsin Master Naturalist Program completed their fifth season in 2017. This milestone resulted in a total of 54,893 volunteer hours being completed providing nearly $1.2 million dollars in value to the state in just the first five years of the program. Fifty-one host organizations have partnered with the program by having 115 individuals trained as instructors who have trained 663 volunteers statewide. There is a presence of Master Naturalists in 63 of Wisconsin's 72 counties.

Wisconsin Master Naturalist Volunteers participate in a wide variety of activities that impact Wisconsin's natural resources, residents and visitors. One quarter of recorded hours show participation in stewardship activities, such as controlling invasive species, collecting native prairie seeds for planting, maintaining trails and rain gardens, and installing and taking care of bluebird houses to name a few. Another quarter of recorded hours cover participation in citizen science activities including monitoring water quality, specific species of plants, mammals, birds and insects, as well as collecting weather information. Educational and interpretive activities make up the remaining half of recorded hours. Master Naturalist volunteers were able to reach 163,998 individuals through educational activities in the first five years.

Diversity and Inclusion is important to the Wisconsin Master Naturalist Program. In addition to providing professional development on inclusivity to instructors, several programs led by Master Naturalist volunteers are addressing aging populations and those with physical or mental disability. These include, but are not limited to:

SPARK! An interactive nature-based program for memory challenged participants and their care partners available at host organization Schlitz Audubon Nature Center;

Self-guided tour curriculum accessible by all-terrain wheelchair developed in partnership with Access Ability Wisconsin at the host organization Friends of Pheasant Branch Conservancy;

A new partnership with Northwest Passage, a host organization that addresses mental health and behavior issues by incorporating nature into therapy provided to children and families.

Course evaluations are overwhelmingly positive. In 2017, 98% of survey respondents said that their knowledge of Wisconsin's natural resources increased after taking the course. According to 93% of respondents the course provides a broad overview of Wisconsin's natural resources and the process that affects them. The course participants represent a variety of Wisconsin residents from across the entire state and occasionally from adjacent states as well.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

To increase the knowledge of youth and teachers in the 4-H STEM program.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	19

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Building Volunteer Capacity in STEM - Robotics Trainings

Faculty and staff time spent building capacity in educators and volunteers to deliver science, technology, engineering, and mathematics (STEM) programming can create ripple effects of impact towards STEM goals. UW-Extension is often asked to provide STEM content training to 4-H educators, 4-H volunteers and UW-Extension community partners. Thus, resources and trainings that convey the technical aspects of science content is key to helping educators describe the outcomes of STEM initiatives in their communities. The content of STEM activities also serves as the "hook" that engages adults and youth in programs. LEGO® Mindstorms® EV3 was introduced by LEGO® in 2015 and is gaining traction in Wisconsin as educators phase out the old NXT robotics systems.

Studies specific to LEGO® Mindstorms® Robotics revealed youth gained problem solving skills, creative thinking skills and an increase in technological knowledge (Barak & Zadok, 2009; Chen Yuan, 2012; Lindh & Holgersson, 2007; Mosley & Kline, 2006; Nagchaudhuri, 2002; Slangen et al., 2011). Other studies showed youth who worked with LEGO® Mindstorms® NXT systems improved in-school performance in STEM and non-STEM related disciplines (Cejka, Rogers, & Portsmore, 2006; Panadero, Romaacuten, & Kloos, 2010).

Youth who worked with robotics also gained teamwork skills, confidence and communication skills (Barker, 2007).

What has been done
An Extension state specialist is currently developing curriculum training materials for the EV3 system with feedback from three adult professional development workshops. Evaluation data was collected from 19 participants who participated in face-to-face robotics professional development events in 2017.

Results
All participants stated an improvement in their understanding of the basics of robotic programming and building.

Approximately 70 percent of respondents rated their confidence to lead a robotics program with youth and ability to train other volunteer leaders as "good" or "very good". Questions on the survey also asked if, after the training, adults could identify STEM and life skills youth gain through involvement with robotics programs within their counties. The majority of respondents (65 percent) stated that they could identify and communicate the skills youth can gain by working with LEGO® robotics. All of the respondents indicated that they would recommend the training to others and felt more excited about leading robotics activities as a result of the training.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development
903	Communication, Education, and Information Delivery

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

Brief Explanation

2017 was a time of transition for Cooperative Extension. As part of that transition, we experienced reduced numbers of employees and some losses of institutional knowledge. We are moving forward with the efficiency and effectiveness of our programs at the forefront. Continuing to meet our mission is possible largely because of consistent NIFA

funding. In late 2017 and into 2018 we entered a significant hiring phase rebuilding our human capitol around program development and delivery.

• In the 2015-2017 Wisconsin State biennial budget, Cooperative Extension saw a reduction of $3.6 million per year in ongoing state funding. The portion of this reduction that impacted the county/tribal arm of Cooperative Extension was $1.2 million.

• Between January 1, 2017 and January 1, 2018, Cooperative Extension saw a total of 59 retirements and resignations of county-based educators.

• There were 34 resignations by county-based educators/coordinators.

• There were 25 retirements by county-based educators/coordinators.

• Cooperative Extension reorganized its 72 single-county administrative structure into 22 Areas overseen by 22 full-time Area Extension Directors. In June of 2017, regional/county based administration of cooperative extension educators was consolidated into these 22 Area Extension Director positions. These are full-time administrative positions that oversee county-based educators in groups of counties across the state. Twenty-two county based educators/coordinators transitioned into these fully administrative roles.

• A major change in federal policy or appropriation affecting the Capacity Grant program could affect CALS's ability to produce our desired outcomes. Training graduate students is a priority of our program. Since these funds do not allow tuition remissions, we continue to discuss alternatives to meeting our capacity grant mission, while continuing to train graduate students for the next generation of agricultural science.

A variety of factors could affect the outputs and outcomes of this planned program including those listed above. However, the breadth of the program ensures that there is still a sustainable base of work being done that can grow and evolve in 2018 and beyond.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Please refer to summaries under outcome number 1 and outcome number 2.

Key Items of Evaluation

In 2017, we started redesigning the Cooperative Extension Program Development and Evaluation unit, which will result in more evaluation being done on high priority planned programs and an increased ability for us to provide concise summaries here in the years to come. For now, please reference the Results section of the Qualitative Outcome or Impact Statement sections above.

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Rural Prosperity

☑ 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
131	Alternative Uses of Land	0%		5%	
134	Outdoor Recreation	0%		5%	
135	Aquatic and Terrestrial Wildlife	0%		5%	
214	Vertebrates, Mollusks, and Other Pests Affecting Plants	0%		5%	
307	Animal Management Systems	0%		5%	
315	Animal Welfare/Well-Being and Protection	0%		5%	
601	Economics of Agricultural Production and Farm Management	60%		15%	
604	Marketing and Distribution Practices	0%		10%	
605	Natural Resource and Environmental Economics	0%		10%	
609	Economic Theory and Methods	0%		5%	
610	Domestic Policy Analysis	0%		5%	
724	Healthy Lifestyle	0%		5%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	40%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	1.0	0.0	3.0	0.0
Actual Paid	16.4	0.0	12.0	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**
830018	0	779615	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
830018	0	779615	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Much Extension work falls under Rural Prosperity, ranging from community economic development to farm management to human development and relationships. The Wisconsin 4-H program and positive youth development contribute to both rural and urban prosperity.

- Community economic development includes providing data and research, building capacity, and planning around local government, community infrastructure, and businesses. Major topics include basics of local government, energy, facilitation, placemaking, racial literacy, food systems, and broadband.
- Farm management mainly includes strategic planning; mission, vision and goal setting; and business planning.
- Financial capability programming covers basic money management and housing (rental and ownership). Strategies include coaching, online programs, video games, and curating current literature. This year, financial capability programming is featured below as a Qualitative Outcome/Impact Statement.
- Human development and relationship work covers mindfulness, protective factors, early childhood development, and more--coalition development is a strategy used.
- Youth programming uses core competencies and authentic, hands-on engagement around topics such as leadership development, life skill development and post-high school pathways.

In 2016-2017, Extension worked to better understand and communicate about our work in the area of Organizational and Leadership Development. What follows is a more detailed description of this work:

Educators in this programmatic area support rural community leaders and organizations in strategic planning, place-making, and strengthening rural community leaders. Main programming efforts in 2017 connected to Rural Prosperity consisted of planning and providing educational events, and the facilitation of organizational change in rural community or government organizations.

For example, a tribal Land and Natural Resource Division Administrator asked our educator to develop strategic plans for each of the division's ten departments. Over the course of one year, our educator led each department through a process of identifying goals and barriers, and creating plans. As a result of each department's strategic plan, the division was able to better align its long term strategy with funding opportunities. Main programming audiences of these efforts are rural local residents and non-profit boards, as well as rural government (municipal, county, tribal nations).

As the example above illustrates, a core outcome of this work is the identification of next steps for community organizations and individuals. One characteristic of our work in rural areas is our ability to respond flexibly. This illustrates how Extension serves as a responsive resource for rural residents and

organizations, helping them build and retain vibrant rural communities.

This Extension Program's work is not limited to strategic planning support in service of Rural Prosperity. Our educators help developing strong community leaders, for example through the Leadership Wisconsin program, which is designed to fill the leadership gap in rural areas. Through supporting rural communities in coming together to address local issues, we are playing a core role in mobilizing and connecting community resources. For example, our educators facilitated several multi-day workshops in rural communities focusing on place-making. The events allowed the community members to build a common vision for the community's future and they are currently developing implementation teams to put ideas from the program into action.

Our long-standing local relationships have positioned us to support tribal nations in sensitive projects. In 2017, educators affiliating their work with this Extension Program supported rural tribal county governments in organizational development aimed at inter-departmental collaboration, and in building a state of emergency protocol.

2. Brief description of the target audience

Integrated activity for our capacity grant program targets a broad group of stakeholder audiences in agriculture, natural resources, and the public. The audience includes colleagues and other professionals, growers and grower associations, land owners, policy makers, Certified Crop Advisors, agricultural service providers, coalitions and cooperatives, community leaders, business owners, local elected officials, town, city, county and tribal governments, state and federal agencies, local planning departments and regional planning commissions, utilities, school districts, economic development practitioners, the news media, families, youth and young adults, parents, caregivers, people in transition (e.g. new couples, new parents, under- or newly-employed, moving off assistance, retirees), low income populations, child and family serving organizations, systems (corrections, healthcare, education, human services), and volunteers.

We serve two core audiences regarding Rural Prosperity in the Extension Program of Organizational and Leadership Development: local government entities (municipal, county, tribal) and rural residents. One-third or more of our programming in this area reached those audiences. Non-profit boards are another key audience, in about a fifth of our programming. In addition, we serve professional communities (such as chambers of commerce) and businesses (such as small rural farms and food producers with this programming.

3. How was eXtension used?

University of Wisconsin-Extension campus and county faculty and staff participate in various communities of practice, engaging with colleagues around the country to improve the educational content of research-based programs and assistance delivered to residents across the state and region. 289 Cooperative Extension colleagues have created accounts with eXtension. They are connected by email ListServ, blogs and online newsletters, and shared resources such as teleconferences and webinars, eXtension Communities of Practice, and the national Extension Disaster Education Network (EDEN) to quickly address critical and emerging issues such as responding to extreme weather. In 2017, two Cooperative Extension colleagues were trained by eXtension to be Designathon/Innovation facilitators and we prepared to host a Designathon event with eXtension in early 2018. We organized teams representing food systems, opioids, nutrition and educational technology to attend. Interdisciplinary colleagues and other professionals in this network include University of Wisconsin researchers on the Madison, Platteville, River Falls and Stevens Point campuses, working with 3 tribes, and at 12 agricultural research stations.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	860	0	339	0

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	26	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension self-directed teams on the relevance, importance and impact of our research program. The output measures listed will also serve as outcome measures in that patents, graduate degrees and publications all include an element of critical review and assessment of uniqueness, originality, contribution to the science and knowledge base, or other performance criteria.

Year	Actual
2017	40

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	To develop and implement programs to improve succession planning, grazing strategies and land management.
2	To develop and implement programs to improve succession planning, farm management, tax policy, health and well-being in rural
3	To develop & implement programs to improve financial well-being in rural communities.
4	Increase financial capability of rural residents.

Outcome #1

1. Outcome Measures

To develop and implement programs to improve succession planning, grazing strategies and land management.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

To develop and implement programs to improve succession planning, farm management, tax policy, health and well-being in rural

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Gaining and Retaining Young People in Wisconsin Rural Communities

For decades, rural communities across the country have wrestled with the effects of "brain drain" as young adults depart to live in more amenity-rich cities. A decline in young adult populations in these communities has led to higher costs for schools, public services, recreational opportunities and other infrastructure, among other negative economic consequences. This trend erodes the quality of life for the remaining residents and threatens the viability of regional, family-farming communities. Past research on this topic has focused on causes-which can restrict creative thinking about the causes of youth population decline-and has analyzed data only at the county level, ignoring factors at play in local communities.

What has been done
Researchers at the University of Wisconsin-Madison and University of Wisconsin-Extension took a different approach to their study by examining effects rather than causes. They identified local communities that have demonstrated success in gaining or retaining young adults (residents aged

20-39) without the presence of an obvious asset (e.g., a major industrial plant or nearby university). They pinpointed these "outliers" through demographic analyses of data from multiple sources spanning the years 1990-2010. The research team narrowed the list to 12 communities-one in each region of the state-to serve as case studies, which included reviews of relevant documents and 210 extensive interviews with residents. With the help of local UW-Extension educators, the team also identified a "core group" of local leaders in each community who helped guide the studies.

Results
Several key factors that may attract young adults to rural communities emerged from the analysis. They include: 1) high-quality schools that also serve as a community and cultural centers; 2) affordable housing with an appropriate mix of housing types suitable for the different life stages of residents; 3) outdoor recreational opportunities, including "silent sports" like skiing and hiking; 4) local gathering spots, like coffee shops, and family spaces such as swimming pools and restaurants; and 5) convenient access to larger cities. Other useful themes arose from the study. For example, programs designed specifically to attract young adults were not cited as a significant factor by interviewees.

To help rural communities formulate strategies for attracting young adults, the results of the case studies have been shared in a variety of ways. A detailed, comprehensive report-free to the public-was published online in October 2017, and it was shared with members of the "core groups" in each community. The report includes a "Do-It-Yourself Manual" that rural communities can use to conduct case studies and inform decisions. UW-Extension educators can be enlisted to help in this process.

In addition, the researchers have presented results at the Wisconsin Rural Summit and to regional and statewide groups composed of rural community leaders. They also coordinated an interactive live streaming event on YouTube. All of these efforts have garnered attention from local, agricultural, and national media. An article for the Economic Indicator Report, produced quarterly by University of Wisconsin-Stevens Point, is in progress, as are academic articles focused on the demographics and case study methods utilized in the study.

4. Associated Knowledge Areas

KA Code	Knowledge Area
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #3

1. Outcome Measures

To develop & implement programs to improve financial well-being in rural communities.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	103

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Financial Coaching Program Contributions

Approximately half of all U.S. households' lack an emergency fund to cover unexpected expenses and pay monthly interest charges on their credit card. Recent studies have highlighted that financial education alone is not sufficient to help individuals adapt new positive financial behaviors. A relatively new approach, financial coaching, helps learners to focus on personal goals, identify action steps, and successfully implement a plan to improve their financial situation. The University of Wisconsin is a leader in the field of financial coaching, providing training, webinars, resources, and conducting research.

What has been done
In 2017, UW-Extension instructors co-facilitated four 2-day workshops on 'Financial Coaching Foundations' around Wisconsin. The UW-Extension Financial Capability Specialist also presented two 1-day Financial Coaching trainings for a partner organization in Philadelphia, PA. In total, these six workshops were attended by 103 UW-Extension educators, financial professionals, and volunteers from Wisconsin and 20 other states, including Extension staff from Iowa, Mississippi, Ohio, and Virginia. Additional efforts related to financial coaching programming include presenting on three national webinars with 434 participants, creating a financial coaching workbook to accompany the workshops, and authoring two chapters for inclusion in a financial coaching textbook.

Results
Of the 82 two-day financial coaching workshop participants, 74 completed a baseline survey and 22 completed a one-month follow-up survey. Overall, more than 90% of participants rated workshop components, such as practicing listening, establishing goals, and asking thought-provoking questions, as useful to their work. Follow-up surveys indicated that 67% of respondents increased their understanding of the difference between "coaching, consulting, therapy and other support professions." In addition, 68% of participants indicated they planned to use the University of Wisconsin coaching model or coaching techniques to serve at least six or more clients in the six months following the training.

4. Associated Knowledge Areas

KA Code	Knowledge Area

803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #4

1. Outcome Measures

Increase financial capability of rural residents.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Money Smart in Head Start

Families throughout the country experience financial difficulties. Low-income individuals living in rural communities have limited access to financial education to help address challenges around budgeting and debt. One barrier to providing services to low-income families is identifying and communicating directly with the target population.

Providing financial education as one component of wrap-around services by multiple organizations can increase likelihood of success in identifying those families most in need of educational resources.

What has been done
Money Smart in Head Start is an innovative approach to targeting limited educational resources to the population who could benefit the most from increased financial information and support. Because self-identification of low-income status can be difficult to ascertain and confirm, UW-Extension, Cooperative Extension Family Living colleagues partnered with low-income participants pre-identified by the federal Head Start program. Specifically, investigators targeted the rural Taylor, Ashland and Iron Counties in Wisconsin. The percentage of children living in poverty in Iron County is among the highest in the state.

With programs such as "How to save a dollar when you don't have a dime to spare" and monthly financial newsletters during the school year, the Money Smart in Head Start curriculum focuses on resources for managing monthly finances. These resources are intended as capability-building

strategies for low-income families with young children in the home.

Results

Participants in targeted counties completed surveys prior to and following completion of this eight-month financial literacy intervention. Investigators reported increased participation in programming due to partnership with Head Start-identified families.

Of those participants who completed surveys, a majority of respondents reported increased confidence in their ability to achieve financial goals. Fifty-five percent began an emergency savings fund and 12% began saving for future use such as retirement.

Money Smart in Head Start was awarded second place for the Communications Newsletter Award from the National Extension Association for Family and Consumer Sciences in 2017.

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

Brief Explanation

2017 was a time of transition for Cooperative Extension. As part of that transition, we experienced reduced numbers of employees and some losses of institutional knowledge. We are moving forward with the efficiency and effectiveness of our programs at the forefront. Continuing to meet our mission is possible largely because of consistent NIFA funding. In late 2017 and into 2018 we entered a significant hiring phase rebuilding our human capitol around program development and delivery.

• In the 2015-2017 Wisconsin State biennial budget, Cooperative Extension saw a reduction of $3.6 million per year in ongoing state funding. The portion of this reduction that impacted the county/tribal arm of Cooperative Extension was $1.2 million.

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• There were 34 resignations by county-based educators/coordinators.

- There were 25 retirements by county-based educators/coordinators.

- Cooperative Extension reorganized its 72 single-county administrative structure into 22 Areas overseen by 22 full-time Area Extension Directors. In June of 2017, regional/county based administration of cooperative extension educators was consolidated into these 22 Area Extension Director positions. These are full-time administrative positions that oversee county-based educators in groups of counties across the state. Twenty-two county based educators/coordinators transitioned into these fully administrative roles.

- A major change in federal policy or appropriation affecting the Capacity Grant program could affect CALS's ability to produce our desired outcomes. Training graduate students is a priority of our program. Since these funds do not allow tuition remissions, we continue to discuss alternatives to meeting our capacity grant mission, while continuing to train graduate students for the next generation of agricultural science.

A variety of factors could affect the outputs and outcomes of this planned program including those listed above. However, the breadth of the program ensures that there is still a sustainable base of work being done that can grow and evolve in 2018 and beyond.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Please refer to the summaries under outcome number 2, outcome number 3 and outcome number 4.

Key Items of Evaluation

In 2017, we started redesigning the Cooperative Extension Program Development and Evaluation unit, which will result in more evaluation being done on high priority planned programs and an increased ability for us to provide concise summaries here in the years to come. For now, please reference the Results section of the Qualitative Outcome or Impact Statement sections above.

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Wisconsin Competitive Research Program

☑ 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
123	Management and Sustainability of Forest Resources	0%		14%	
134	Outdoor Recreation	0%		6%	
135	Aquatic and Terrestrial Wildlife	0%		6%	
136	Conservation of Biological Diversity	0%		6%	
301	Reproductive Performance of Animals	0%		6%	
305	Animal Physiological Processes	0%		6%	
306	Environmental Stress in Animals	0%		6%	
311	Animal Diseases	0%		6%	
312	External Parasites and Pests of Animals	0%		14%	
501	New and Improved Food Processing Technologies	0%		6%	
502	New and Improved Food Products	0%		6%	
721	Insects and Other Pests Affecting Humans	0%		6%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%		6%	
902	Administration of Projects and Programs	0%		6%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.3	0.0
Actual Paid	0.0	0.0	5.0	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**
0	0	340928	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	340928	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Capacity grants are being used to address a number of state priority research activities that cannot be classified in the nine priorities. We have grouped these ongoing projects under the rubric of the "Wisconsin Competitive Research Program", but funds supporting these projects will be redirected to the new national priorities in the future. These projects do contribute to a variety of important state needs and are focused in several areas, including water resource issues, applied statistics in support of agricultural research, policy analysis for use in land use planning and commodity programs, management of invasive exotic organisms and bio-waste management.

2. Brief description of the target audience

Integrated activity for our capacity grant program targets a broad group of stakeholder audiences in agricultural, natural resources, and the public.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	9	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension teams on the relevance, importance and impact of our research program. The output measures listed will also serve as outcome measures in that patents, graduate degrees and publications all include an element of critical review and assessment of uniqueness, originality, contribution to the science and knowledge base, or other performance criteria.

Year	Actual
2017	15

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW Extension teams on the relevance, importance and impact of our research program.
2	Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension teams on the relevance, importance and impact of our research program.

Outcome #1

1. Outcome Measures

Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW Extension teams on the relevance, importance and impact of our research program.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Influence of White-tailed Deer on Wisconsin Forest Ecosystems

In many regions of the United States, populations of white-tailed deer are much denser than they were prior to European settlement, which exacerbates their impact on the environment. Researchers aim to gain a better understanding of the deer-forest ecosystem relationship to aid in the development of appropriate goals and management strategies for deer populations in northern forests in the United States.

What has been done
The original scope of this four-year project was to set up an array of large deer enclosures with varying population densities and monitor each for changes in key aspects of forest integrity. However, state and federal land managers were reluctant to allow construction of enclosures in publicly owned forests, so a different plan was devised for a parallel research project.

It has been well established that the eating habits of deer have a direct effect on the success of many forest plant species, but less is understood about how deer indirectly influence the composition and health of the "understory communities" of wildflowers and herbs on the forest floor. This study focused on 17 deer "exclosures" - forested areas of varying sizes where fences have been installed to keep deer out - in northern Wisconsin and Michigan's Upper Peninsula. Comparisons of the exclosures to adjacent areas outside the fences revealed that deer modify key aspects of the forest environment. For example, deer tend to nibble on and kill saplings, which increases light levels on the forest floor and accelerates leaching of nutrients and organic matter from upper soil horizons. Soil compaction also increases under the tread of deer hooves.

Because different plants thrive under different conditions, these changes have implications for forest plant composition. For example, ferns and raspberries will favor higher light levels. Grasses, sedges, and non-native plants like dandelions do better in more compacted soil, whereas lilies and violets will struggle.

Results
Previously, ecologists have understood plant consumption to be the largest impact that deer have on understory species. However, these new findings point to another research angle for ecologists to pursue. This study also underscores the legacy effects that may account for why forest understory communities are slow to recover after pressure from deer is alleviated. Finally, the study can be used to help scientists design experiments that study how changes in light and soil conditions affect plant communities, and they can guide conservation and forest restoration efforts.

The research team presented its findings at the proceedings of the annual meeting of the Ecological Society of America and published a peer-reviewed article in the Journal of Ecology. The study also allowed a graduate student to master numerous techniques in field data acquisition and new statistical approaches for analyzing plant community data.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #2

1. Outcome Measures

Outcome measures for this work are both qualitative and quantitative. We will rely on feedback from stakeholder groups, advisory boards, and individual constituents, as well as from UW-Extension teams on the relevance, importance and impact of our research program.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Title: An "Ecological Time Machine" to Restore Cyclical Population Dynamics in Forested Ecosystems

Global climate change is affecting where different animal species can survive and thrive. Because of redistributions, ecosystems are changing rapidly. Snowshoe hares, especially those living in the southern parts of the Great Lakes Region, are a prime example of a species affected by changes in climate. The hares use their coloring-white in winter and brown in summer-as camouflage, but as periods of snow cover become shorter in this region, predation rates of hares have gone up. At the same time, species that coexist with hares, such as porcupines and fishers, are also undergoing changes. How these species are responding to the presence and absence of each other needs to be carefully studied to better manage the effects of climate change.

What has been done
Researchers at the University of Wisconsin-Madison wanted to understand why the population of porcupines in central Wisconsin was growing older and why it appeared that juveniles were not being added to the population, observations gleaned from years of data at the Sandhill Wildlife Area near Babcock, WI. They hypothesized that porcupettes (baby porcupines) were being preyed upon more heavily due to the loss of snowshoe hares in the area. In the absence of hares, the researchers hypothesized, fishers were instead preying on porcupettes. To test this hypothesis, they turned back time in the Wildlife Area by releasing snowshoe hares back into the fenced property during winter (during snow cover and while the hares were white) and monitoring survival. During mid-winter, the area saw a complete loss of snow, and the researchers saw an increase in deaths of snowshoe hares. The overwhelming cause of death once the snow was gone was predation. Thus, the scientists showed a direct link between climate (snow cover loss) and mortality in snowshoe hares. Over the next year of the project, they will determine the predator species using saliva collected from the hares to determine if there is a link to fishers and, in turn, to porcupines.

Results
This study firmly links climate change with a reason for the local extinction of snowshoe hares in the Sandhill Wildlife Area. These findings are also applicable to other areas of North America where hares are moving north. By better understanding the dynamics of these ecosystems and how they are responding to climate change, management systems could be used to offset these losses. For instance, managing habitat to promote snow coverage or encourage specific forest types could support hare populations in areas they are currently being lost.

Researchers have shared their study strategies and findings with K-12 students through the skill center at Sandhill Wildlife Area. They have also interacted with state and federal agencies as well as presented at advisory boards, conferences and meetings including the American Society for Mammalogists. A peer-reviewed scientific paper is currently in the publication process, and a graduate student was supported through work on this project.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

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

Brief Explanation

A variety of factors could affect the outcomes of this project including those listed above. However, the breadth of the program makes it unlikely that the outcomes would be completely disrupted unless there was some major natural, economic, or public policy disruption.

A major change in federal policy or appropriation affecting the Capacity Grant program could affect our ability to produce our desired outcomes. Training graduate students is a priority of our program. Since these funds do not allow tuition remission, we continue to discuss alternatives to meeting our capacity grant mission, while continuing to train graduate students for the next generation of agricultural science.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

See summaries under outcomes 1 and 2.

Key Items of Evaluation

N/A

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)	
0	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	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.