2014 University of Wisconsin Research Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 05/29/2015

I. Report Overview

1. Executive Summary

Operating Philosophy/ Program Overview:

The Wisconsin Agricultural Experiment Station (WAES) is committed to investigator-driven and peer-reviewed research. Our philosophy is to allocate capacity funding to support specific, peer-reviewed projects rather than to distribute block grants to departments. The largest portion of our allocation goes to support graduate student education. The expenditures that we allow to be covered with capacity funding are detailed in a set of guidelines that is reviewed annually by a faculty committee. The capacity funds are matched at the state level primarily in the form of state support of salaries for investigators and research staff. As in prior years, we administered a small percentage of our funds to address emerging issues or critical needs.

Allocation of Funds:

We use capacity funds to support approximately 130 projects each year with budgets that cover personnel (mainly graduate students) as well as supplies, student hourly help and travel. Funding of capital equipment items is distributed in a separate exercise and prioritized by departments, with some capital equipment items shared by several projects. We pay for travel to multistate research meetings out of a central pool of funds, covering travel costs of one representative per project per year.

The Research Program in this Plan of Work consists of a number of projects with individual review and reporting. While the program itself may extend for multiple years, the projects that comprise it are a constantly shifting portfolio that can be quickly redirected. Projects are approved for periods of one to four years, with most on a three- or four-year cycle. Proposals for new projects require an evaluation of productivity of previous projects that received capacity fund support. Past performance is one of several criteria that we use to rank proposals and evaluate the research team's ability to complete the research project successfully. Multistate revised proposals must be reviewed and approved at least once every four years.

By continually re-examining our portfolio, we are able 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 emerging problems require immediate attention. These mid-year projects are funded at the discretion of the Associate Dean for Research/Assistant Dean of the WAES with input from the WAES/College of Agricultural and Life Sciences Administrative Leadership Group. 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.

Establishing Research Priorities:

The WAES establishes research priorities using a general "logic model" process. To identify state priorities, we seek input from diverse stakeholders representing traditional and non-traditional agriculture, natural resource, and human health and community groups. We also seek input at public meetings, such as field days at our Agricultural Research Stations and other Extension events. In addition, we ask issue-based teams composed of UW-Extension faculty and county-based educators, about the priorities in their areas.

In addition, our research priorities follow those spelled out in the five goals established by the USDA National Institute of Food and Agriculture (NIFA): 1) Global Food Security and Hunger; 2) Climate Change; 3) Sustainable Energy; 4) Childhood Obesity; and 5) Food Safety.

Within these national goals, states are asked to draw on stakeholder input to help direct use of capacity grant funding. In Wisconsin, the CALS Administrative Leadership Group and faculty meet regularly with college and departmental advisory groups, commodity organizations, state agencies, consumer groups and private citizens. What we learn from our stakeholders and from those performing the research helps us identify areas where research is needed. We also ask department chairs to propose a small number of research topics for use in the Hatch, Hatch Multistate, and McIntire-Stennis Call for Proposals. Input from stakeholders is reviewed periodically and information is obtained at regularly scheduled meetings of the CALS Administrative Leadership Group.

It should be noted that our research projects often do not fall into a single priority category, but rather intersect two or more. We feel that our researchers' engagement across a breadth of disciplines and priorities is a key strength of our program.

Our research priorities are reflected in the following themes compiled from recent WAES Calls for Proposals for our Formula Grant program.

1. Mechanisms of pest and pathogen resistance as well as the safe and effective control of pests and pathogens, with minimum effects on environmental quality and human health.
2. Effects of change in global climate, human population pressures, and public policy on agricultural production, environmental resources, ecosystem management, and future land uses.
3. Identification of socioeconomic or other forces that shape the viability of Wisconsin industries and employment including agriculture, bio-based industry, forestry, wildlife management, recreation, and other land uses.
4. Research on food safety, nutritional health, environmental protection, and biotechnology and on providing information on dietary choices, lifestyle and community decisions.
5. Sustainable agricultural and forestry production and processing systems that provides improved food safety and security, environmental protection, economically viable communities, protection of public goods, and human well-being. This need requires an understanding of basic life processes and model plant/animal systems in order to manage biotic systems for human use.
6. Research and development related to agricultural processes with the potential to enhance the productivity and quality of livestock and food and bio-fuel crops in a sustainable manner.

We provide a list of Wisconsin priorities and national goals to faculty for use in developing proposals for funding under the capacity grant programs. The panel evaluates each proposal and makes its recommendations using these priorities and other criteria related to Extension/Integrated activity, multistate participation, under-represented populations/groups and the researcher's past capacity grant productivity.

The Call for Proposals for projects to be supported beginning in October of each year is initiated in June, approximately 16 months prior to when projects are to begin. Proposals are due annually in September. A copy of the Call for Proposals, guidelines and merit criteria are available at http://www.waes.cals.wisc.edu/application-process/call-for-proposals/.

Evaluation of Proposals:

Proposals are evaluated by a 10-person faculty Research Advisory Committee (RAC), who are appointed by the CALS Associate Dean of the Agricultural Experiment Station. RAC members are selected to represent the broad cross section of the college and serve rotating three-year terms. 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 organization and other states, who are established experts in the field. The RAC convened in late November to rank the proposals. This process is detailed under "Nature of the Proposal reviews for Hatch, Hatch Multistate, and McIntire-Stennis Proposals" included at the end of the Call for Proposals

document referenced above.

Assessing Outcomes and Impact:

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 through workshops or other venues, patent disclosures and graduate students trained. The list of indicators may be expanded in the future to include other criteria. This information will be used not only to assess current program effectiveness and accomplishment, but also as a consideration in determining future capacity grant funding priorities.

The College of Agricultural and Life Sciences (CALS) feels that Wisconsin accomplishments relate very well to high-priority issues cited earlier. Publications in refereed journals, books, and extension bulletins have been reported on projects using the annual reports in the REEport system. UW-Madison-CALS has been rated first among peer institutions in the Scientific Impact Factor of its publications. We feel this achievement reflects our entire research portfolio, including projects funded by capacity grants. Capacity funding of research often leads to significant funding from other sources. CALS also rates very high in extramural funding awarded to land-grant universities and public institutions, as well as private universities. Representative projects showing these high-priority issues are reported as impacts below:

Title: Nanotechnology and biosensors

Issue (who cares and why): The quality and safety of foods and other biological materials are affected by both time and temperature. While existing sensors are able to detect exposure to an undesirable (high) temperature, they aren't able to account for the length of time spent at that temperature, an important factor when considering food safety and biological material degradation. A new type of sensor is needed that can capture more complex information about a product's thermal history. This technology could help reduce rates of food spoilage and food-borne illness.

What has been done: A team of University of Wisconsin-Madison researchers has developed a nanotechnology-based sensor that can be applied to food and other packaging--like a sticker--that is able to detect a product's thermal history. The technology utilizes gold nanoparticles that grow in size and change in shape in response to temperature and time, respectively. These size and shape changes of the nanoparticles cause the sensor to change colors in response to the thermal environment to which it is exposed. Affixed to food packaging, this sensor gives a much fuller picture of the temperature abuse experienced by a food product than existing sensors can provide. It can tell the difference, for example, between a food product that experienced a short temperature spike and another that was exposed to high temperatures for an extended period of time. Existing sensors can't distinguish the difference between these two situations.

Results/Impact: Researchers have developed a sensor they call the nTHI--nanotechnology-based Thermal History Indicator--that can be used to assess the temperature abuse of foods and other biological materials. The researchers have patented this technology, and estimate it could cost as little as several pennies per unit to produce commercially. A team of UW-Madison graduate students, including the graduate student who conducted much of this research, won a UW-Madison Discovery to Product award to help commercialize this technology. The student team, which is interested in founding a startup company, also won a "People's Choice" award in the 2014 Agricultural Innovation Prize competition, a contest started in 2014 by the Howard G. Buffett Foundation to reward innovative plans to address social and agricultural challenges within food systems, as well as a poster award for their presentation at the Institute of Food Technologists (IFT) 2013 annual meeting. These research findings have been shared via four peer-reviewed journal articles.

Funding: WIS01620

More Information: Sundaram Gunasekaran, guna@wisc.edu
Knowledge area(s): 503
****

Title: Calcium homeostasis in transition dairy cattle

Issue (who cares and why): For dairy cows, generating the amount of calcium necessary for milk production and good health can be challenging, especially during the early stages of lactation. In some cows, calcium levels drop to dangerously low levels, a condition called milk fever. The acute version of milk fever, which impacts around five percent of animals, is a life-threatening condition with established treatment protocols. However, as many as 50 percent of dairy cattle are believed to suffer from chronic, sub-clinical milk fever that goes unrecognized and untreated, weakening the animals and making them susceptible to other diseases. In addition to adversely affecting animal well-being, milk fever costs the U.S. dairy business around $150 million per year--about $12,000 per Wisconsin dairy farm--in treatment expenses and lost productivity.

What has been done: Using a rodent model, a team of University of Wisconsin-Madison researchers showed that serotonin plays an important role in calcium homeostasis--maintaining healthy calcium levels in the bloodstream--during lactation in mammals. By feeding rats a serotonin precursor known as 5-hydroxytryptophan (5-HTP), they were able to increase the release of calcium stored in the animals' bones into the bloodstream. Additionally, in a mouse model, researchers demonstrated that serotonin was critical to calcium transport from blood into milk during lactation. Subsequently, a series of trials in dairy cattle showed that 5-HTP also helps increase blood calcium levels in lactating cows, identifying the compound as a promising treatment for milk fever. Research is focused on determining the exact physiological mechanisms regulating this response in dairy cattle. Researchers are now developing a process to orally administer the compound to cows as a feed additive, searching for a way to better protect the compound from degradation as it passes through the digestive system so it can be absorbed into the bloodstream. Trials are underway to perfect the product, with the goal of bringing it to commercial market in the next seven to ten years.

Results/Impact: Researchers made an important basic discovery about the role of serotonin in calcium homeostasis during lactation in mammals. While doing so, they discovered that a compound known as 5-HTP, a serotonin precursor, shows promise for the prevention and treatment of milk fever. They are in the process of patenting their discovery and developing it into a commercial product that is expected to enhance the well-being of dairy cattle and improve dairy productivity, with the potential to save the U.S. dairy business approximately $150 million per year. This work may have implications for human health as well, as the findings point to the possibility that a popular class of antidepressant drugs may have negative health impacts--particularly on new mothers who are breastfeeding--opening an exciting new line of research and potential funding for the researchers involved. This research has been shared at numerous scientific talks, published in more than six scientific journal articles and helped train three graduate students.

Funding: WIS01618
More Information: Laura Hernandez, llhernandez@wisc.edu
Knowledge Area(s): 305,311
****

Title: Characterization of giant ragweed resistance to glyphosate in Wisconsin

Issue (who cares and why): Giant ragweed is the most competitive weed in midwest cropping systems. In Wisconsin, farmers consider it the most troublesome weed in corn and the second most troublesome weed in soybean. Glyphosate is a widely used herbicide in these cropping systems, which leads to the selective survival and propagation of weeds that are naturally resistant to the herbicide. Worldwide, more than 30 species of weeds are now resistant to glyphosate. While glyphosate-resistant weeds have been identified

in many midwestern states, such weeds had remained absent from Wisconsin until recently. The first population of potentially resistant weeds in Wisconsin was identified in Rock County in 2011.

What has been done: Researchers at the University of Wisconsin-Madison confirmed glyphosate resistance in the Rock County giant ragweed population and determined that it was 6.5-fold more resistant to glyphosate than normal weeds from the same field. They also found that while growth and development were not different in resistant weeds compared to normal weeds, fecundity - or the number of seeds produced - was higher in resistant weeds. The researchers then set out to identify the mechanism by which the weeds are resistant to glyphosate. After ruling out two common mechanisms, they then focused on the enzyme to which glyphosate binds. They found that the enzyme in resistant weeds was less sensitive to glyphosate at low concentrations. However, at higher glyphosate concentrations, the enzyme in resistant weeds was as sensitive as that in normal weeds. Partial DNA sequence analysis of the enzyme gene found no known mutations that would confer resistance to glyphosate. They are currently involved in a collaborative project to investigate other possible mechanisms that may be responsible for this resistance.

Results/Impact: Researchers confirmed the first case of a glyphosate-resistant weed population in Wisconsin and are in the process of studying the mechanism responsible for the plant's resistance. UW-Extension agents are using this new information to help educate growers about herbicide-resistant weeds and prepare them to adjust their weed management practices. Growers need to know, for instance, that glyphosate-resistant weeds can continue to spread rapidly even after they stop using glyphosate--and they need to respond accordingly. The project findings have been published in an article in the Wisconsin Crop Manager, discussed at the Wisconsin Crop Management Conference and communicated in Agri-View and other agricultural news outlets. A research paper describing these findings is in press, and another is currently being prepared. This project provided the training for a master's graduate student.

Funding: WIS01527
More Information: David Stoltenberg, destole@wisc.edu
Knowledge Area(s): 213

Total Actual Amount of professional FTEs/SYs for this State

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	154.0	0.0
Actual	0.0	0.0	133.5	0.0

II. Merit Review Process

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

- Internal University Panel
- Expert Peer Review

2. Brief Explanation

Program Review Process:
Hatch, Hatch Multistate, McIntire-Stennis, and Animal Health funds support specific projects solicited in

an annual Call for Proposals. These are reviewed and funded based on a peer-review system. Animal Health proposals are reviewed at the School of Veterinary Medicine; Hatch, Hatch Multistate, and McIntire-Stennis proposals are reviewed in CALS.

CALS Process:

The following is published in the Call for Proposals as guidance to the scientists requesting Hatch, Hatch Multistate, or McIntire-Stennis grants. This process occurred in November with an estimate of 50 new proposals.

The Faculty Review Panel (FRP):

A 10-person faculty Research Advisory Committee (RAC), appointed by the CALS Associate Dean of the Agricultural Experiment Station, reviews proposals for capacity grant funding on the UW- Madison campus. The selection criteria for RAC members and ad hoc reviewers are scientific excellence, appropriate disciplinary expertise, and overall balance. No member of the RAC may have a proposal being reviewed under this Call. Each proposal is reviewed by two RAC members (designated primary and secondary reviewers) and by two non-committee members. The non-committee members can be from the Madison campus, other UW campuses, state agencies, and non-governmental organizations who are established experts in the field.

Review Criteria for Reviewers:

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. Reviews should be concise and include comments addressing each of the following:

- An evaluation of the scientific significance of the objectives and alignment of project goals and funding source. This appropriateness criterion is equally important to scientific merit and PI record of achievement.
- A judgment of the potential for solving Wisconsin problems is a key element of the capacity grant funding guidelines.
- An evaluation of the research team's ability to accomplish the stated objectives, and the match between these objectives and available resources. For teams with multiple investigators, the PIs are to include a plan of coordination across team members.
- Multistate and integrated activity priorities.

III. Stakeholder Input

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

- 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

Brief explanation.

Methods of collecting stakeholder input vary depending on the type of meeting or activity at which we're connecting with stakeholders. Most often, this involves personal contact with someone from the UW-Madison WAES/CALS administrative leadership group and 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 we visited with representatives from the grape growers

and wine makers about their emerging research needs, and visited facilities run by a number of industry partners in the crop, meat and dairy industries.

Other examples of such face-to-face stakeholder contacts include:

1) We hosted a summit on nitrogen issues in Wisconsin and the Midwest. Representatives from state and federal agencies joined experts from industry and universities in a robust discussion identifying the top priorities related to nitrogen in the state.

2) This summer, we co-hosted the international Reciprocal Meat Conference in Madison, Wisconsin along with our local industry partner Oscar Mayer. This multi-day meeting brought more than 800 industry and academic leaders to Madison to discuss emerging issues in the meat industry.

3) In honor of our 125th anniversary, the college organized a public event at the Wisconsin Science Festival highlighting scientific contributions to the Wisconsin food industry called the "Science of Supper Clubs." This public outreach event attracted more than 500 community members to engage in dialog with more than 30 university researchers working on food system-related issues.

4) We also learn from stakeholders who come to CALS for professional development/learning. Several CALS units hold short courses for professionals in the industries they serve. For example, food manufacturers send their R&D staff here to gain knowledge that helps them make a better, more consistent product. As our scientists help these professionals address their problems, they usually learn about on the challenges these industries face.

5) A number of CALS researchers connected with stakeholders by serving on advisory boards or similar bodies that are comprised primarily of leaders in specific industries or interest areas. For example, a CALS forestry professor served on the Wisconsin Council on Forestry, a group appointed by the Governor that includes representatives from the timber, wood products and green industries, as well as, environmental groups and state and local government.

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

Brief explanation.

CALS and WAES employ a number of strategies to identify stakeholders. We rely heavily on advisory groups both at the college-wide and departmental level. The CALS Administrative Leadership Group maintains a close relationship with leaders of the industries and advocacy groups that have an interest in the disciplines we study. These individuals keep us informed about their needs and issues of concern and help put us in contact with other potential stakeholders. Departments, department chairs and faculty can also recommend contacts.

A guiding principle in our efforts to encourage participation from our diverse constituency is to reach out to individuals and groups in a way that makes it clear that their input is welcome. This entails extending a personal invitation and engaging in as much personal contact as possible, both before making the invitation (to cultivate the relationship) and after we have received the input to confirm that we got the message and explain how we intend to follow through. To the extent possible, we endeavor to meet stakeholders on their turf--their office or farm or business--as a

further indication of the value we place on what they have to say.

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

Brief explanation.

Most of the input we gather from stakeholders is verbal, but we also receive email and even letters with suggestions or comments. Much of what we hear has to do with very specific concerns, e.g. questions about crop pest management or management practices. Other stakeholders are more focused on broader quality of life issues and wish to remind us of our larger role here. We rely upon the essentially continuous engagement of our deans, faculty and staff. It is second nature to them to listen to clientele for suggestions or ideas that would enable us to serve them better.

Stakeholders' input for the development and conduct of research relating to state needs is 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. The College of Agricultural and Life Sciences is advised by a Board of Visitors that meets with the Administrative Leadership Group twice a year. That board includes accomplished and influential individuals representing a number of interest groups, including ag 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 for various constituencies.

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.

Below is a list of Agricultural Research Station Field Days:
Agronomy/Soils Field Day
Arlington Sheep Day
Container and Vertical Gardening Technique Workshop
Commercial Flower Growers of Wisconsin
Cover Crops Field Day
Crop and Pest Management Workshop
Dairy Goat Field Day
Grandparents' University
Homeowner Lawn Care Day
Potato Field Day
Preparing your Garden for Winter Workshop
Spooner Sheep Day

Twilight Garden Tour
Wisconsin Potato Vegetable Growers Association Potato Field Day
WTA Summer Field Day
Urban Horticultural Field Day

Below is a list of Stakeholder meetings attended by the Administrative Leadership Team:
January
8 Community and Economic Development Opportunities
13 Wisconsin Science Festival
15 Tour of Wollersheim Winery, Prairie du Sac, WI

February
4 Land O'Lakes Legislative day
6 Corn/Soy/Pork Expo

March
21 Nitrogen Science Summit
April
15 Visit with Syngenta, Madison, WI

May
6 Oscar Meyer Visit, Madison, WI
12 Wisconsin Ag Coalition
21 Eckburg Board Meeting, Madison, WI
30 John Deere Visit, Madison, WI

June
5 World Dairy Expo Board Meeting

July
7 Kikkoman visit with Chancellor Blank

September
3 Daughters of Demeter Corn Roast
6 WALSSA Fireup, Madison, WI
7 Wisconsin Sheep and Wool Festival

October
1 World Dairy Expo

December
3 Madison Science Museum Event

3. A statement of how the input will be considered

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

Brief explanation.

The CALS Administrative Leadership Group uses input from stakeholders in a number of ways. Perhaps most significantly, it influences future direction of the college by informing the process of allocating faculty positions. Deciding which departments or areas of expertise get hiring priority determines the college's ability to address both current and emerging issues. A successful strategic hire will enable us to meet existing needs and at the same time reposition for those on the horizon. Our stakeholders help us see into the future to identify those emerging issues. For example, in the past year we decided to hire a new faculty member to focus on potato research. Input from the state's potato growers and processors about that industry's needs helped inform this decision, and the industry was represented on the search committee.

CALS makes an effort to get stakeholders directly involved in important decisions that will set the course of the college for years to come. For example, the private sector was represented on the search committees that hired our new CALS dean and two new associate deans. And there are stakeholders on the committee that's undertaking our current yearlong strategic planning exercise, the results of which will guide many important decisions.

We also need stakeholder input to make more immediate decisions, such as where to invest funding to direct current faculty and their research into emerging issues such as bioenergy and the bioeconomy. We also consider this input in other activities such as annual budget allocation, providing feedback to departments and faculty, and most importantly, in setting priorities for our Capacity Grant research Call for Proposals and deciding how to allocate these funds.

Brief Explanation of what you learned from your Stakeholders

In meeting with stakeholders, we learn of their interest in many areas related to agriculture, natural resources and environment, food, energy, rural life, and health issues and rural economic development. Examples include:

1. Nutrient management. Nitrogen and phosphorous management issues are important throughout the state. Manure digesters were especially topical this year as a few new large-scale digesters were installed in locations around the state with varying degrees of success.
2. Animal welfare. Consumers and producers continue to ask for more research to guarantee animal wellbeing in agriculture. A number of researchers are focusing on these topics.
3. Every year, the Department of Dairy Science holds an all-day "research showcase" in the fall. This is an opportunity for industry leaders to talk about current challenges and to learn about new research from professors, post-docs, and students, which is focused on dairy genetics, nutrition, and the quality and production of milk.
4. The CALS administrative leadership team keeps current on ag stakeholder concerns by meeting 2-4 times a year with the Wisconsin Ag Coalition, a group made up of leaders of major ag producer and processor organizations. This year, they discussed the collegiate strategic plan and offered feedback on steps taken in the first year.
5. The administrative leadership also meets twice yearly with a Board of Advisors. The 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.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	6556599	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	5919055	0
Actual Matching	0	0	5919055	0
Actual All Other	0	0	0	0
Total Actual Expended	0	0	11838110	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	4578740	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

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
101	Appraisal of Soil Resources			3%	
112	Watershed Protection and Management			6%	
123	Management and Sustainability of Forest Resources			6%	
131	Alternative Uses of Land			6%	
134	Outdoor Recreation			3%	
135	Aquatic and Terrestrial Wildlife			8%	
136	Conservation of Biological Diversity			8%	
301	Reproductive Performance of Animals			8%	
303	Genetic Improvement of Animals			6%	
305	Animal Physiological Processes			3%	
312	External Parasites and Pests of Animals			3%	
502	New and Improved Food Products			3%	
503	Quality Maintenance in Storing and Marketing Food Products			3%	
605	Natural Resource and Environmental Economics			3%	
610	Domestic Policy Analysis			6%	
701	Nutrient Composition of Food			3%	
702	Requirements and Function of Nutrients and Other Food Components			13%	
721	Insects and Other Pests Affecting Humans			3%	
722	Zoonotic Diseases and Parasites Affecting Humans			3%	
723	Hazards to Human Health and Safety			3%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	154.0	0.0
Actual Paid	0.0	0.0	17.9	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	854455	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	854455	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 funds are being used to address a number of state priority research activities that cannot be classified as 'Global Food Security', 'Climate Change', 'Sustainable Energy', Childhood Obesity', and 'Food Safety'. 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, animal health, including wildlife and non-farm animals, applied statistics in support of agricultural research, policy analysis for use in land use planning and commodity programs, immigrant farm labor issues, management of invasive exotic organisms and bio-waste management.

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. Examples can be seen in our stakeholder information section provided elsewhere in this report.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2014

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	50	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Output measures for this project include patents, graduate students trained, and publications. This estimated output will be refined as we gain experience with this measure for Formula Grant supported work. Graduate Students Trained:31

Year	Actual
2014	20

Output #2

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 earlier 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. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. The number of submitted publications is below.

Year	Actual
2014	50

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications:51

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications:51

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Water quality modeling in Lake Mendota: do the bacteria matter?

Harmful algal blooms pose an environmental problem nationwide, with severe impacts on the economy, aquatic ecosystems and human health. Such blooms may produce toxins that can create dead zones in the water, raise treatment costs for drinking water, hurt industries that depend on clean water, and sicken or kill people and animals. It is crucial to learn more about the fundamental mechanisms responsible for bloom formation, toxin production, and nutrient recycling in order to make more accurate predictions of when and why toxic blooms form.

What has been done
Researchers studied bacteria in a freshwater lake that suffers from chronic blue-green algal blooms, focusing on how different forms of the nutrient nitrogen influence which types of blue-green algae are present during critical times of the year. The results point to a previously unrecognized role for nitrogen metabolism in the production of toxins by blue-green algae (cyanobacteria). The group also analyzed a decade of archived samples from the lake to learn more about how the kinds of microbes present in the lake change throughout a year and from year to year. These changes have important implications for carbon and nutrient cycling in the

lake. Findings from this work have been incorporated into conceptual and computational models used to quantify the role of bacteria in providing such ecosystem services as maintaining clean water, recycling nutrients and sequestering carbon. The models may be used for a number of purposes, including informing agricultural management decisions about nutrient application.

Results
Researchers have created a water quality model that can forecast the effects of reduced nutrient inputs on algae and other microorganisms, making it useful to all lake stakeholders, including those making agricultural management decisions.

Results have been presented at meetings of the American Society for Microbiology and the International Society for Microbial Ecology. The work has fueled international collaborations with researchers in Germany and Sweden via the Global Lakes Ecological Observatory Network. Samples collected as part of the project were analyzed in collaboration with the Earth Microbiome Project. The Joint Genome Institute recently sequenced some 100 samples from the dataset, and researchers continue to analyze those data. Preliminary results from this analysis were the foundation for a new NSF-funded project aimed at inferring ecological traits from genome sequences in order to parameterize water quality models. Findings have also fueled two other successful grant applications.

Funding: WIS01516
More Information: Katherine McMahon, tmcmahon@engr.wisc.edu
Knowledge area(s): 112

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
131	Alternative Uses of Land
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
301	Reproductive Performance of Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
312	External Parasites and Pests of Animals
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
605	Natural Resource and Environmental Economics
610	Domestic Policy Analysis
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components

721	Insects and Other Pests Affecting Humans
722	Zoonotic Diseases and Parasites Affecting Humans
723	Hazards to Human Health and Safety

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

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 outputs 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 outcomes. Training graduate students is a priority to 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

N/A

Key Items of Evaluation

N/A

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Global Food Security and Hunger

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			10%	
202	Plant Genetic Resources			5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			4%	
204	Plant Product Quality and Utility (Preharvest)			4%	
205	Plant Management Systems			4%	
211	Insects, Mites, and Other Arthropods Affecting Plants			5%	
212	Diseases and Nematodes Affecting Plants			8%	
216	Integrated Pest Management Systems			4%	
301	Reproductive Performance of Animals			4%	
302	Nutrient Utilization in Animals			8%	
303	Genetic Improvement of Animals			5%	
304	Animal Genome			4%	
305	Animal Physiological Processes			8%	
307	Animal Management Systems			8%	
311	Animal Diseases			4%	
315	Animal Welfare/Well-Being and Protection			3%	
501	New and Improved Food Processing Technologies			3%	
601	Economics of Agricultural Production and Farm Management			3%	
604	Marketing and Distribution Practices			3%	
702	Requirements and Function of Nutrients and Other Food Components			3%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	57.0	0.0
Actual Paid	0.0	0.0	51.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	2062076	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	2062076	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 security and hunger 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 livestock and crop food sources, especially in the upper Midwestern US, but many projects will have broad applications beyond our borders, including herbicide resistance, identification and application of genes of economic significance, practices for maintaining soil fertility, conservation and management of crop genetic resources, technologies to improve fertility in livestock, and management of a variety of globally important micro-organisms.

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. Examples can be seen in our stakeholder section information provided elsewhere in this report.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	64	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Output measures for this project include patents, graduate students trained, and publications. This estimated output will be refined as we gain experience with this measure for Formula Grant supported work. Graduate Students Trained:47

Year	Actual
2014	45

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications:113

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications:113

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	64

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Methods to increase reproductive efficiency in dairy cattle-(NC1038)

Reproductive efficiency, the rate at which cows become pregnant within the herd has a major impact on a dairy farm's total milk production and bottom line. While major improvements in efficiency have been made by adopting a timed breeding technique, many cows require a second or third breeding before actually developing a viable pregnancy. It is important to speed the breeding process along because the longer a cow goes before becoming pregnant again, the more likely she isn't going to breed at all and will have to be removed from the herd. Farmers need better methods that improve the success of these breeding attempts and minimize the time between breeding cycles, helping to maximize each animal's contribution to overall farm productivity.

What has been done
A team of University of Wisconsin-Madison scientists is conducting studies to assess and improve methods to resynchronize the ovulation of cows that failed to conceive during a previous breeding attempt. They are comparing common methods to various modified approaches, varying the timing and sequence of hormone injections, etc., and assessing the effect of these modifications

on blood hormone levels, ovarian responses and conception rate in cows. Through this work, the team is also helping to evaluate a pregnancy test for cows that is being commercialized and further developed by a private company. This product evaluation should assist in developing a simple, fast and inexpensive on-farm pregnancy test that can save dairy farmers the expense of having a veterinarian conduct cow-by-cow physical exams.

Results

To help reach their overarching goal of improving dairy reproductive efficiency, researchers have developed methods that increase the success of breeding and reduce the time between breeding attempts in dairy cows. They have held two reproductive workshops for 60 bovine practitioners to disseminate these results. They have also shared this information at dozens of UW-Extension meetings in Wisconsin with over 500 dairy farmers, industry representatives and bovine practitioners in attendance. This long-term project has also supported the training of 11 master's students and four doctoral students, and led to the publication of 13 peer-reviewed papers.

Funding: WIS01581
More Information: Paul Fricke, pmfricke@wisc.edu
Knowledge area(s): 301,305,307

4. Associated Knowledge Areas

KA Code	Knowledge Area
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
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
216	Integrated Pest Management Systems
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
304	Animal Genome
305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection
501	New and Improved Food Processing Technologies
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices
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

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 outputs 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 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

N/A

Key Items of Evaluation

N/A

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Climate Change

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			14%	
132	Weather and Climate			5%	
133	Pollution Prevention and Mitigation			10%	
201	Plant Genome, Genetics, and Genetic Mechanisms			5%	
202	Plant Genetic Resources			5%	
206	Basic Plant Biology			5%	
306	Environmental Stress in Animals			3%	
307	Animal Management Systems			5%	
311	Animal Diseases			3%	
401	Structures, Facilities, and General Purpose Farm Supplies			3%	
402	Engineering Systems and Equipment			3%	
403	Waste Disposal, Recycling, and Reuse			10%	
404	Instrumentation and Control Systems			3%	
601	Economics of Agricultural Production and Farm Management			8%	
605	Natural Resource and Environmental Economics			3%	
609	Economic Theory and Methods			3%	
610	Domestic Policy Analysis			3%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			3%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			3%	
903	Communication, Education, and Information Delivery			3%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.0	0.0
Actual Paid	0.0	0.0	25.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	1325672	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1325672	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

Our faculty has initiated several projects that anticipate the impacts of climate change on agricultural and wild ecosystems in the upper Midwestern US. The State of Wisconsin has initiated a Wisconsin Climate Change Initiative (WICCI) group that brings together our faculty and interested clientele from other agencies and industries to discuss and plan for research on, and adaptive response to, climate change. Current projects include work on development of monitoring systems for detecting changes in ecosystems structure and processes over time, soil carbon management practices, silvicultural practices to help ameliorate ecosystem changes resulting from anticipated climate change, remote sensing detection of insect and disease problems associated with climate change, and modeling of conservation practices and land use patterns that might result from climate change.

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. Examples can be seen in our stakeholder section information provided elsewhere in this report.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year:	2014
Actual:	1

Patents listed

Title: Plant Virus Ires Element for Bicistronic Vector Expression in Plant System
Investigator: Aurelie Rakotondrafara
Patent Application: 14/593700 (filed 11/08/2013)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	37	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Output measures for this project include patents, graduate students trained, and publications. This estimated output will be refined as we gain experience with this measure for Formula Grant supported work. Graduate Students Trained:19

Year	Actual
2014	26

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications: 22

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications: 22

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	37

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Fertilizer-Grade Phosphate Recovery from Wastewater Treatment Plants, Part II

Phosphorus is a big headache for municipal wastewater treatment plants. Phosphorus levels are high in incoming wastewater and must be reduced before treated water can be released back into the environment, where the nutrient can contaminate surface waters and cause algal blooms. Phosphorus also causes problems inside the treatment plant itself, where it crystalizes into a cement-hard mineral called struvite that clogs pipes, pumps and valves and must be removed. Treatment plants need a better way to deal with these phosphorus problems.

What has been done
A team of University of Wisconsin-Madison scientists has developed an efficient method to extract phosphorus from wastewater early in the wastewater treatment process. The method, which can be fully automated and integrated into many existing facilities, involves intercepting sewage in the first, short step in full anaerobic digestion, when the sewage sludge, known as organic acid digest at this stage, contains the highest concentration of dissolved phosphorus. At this point, the sludge is centrifuged, separating liquids from solids, and then calcium hydroxide is added to the liquid fraction. This causes the phosphorus to form calcium phosphate crystals that fall out of solution and are easy to collect (while the remaining solids and liquids are returned to the digestion

process). The resultant mineral, known as brushite, is a very promising fertilizer. It scored well on a chemical measure of plant-availability, and it performed as well as other popular phosphorus-based fertilizers in greenhouse trials.

Results
A novel method to remove phosphorus from municipal wastewater has multiple benefits. It helps keep wastewater treatment plants running smoothly, protects surface waters from phosphorus contamination and creates a new saleable product that treatment plants can sell a fertilizer of recycled phosphorus to help offset operation costs.

Researchers have developed and patented a method that extracts more phosphorus and does so earlier in the wastewater treatment process than rival methods. The approach is now being developed and commercialized by Nutrient Recovery & Upcycling (NRU), a spinoff company founded by scientists involved in the initial research. Since its founding in 2011, NRU has received two federal Small Business Innovation Research grants to support this work. The Phase II SBIR grant, which totaled $450,000 and helped attract an additional $75,000 in support from the state of Wisconsin, is helping to finance the manufacture (by a Milwaukee-based company) and installation of pilot-scale phosphorus-removal equipment at a sewage treatment plant in Woodbridge, Illinois in spring 2015. The grant will also enable the company to study the effectiveness of brushite as a fertilizer in field trials, helping to bring the technology closer to commercialization.

Funding: WIS01573
More Information: Phillip Barak, phillip.barak@wisc.edu
Knowledge area(s): 403

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
132	Weather and Climate
133	Pollution Prevention and Mitigation
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
206	Basic Plant Biology
306	Environmental Stress in Animals
307	Animal Management Systems
311	Animal Diseases
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
404	Instrumentation and Control Systems
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
609	Economic Theory and Methods
610	Domestic Policy Analysis

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
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

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 outputs 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 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

N/A

Key Items of Evaluation

N/A

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Sustainable Energy

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources			4%	
102	Soil, Plant, Water, Nutrient Relationships			4%	
104	Protect Soil from Harmful Effects of Natural Elements			4%	
112	Watershed Protection and Management			4%	
131	Alternative Uses of Land			4%	
201	Plant Genome, Genetics, and Genetic Mechanisms			4%	
202	Plant Genetic Resources			6%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			4%	
204	Plant Product Quality and Utility (Preharvest)			4%	
205	Plant Management Systems			4%	
206	Basic Plant Biology			12%	
215	Biological Control of Pests Affecting Plants			4%	
216	Integrated Pest Management Systems			4%	
511	New and Improved Non-Food Products and Processes			12%	
601	Economics of Agricultural Production and Farm Management			4%	
603	Market Economics			4%	
605	Natural Resource and Environmental Economics			6%	
608	Community Resource Planning and Development			4%	
610	Domestic Policy Analysis			4%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			4%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	9.0	0.0
Actual Paid	0.0	0.0	15.2	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	466380	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	466380	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

Our engineering and life science faculty have become heavily involved in the development of sustainable energy systems for the upper Midwestern US. Projects are ongoing in the areas of energy efficient construction technologies for farm buildings, textile material development with energy conservation applications, bioconversion of cellulose to fuel ethanol, value-added uses of byproducts of biofuel production systems, capacity building in support of bio-fuels outreach development, evaluation and production of various new bio-feedstocks, and carbon sequestration issues on private and public lands.

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. Examples can be seen in our stakeholder section information provided elsewhere in this report.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	26	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Output measures for this project include patents, graduate students trained, and publications. This estimated output will be refined as we gain experience with this measure for Formula Grant supported work. Graduate Students Trained:11

Year	Actual
2014	12

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications:13

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications:13

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	26

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Ecology and Management of European Corn Borer and other lepidopteran pests of corn

Corn is grown on more than 90 million acres of farmland across the nation each year, and insect pests of corn present a huge challenge for U.S. farmers. The European Corn Borer, for one, is estimated to cause in excess of $1 billion worth of corn yield reductions in the U.S. each year. While insecticides and genetically modified corn have helped reduce the risks associated with insect damage, it's only a matter of time before resistance to existing control measures arises among insect pest populations. New options are needed.

An underdeveloped resource for insect control lurks in entomopathogenic nematodes and bacteria (EPNB). The study of these complexes, which are composed of bacteria-carrying nematodes that can infect and kill a wide variety of insects, has the potential to yield novel insecticidal compounds as well as new-and-improved EPNB complexes with increased lethality and target specificity.

What has been done

Researchers at the University of Wisconsin-Madison are working to identify the specific compounds made by EPNB bacteria that weaken or kill target insects, as well as the bacterial genes that are involved in the production of these compounds. Several promising compounds have been identified that are toxic to or suppress the immunity of these insects. Some of these compounds appear to act specifically on the target insect pests, decreasing the chance that they would inadvertently harm beneficial, non-target insects such as pollinators and butterflies. Genetic studies have helped identify and characterize a gene regulator involved in turning key virulence genes on and off in EPNB bacteria. This work is laying the foundation for the development of improved EPNB complexes with superior performance.

Results
Research on EPNB complexes has yielded a number of promising new insecticidal compounds. Once the specific compounds are known and described, they will be made available for commercial development and could come to market in the next 10 years. This work has been described in several peer reviewed journal articles, and four more papers are in preparation. The findings have also been shared at numerous academic talks. Three doctoral students and two post-doctoral fellows have received training while working on this project.

Funding: WIS01582
More Information: Heidi Goodrich-Blair, hgblair@bact.wisc.edu
Knowledge area(s): 215, 216

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
112	Watershed Protection and Management
131	Alternative Uses of Land
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
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
610	Domestic Policy Analysis
803	Sociological and Technological Change Affecting Individuals, Families, and

Communities

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 outputs 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 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

N/A

Key Items of Evaluation

N/A

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Childhood Obesity

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			6%	
206	Basic Plant Biology			6%	
305	Animal Physiological Processes			19%	
502	New and Improved Food Products			13%	
701	Nutrient Composition of Food			6%	
702	Requirements and Function of Nutrients and Other Food Components			13%	
703	Nutrition Education and Behavior			19%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			6%	
724	Healthy Lifestyle			6%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			6%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.0	0.0
Actual Paid	0.0	0.0	8.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	354701	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	354701	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 Nutritional Sciences, Biochemistry, Food Science, and Genetics are assessing the causes and consequences of childhood obesity. Ongoing projects include work in nutritional aspects of diabetes, promotion of healthful eating campaigns, dietary markers of human health and nutrition, obesity prevention, and related studies.

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. Examples can be seen in our stakeholder section information provided elsewhere in this report.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2014

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	9	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Output measures for this project include patents, graduate students trained, and publications. This estimated output will be refined as we gain experience with this measure for Formula Grant supported work. Graduate Students Trained:2

Year	Actual
2014	9

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications:1

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications:1

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Evaluation of Wisconsin school lunch programs to prevent childhood obesity and improve nutrition

Prevalence of obesity among school-age children has tripled since the 1970s, putting kids at risk for continued obesity and related health problems well into adulthood. One method of improving children's diets is to increase children's consumption of fruits and vegetables as well as the nutritional value of meals. "Farm-to-School" programs bring locally grown fruits and vegetables into school lunches and include instruction (often from farmers themselves) about how they are grown, their nutritional value and how to prepare them. While clearly such programs are well intended, we need concrete information about their impact on children's consumption of fruits and vegetables and understanding of the links between nutrition and health.

What has been done
Research conducted at elementary schools around Wisconsin analyzed changes in eating habits and attitudes about fruits and vegetables among children in grades 3 to 5 who were exposed to Farm to School programs. Part of the study involved analyzing "before and after" photos of some 4,500 student lunch trays to see which foods had been eaten. Children at schools with established Farm to School programs consumed more than twice as much fruits and vegetables

at lunch than kids at schools that were just starting Farm to School. Moreover, students in schools with several years of Farm to School programs were more likely to choose a greater variety of fruits and vegetables.

Results
The research demonstrated that Farm-to-School programs are associated with an improvement in the nutritional quality of school lunches and their consumption. Thus far, the programs have not, however, been associated with less obesity. This and other longer-term results from such programs await further study. However, children who were exposed to school lunch programs that included locally grown fruits and vegetables as well as education about their nutritional value chose to eat more of them, a habit that, over time, could lead to less obesity and improved overall health among young people. Researchers shared their findings at professional gatherings of the American Public Health Association, The Obesity Society and the Wisconsin Farm-to-School Summit.

Further research on the impacts of Farm-to-School is being conducted as part of the Transform Wisconsin Fund, a three-year, $15 million grant from the Centers for Disease Control and Prevention administered by the UW's Wisconsin Clearinghouse for Prevention.

Funding: WIS01634
More Information: Beth Olson, Dale Schoeller, bholson@wisc.edu
Knowledge area(s): 703, 724, 803

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
305	Animal Physiological Processes
502	New and Improved Food Products
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
724	Healthy Lifestyle
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

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 outputs 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 outcomes. 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

N/A

Key Items of Evaluation

N/A

V(A). Planned Program (Summary)

Program # 6

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
212	Diseases and Nematodes Affecting Plants			7%	
305	Animal Physiological Processes			3%	
311	Animal Diseases			11%	
501	New and Improved Food Processing Technologies			7%	
502	New and Improved Food Products			15%	
503	Quality Maintenance in Storing and Marketing Food Products			3%	
701	Nutrient Composition of Food			3%	
702	Requirements and Function of Nutrients and Other Food Components			3%	
703	Nutrition Education and Behavior			3%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			7%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			35%	
903	Communication, Education, and Information Delivery			3%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	25.0	0.0
Actual Paid	0.0	0.0	16.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	855771	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	855771	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 development and evaluation of improved technologies in food processing, on-farm food safety practices and the root cause of Salmonella have received increasing attention from faculty in several departments. Research is being conducted on several important food toxins and their causal organisms (e.g. Aspergillus), mastitis resistance as a component of on-farm food safety, the development of new thermal food preservation technologies, biotoxins and food safety, nanotechnology applications in food sensors, residual pesticides in foods, symbiotic associations between antibiotic producing bacteria, and several other areas.

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. Examples can be seen in our stakeholder section information provided elsewhere in this report.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Year:	2014
Actual:	2

Patents listed
Title: Preparing Flexible Carbon Nanotube Thin-Film Using a Diazo Dye as a Dispersant and Template
Investigator: Sundaram Gunasekaran
Patent Application: 61/986973 (filed 4/14/2014)

Title: Remediating Effluents Containing Heavy Metals Complexed with Organic and Inorganic Species
Investigator: Sundaram Gunasekaran
Patent Application: 6/035130 (filed 6/20/2014

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	30	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Output measures for this project include patents, graduate students trained, and publications. This estimated output will be refined as we gain experience with this measure for Formula Grant supported work. Graduate Students Trained: 21

Year	Actual
2014	18

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications:39

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. The output measures listed earlier 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. Finally, we will use the Thomson ISI Essential Science for agricultural science as one of our measures of impact of our research program. Our target for these outcome measures is to be ranked in the top 5 institutions in the United States. We will continue to develop impact statements for individual projects which have shown exemplary and significant impact. Publications:39

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	30

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Title: Improvement of Thermal and Alternative Processes for Foods

The U.S. ice cream industry generates more than $10 billion in sales each year, making it one of our nation's most popular treats. It is, however, a treat that can be high in fat. In the interest of public health, it is of great societal and economic benefit to develop lower-fat ice cream that consumers can turn to as a genuinely acceptable option rather than a less palatable "diet" food. There is a growing market for such alternatives, as the rise of such lower-fat options as frozen yogurt demonstrates. Research enabling manufacturers to control ice crystal formation and other key structural factors determining texture and flavor will allow them to develop and serve that market.

What has been done
A key factor in determining ice cream quality and shelf life is the size of ice crystals, with small ice crystals being optimal for both. Better understanding of ice crystal formation during ice cream production is helping manufacturers' better control crystal size, to the benefit of ice cream consumers. Researchers used a scraped surface freezer to study the formation of ice crystals during the ice cream production. They evaluated ice crystal size distribution under carefully controlled operating conditions, studying the effects of those conditions on ice formation and the

ripening of crystals in both full-fat and reduced-fat ice creams. They were able to develop a novel mechanism that explains ice crystal formation in ice cream, as well as a working model to predict ice crystal size under various operating conditions. They also studied methods to produce small ice crystals within the freezer. The team's mechanism and research findings led to specific recommendations for ice cream manufacturers regarding freezer operation, offering manufacturers of both ice cream and ice cream equipment information they need to produce better products.

Results
Results of this project were shared at the Institute of Food Technologies (IFT) Annual Meeting and at an industry-sponsored advanced symposium on ice cream. Based on the industry's keen interest in this work, it is likely that some ice cream companies have incorporated these recommendations into their ice cream-making protocols (we cannot know for sure as this information is proprietary). The project also served as the basis of a number of publications with widespread influence among researchers, the ice cream industry and beyond.

Funding: WIS01512
More Information: Richard Hartel, rwhartel@wisc.edu
Knowledge area(s): 502

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Diseases and Nematodes Affecting Plants
305	Animal Physiological Processes
311	Animal Diseases
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
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
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

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 outputs 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 outcomes. 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

N/A

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.