Center for Sustaining Agriculture & Natural Resources

Science In Action to Improve the Sustainability of Agriculture, Natural Resources & Food Systems

2015 Annual Report
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Jill Smith, Pure Eire Dairy
Bill Warren, Warren Orchards
Rachel Wieme, WSU Graduate Student Representative
The WSU Center for Sustaining Agriculture & Natural Resources (CSANR) can best be described as an incubator for research and education embedded within WSU. Our goal is to connect affiliated faculty and students with the stakeholders, opportunities and resources necessary to initiate valuable research and educational activities that advance the sustainability of food and agriculture in the state of Washington. Our external Advisory Committee is instrumental in helping us define both our annual and long-term priority investments, identifying important emerging needs and ensuring that we stay focused on challenges that matter to the state. We utilize a number of different strategies to achieve our goals, including three internal grant programs (BIOAg, SARE PDP, and Kaiser Conservation Endowment), coordinated program and project efforts, and partnerships with other centers, departments, institutes, agencies, industry and non-governmental organizations.

The breadth and depth of the Center’s work is quite incredible for a relatively small unit in the University. We have an excellent track record facilitating the success of WSU faculty with expertise in a very broad set of disciplines and issues. The mission that ties the Center’s work together is our commitment to generating and disseminating scientific knowledge that improves the sustainability of agriculture, natural resource and food systems in Washington State.

In 2015, the Center awarded 14 new BIOAg grants to initiate research inquiries in new areas and to provide educational training to Washington farmers and ranchers. These grants provided funding to 14 faculty members from 9 different WSU units. In addition, we partnered with the State of Washington Water Research Center and the Center for Environmental Research, Education and Outreach to fund 3 Food-Energy-Water Nexus Grand Challenge seed grants, which included 6 WSU faculty affiliates new to CSANR. This brings our total affiliated faculty to 146, representing 19 different units.

Through the diverse efforts of our affiliated faculty and students, more than $10 million in new extramural grants and contracts were secured and more than 50 new research papers and 16 formal Extension publications were completed in 2015. In this report, you’ll read a few examples of the work from our affiliated faculty and students. We also post final reports from our BIOAg grant programs in our grants database (csanr.wsu.edu/csanr-grants/database/) as well as research and extension publications resulting from these and other projects on our website (csanr.wsu.edu/publications/). There is literally tens of millions of dollars’ worth of research-based information warehoused on our website for use by Washington’s food and farming community.

As I interact with people throughout the state there is never a shortage of interesting research ideas or challenging problems to solve that may improve the sustainability of food and agriculture in Washington. Virtually every project we work on was spurred through a conversation with someone who cares about the sustainability of Washington’s food and agriculture system. Please feel free to contact me, program faculty and staff or members of the CSANR Leadership Team listed on page 12.

If you don’t know the Center’s work, I encourage you to take a look at this annual report. If you do know the Center’s work historically, I’d encourage you to take a new look at us as I suspect that our affiliated faculty are doing work you didn’t know about. Either way, in addition to the snap-shot presented in this report, I’d encourage you to dig deeper on our website and blog (csanr.wsu.edu) or follow us via social media on Facebook (/CSANR) and Twitter (@wsuCSANR).

Chad Kruger
Director
New BIOAg Grant Projects Funded in 2015

The Center for Sustaining Agriculture & Natural Resources administers the Biologically Intensive Agriculture & Organic Farming (BIOAg) grant program on a yearly basis. BIOAg is our internal competitive grant program that we use to initiate new research and education activities focusing on biologically intensive and organic approaches to sustainable agriculture. For more go to bit.ly/BIOAg.

ID 156  Creation of a web-based training course to promote biological control. *Pl: U. Chambers*

ID 154  Flexible farming (FlexFarm) production systems: integrating crops and livestock for diverse, resilient, and sustainable agricultural landscapes. *Pl: K. Johnson*

ID 153  Bovine-avian interactions on dairies: improving cow welfare and farm economic stability by implementing effective and sustainable bird deterrence methods. *Pl: A. Adams-Progar*

ID 152  WSU Plasticulture website development. *Pl: J. Cowan*

ID 151  Birds and biosecurity: contact rates and parasite exchange between livestock and songbirds. *Pl: J. Owen*

ID 150  Determining the effect of biodegradable and living mulches on annual weeds and growth of newly-planted blueberry. *Pl: T. Miller*

ID 149  Spatial and temporal dynamics of attracting green lacewings to synthetic lures in apple orchards for pest suppression. *Pl: V. Jones*

ID 148  Breeding colored wheat and barley for nutrition and novelty for low-input integrated farms. *Pl: S. Jones*

ID 147  Improving anaerobically digested dairy manure solids by economical post treatment to create value-added and sustainable greenhouse potting mix fiber products. *Pl: R. Hummel*

ID 146  Soil health and pasture productivity under mob grazing and fertility management. *Pl: T. Hudson*

ID 145  Bi-functional crops: fall-sown cool season grain legumes provide cover crop attributes. *Pl: S. Guy*

ID 144  Understanding the molecular basis of plant response to organic versus conventional fertilizer using a metatranscriptomic approach. *Pl: A. Dhingra*

ID 143  The search for acid-tolerant rhizobia to improve pulse production. *Pl: L. Carpenter-Boggs*

ID 142  Garden-based STEM nutrition and biology K-12 curriculum to increase pulse consumption. *Pl: C. Miles*
Ultraviolet-C light technology for improving safety of organic fruits

Researchers: Shyam Sablani, Karen Killinger, Barbara Rasco

Dr. Sablani and his team have received funding through CSANR’s BIOAg grant program to research new techniques for improving organic fruit safety. These projects focused on finding a method for removing food-borne pathogens from the surface of organic fruits that achieves the same level of efficacy as the methods used for conventionally grown fruits, namely chlorine and other chemical-based methods. This project has particular relevance given that the Food Safety Modernization Act (recently adopted by the Food and Drug Administration) now requires the adoption and implementation of science based preventative controls for growers and packers of all fresh produce to minimize the risk of human pathogens.

The team investigated how well ultraviolet-C (UV-C 254nm) light could sanitize the surface of fruits. Their research indicated that UV-C light was effective at reducing the Listeria monocytogenes and E. coli O157:H7 from apples, pears, raspberries, strawberries, and cantaloupes. The level of microbial reduction and the UV-C dose required to achieve particular reduction depend on the morphology of fruit surface and target pathogen. For example, Listeria monocytogenes is more UV-C light resistant than E. coli O157:H7. A maximum reduction of 2.9 log CFU/g and 1.7 log CFU/g was achieved for Listeria monocytogenes and E. coli O157:H7, respectively. The microbial inactivation rates were higher for less hydrophobic fruits with smoother surfaces (apples and pears) as compared to fruits with rougher surfaces (cantaloupe, strawberry and raspberry). The levels of microbial reductions achieved on fruit surfaces using UV-C light were comparable to the chlorine-based methods.

This study produced many publications and additional research is underway using funding that was leveraged as a result of this project. For more information on this BIOAg project visit bit.ly/Sablani.

Understanding the molecular basis of plant response to organic versus conventional fertilizer

Researchers: Amit Dhingra and Preston Andrews

Through earlier BIOAg-supported research, Dr. Andrews, Dr. Dhingra and their teams demonstrated that tomato fruit grown under an organic fertilizer regime has higher phytonutrient content. Additional BIOAg funding in 2013 enabled Dr. Dhingra and his team to perform a global analysis of the gene expression in these tissues where higher phytonutrients were detected, to better understand the molecular basis of the plant response to organic fertilizers.

Dhingra and Andrews were able to establish that the same plant variety adjusts its global gene expression in response to different nitrogen regimes (organic versus conventional). Growth under an organic fertilizer regime resulted in differential expression of the tomato genome, and higher expression was demonstrated by genes and pathways associated with the phytonutrients that were previously observed to be significantly higher under organic fertilizer regime. Data collected in the project enabled the identification of these genes and associated pathways, including lycopene, ascorbate, soluble solids, and salvage pathways.

Building on these results, the team, supported by a new BIOAg funded project (bit.ly/BIOAg144), is evaluating if different fertilizer regimes will elicit differential expression of nitrogen metabolism genes in the roots and if different microbiomes (communities of microorganisms – primarily bacteria and fungi beneficial to plant growth and development) will be fostered under organic nitrogen conditions. The gene-based knowledge generated through their investigation is expected to facilitate identification of genotypes that are able to utilize organic fertilizer efficiently. The methodology developed through these projects with BIOAg support is being applied to study the impact of different soil inputs on genome-wide responses in tomatoes and grasses supported by other funding agencies.
The challenges of increasing inherent soil fertility and controlling weeds associated with the transition from conventional to organic wheat cultivation in the dryland inland Pacific Northwest serve as large barriers to producing organic wheat. The three-year transition period is often associated with increased weed pressure and decreased yields, resulting in large losses in revenue for growers. These challenges have slowed the adoption of organic agriculture in the dryland region of the inland Northwest, relative to other areas of the U.S. To address these challenges and investigate management methods to increase productivity during the transition period and into the certified organic production period, a long-term organic cropping systems trial was established near Pullman, WA.

Phase I examined different crop rotation strategies with wheat, winter pea green manure, and an alfalfa forage mix to evaluate the ability of different rotations to compete with weeds and increase soil nitrogen during the transition period. In Phase II, the researchers capitalized on the lessons learned during the transition period and focused on creating sustainable organic rotations. The strategy of intercropping small grains and pea green manure was investigated to provide weed control and soil nitrogen while producing a wheat crop (see figures A-C).

The project produced new information that growers can use to meet challenges during the transition period and into certified organic production. Research findings have been extended to producers in a number of ways, including the following:

- Provided farm tours, speakers and presentations for approximately 160 total participants. Subsequent press from these events led to increasing outreach of new methodologies.
- Research findings were published in peer-reviewed journals.
- Interviews with 12 organic small grains producers in the inland Pacific Northwest, were published as a collection of case studies, as a Pacific Northwest Extension Publication.
- Results from a survey of certified organic growers in five Northwest states were published in a report available online.
- Adoption of surface tillage practices for weed management developed in this research by a grower near Fairfield, WA.
- Adoption of a precision weed management tool developed in this research by a grower near Pendleton, OR.

Several Organic Crop and BIOAg grants from CSANR enabled this research team to apply for more funding over the course of the study. Since that time, this project has leveraged grants totaling over $1 million for research spanning through 2014. In addition, the project published multiple articles, provided various extension programming opportunities and facilitated successful grower networks. For BIOAg project reports, please see csanr.wsu.edu/investigators/burke-ian/.
Featured BIOAg Projects

Project Research Photos:

A) Winter pea grown for green manure during the conventional-to-organic transition period, near Pullman, WA; B) Intercropped spring wheat and spring pea green manure near Pullman, WA; C) The rotary hoe was an important component of the organic weed management program throughout the study. The rotary hoe dislodges small, shallow-rooted weed seedlings when operated at high speeds across the field. It is a popular post-emergence weed control tool for many organic growers in the inland Pacific Northwest.

Publications:


I have directed CSANR since Chris Feise’s retirement in early 2008 (2008-2010 in an interim capacity). It’s an incredibly inspiring job and an enormous privilege for me to serve my home state in this capacity. Entering 2015 I literally couldn’t have imagined any other opportunity in the University that would interest me. Well, apparently CAHNRS Dean Ron Mittelhammer has a bigger imagination than me!

In August of 2015, I moved to Mount Vernon to assume the directorship of WSU’s Northwestern Washington Research & Extension Center (NWREC) while also maintaining my role as CSANR Director. NWREC is one of the College’s four regional farm and laboratory facilities with a mission focused on agricultural research and extension relevant to the northwest region of the state. NWREC is the only unit at WSU in which all of the unit faculty members are also affiliated faculty of CSANR, so in many ways this was a “natural fit” for me.

While this move creates some additional potential synergies for CSANR and NWREC (such as the new Organic Major at WSU Everett) as well as an opportunity to translate some of my place-focused programmatic work to northwest Washington (including climate and water projects), I think it’s important to clarify that this move is NOT a merger of CSANR and NWREC. These are and will remain two separate and independent units with distinct purposes and missions. NWREC is a physical campus focused on research, teaching and extension targeted toward the unique regional character of Northwest Washington. CSANR continues its state-wide mandate and mission that includes, but is not limited to the geographic scope of northwest Washington. Also, at this time, no other CSANR faculty or staff will relocate with me, and we continue to house people throughout the state appropriate to the work that they are directly engaged in.

Obviously, this move adds a significant amount of responsibility to my plate and raises a concern regarding continued effective leadership for CSANR. To replace CSANR’s “lost administrative capacity” we have appointed Georgine Yorgey as Assistant Director of CSANR. Georgine has worked with me for the past 7 years as a research associate in the climate, energy and water program areas of CSANR, where she has made significant contributions to the management and leadership of a number of large team projects. Georgine will continue working in these programs, but she has assumed additional responsibility for several Center-wide efforts including project development and management activities, oversight for a number of administrative functions critical to faculty and staff success, and direct management of several existing projects. In addition to the specific functions she now manages, Georgine brings a fresh perspective and complementary skill set to leadership for CSANR that will help us avoid the trap of complacency in many of the programs and initiatives that have been so successful, such as the BIOAg grant program. Georgine is one of the most talented and conscientious people I have ever known and I’m extremely excited to have her working with me as I continue to lead CSANR.
A second major change for CSANR concerns the Small Farms Program. In late 2015, a Steering Committee completed the process of reviewing recommendations from the Small Farms Program Task Force and presented a proposed plan for reorganization to the Small Farms Team. They then began the operational transition toward a new structure that sets the stage for future investment and coordination to ensure continued success in this important programming area. More details on these changes are described in the article on page 9. Doug Collins agreed to assume interim leadership of the Steering Committee while a process is initiated to identify new long-term leadership.

I want to take this opportunity to acknowledge and thank Marcy Ostrom for over 15 years of leadership for the Small Farms Program. Marcy came to WSU in 2000 with the charge to lead and fund a nationally recognized Small Farms Program at a time that small farm-focused programming was an emerging interest throughout the country. Marcy came to WSU with a vision for programs that utilize farmer-to-farmer learning in multiple venues, classroom-style courses in sustainable and organic farming and ranching, educational opportunities for beginning, immigrant and limited-resource farmers, and research and extension efforts focused on improving farmer access and success in alternative marketing systems. Marcy’s efforts helped to put WSU Small Farms on the map nationally, including a sustained, robustly funded effort in innovative programs like Cultivating Success, immigrant farmer programs, and strong partnerships with other organizations that enhance farmer-to-farmer learning through activities like the Farm Walk partnership with Tilth producers. Marcy will continue to be involved in the renewed Farm and Food Systems Team moving forward, but will now devote her full attention to developing much needed research, teaching, graduate student training and extension activities focused on sustainable food systems.

In addition to the big changes described above, CSANR experienced a number of other programmatic transition in 2015 – as with any organization that is primarily funded through grants and contracts. We are in the process of reviewing, re-organizing, and re-staffing several long-standing programmatic areas including organic agriculture, immigrant farmer education, bioenergy and food systems. These are program areas where the funding landscape and program contexts have changed, and we are re-tooling our approach so that the programs important to our state’s farmers and communities stay competitive and effective. In some of these cases (organic and food systems), the “re-tooling” is happening at the College level -- demonstrating that these issues of long-term importance to CSANR constituents have increased in profile within WSU. That’s a very exciting development for those that have engaged in and supported the Center’s work in these areas for the past 20+ years. Look for more information on these additional programmatic developments in the near future.
In response to citizen requests, Washington State University’s Small Farms Program was established in 2000 by a state legislative allocation to serve the unique needs of the state’s small-scale and minority farmers. The program’s mission is to work with communities across the state to foster profitable, small-scale farms, land and water stewardship, and access to healthy food. The statewide Team is comprised of approximately 45 extension, teaching, research faculty and staff and key external partners.

Over the past fifteen years the Team has had many successes, working on educational opportunities for small farmers, research on sustainable small-scale farming systems, strengthening community food systems, and immigrant farmer programs. Notable successes have included Cultivating Success (a training program for new and transitioning farmers) and the annual Farm Walk program, which is co-facilitated with Tilth Producers of Washington (now Seattle Tilth).

The Small Farms Program has thrived under strong leadership, great team support and a statewide stakeholder advisory group. To guide new investment and ensure continued success, WSU’s Extension Administration convened a Task Force in late 2013. The Task Force, which was comprised of representatives from WSU and external partners evaluated the program and provided a concise set of recommendations for new investments and organizational structures to solidify future success of the program.

Beginning in summer of 2015 and continuing through the end of 2016, an implementation Steering Committee was charged with developing plans and procedures for executing the Task Force recommendations. A group of eleven WSU faculty and staff were appointed to the team including:

Brian Bodah, Chris Benedict, Doug Collins, Jeremy Cowan, Candace Jagel, Paul Kuber, Laura Lewis, Carol Miles, Marcy Ostrom, Clea Rome, and Brooke Saari (facilitator).

The Small Farms Program will now be called the WSU Farm and Food Systems Program, representing the commitment of the team to providing education and programming to a wide, diverse group of stakeholders. The Farm and Food Systems Program is also implementing an official advisory committee, team member application process, steering committee, website overhaul and two new hires within the next two years.

The Farm and Food Systems Program’s updated objectives affirm the Program’s commitment to sustainable production practices, access to healthy food, waste reduction, addressing barriers to distribution, inform policy discussions, contributing to community economic development, and protecting farmland. WSU faculty, staff, and partners bring expertise in multiple fields and are dedicated to extending their work statewide and across disciplines through this partnership. CSANR is committed to supporting this team and thankful to everyone who is contributing to make the Farm and Food Systems Program stronger than ever.
Kirti Rajagopalan, Ph.D. Student in Civil and Environmental Engineering

Kirti Rajagopalan came to United States from beautiful Kerala in southern India, worked in Iowa, and then moved to Washington. Prior to WSU, she was involved in marketing analytics for the agriculture equipment industry. She joined the Ph.D. program in the Civil and Environmental Engineering Department, with Dr. Jennifer Adam in 2010. Her interests include understanding the implications of climate change on regional water resources and agricultural production. Kirti has focused on two projects thus far at WSU. The first is a water supply and demand forecasting project for the Washington Department of Ecology, and the second is BioEarth, a regional scale effort to understand the interactions between the carbon, nitrogen and water cycles, in the context of global change, to inform agriculture and natural resource management decisions.

Kirti’s doctoral research relates to understanding the impacts of climate change on irrigated agricultural production in the Columbia River basin with a focus on the following questions:
1) What are the direct impacts of climate change (temperature and precipitation patterns, and elevated carbon dioxide levels) on irrigation water demands and crop yields?
2) What are the indirect impacts of climate change on agricultural production due to changes in water availability and resulting water shortages?
3) How do these impacts vary over space and time, and what adaptation strategies can help address negative impacts?

Answering these questions can inform decisions that help ensure sustainable water resources for agriculture, now and in the future. Kirti has enjoyed interacting with a broad range of stakeholders as part her dissertation work. Upon graduation she would like to make a career developing relations with stakeholders for agricultural water resources, and carry out tailored research to meet their needs.

Colin Curwen-McAdams, Ph.D. Student in Crop and Soil Sciences

Colin Curwen-McAdams was born and raised outside of Corvallis, OR where his family always had a big garden and he especially liked growing melons – so much so that he used to have a race with his retired neighbor to see who could grow the biggest melons the fastest. The neighbor always won, but this didn’t deter Colin.

Though he entered college at the University of Oregon studying audio engineering and classics, Colin graduated with a degree in environmental science. After graduating, he worked at Seed Savers Exchange in Decorah, Iowa. Participating in the production of seed for the vegetable crops there and working in an orchard of antique apples was a transformative experience for Colin. Afterwards he worked on an organic vegetable farm for a year and was involved in everything from farmers markets to planting, cultivation, harvesting and compost. The time on the farm combined with seeing the diversity of crops at Seed Savers Exchange inspired Colin to study plant breeding.

As a Ph.D. student with Steve Jones in The WSU Bread Lab, Colin’s research focuses on two efforts: breeding perennial wheat, and breeding for novel seed colors and whole wheat bread baking quality in spring wheat. More broadly, his research looks at what plant breeding can do for regional agricultural systems, using wheat as an example. His projects aim to increase the value of the crop in two ways. First, it aims to generate improved revenues through a wheat that is differentiated for the baker and the end consumer. Second, it aims to contribute to better soil quality through enhanced residues and reduced need for tillage. Upon completion of his doctorate, Colin hopes to work as a plant breeder developing varieties for the public domain.
CSANR by the Numbers

2015 List of Funders:

King Conservation District
Laird Norton Family Foundation
National Science Foundation
Seattle Tilth
USDA IR4
USDA Northwest Regional Climate Hub
USDA National Institutes for Food and Agriculture
USDA Natural Resource Conservation Service
Washington State Department of Agriculture
Washington Department of Ecology
Western SARE

CSANR Affiliated Faculty and Staff:

14 faculty were awarded BIOAg grants in the 2015 solicitation, representing Animal Sciences (1), Crop and Soil Sciences (1), Entomology (1), Extension (3), Horticulture (2), TFREC (1), Allen School for Global Animal Health (1), School of Biological Sciences (1), USDA ARS (3). 14 total BIOAg grants were awarded in FY15. In addition, 6 new faculty (all non-CAHNRS) were on successful FEW seed / planning grants. Total affiliated faculty who have received CSANR seed grants is now 146 representing 19 different WSU units.

*Reported grant and contract leveraged awards for 2015 total $10,790,160
CSANR Leadership Team, Program Faculty and Staff

**CSANR Leadership Team**

Chris Benedict, Whatcom County Extension  
Ian Burke, Crop and Soil Sciences  
Jeremy Cowan, Spokane County Extension  
Lindsey du Toit, Plant Pathology  
Kate Evans, Horticulture  
Jim Jensen, Energy Program  
Kris Johnson, Animal Sciences  
Steve Jones, Crop and Soil Sciences  
Laura Lewis, Jefferson County Extension  
Vicki McCracken, Economic Sciences  
Kevin Murphy, Crop and Soil Sciences  
Bill Snyder, Entomology  
Claudio Stockle, Biological Systems Engineering

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**CSANR Faculty & Staff**

**Faculty**  
Chad Kruger, Director  
Georgine Yorgey, Assistant Director  
Doug Collins, Farm and Food Systems  
David Granatstein, Sustainable Agriculture Specialist  
Andy McGuire, Irrigated Cropping Systems Agronomist  
Marcy Ostrom, Farm and Food Systems  
Colleen Donovan, Associate in Research  
Tim Ewing, Research Engineer  
Sonia Hall, Associate in Research  
Elizabeth Kirby, Associate in Research  
Nicholas Potter, Associate in Research  
Kirti Rajagopalan, Associate in Research  
Brooke Saari, Extension Coordinator  
Kate Selting Smith, Extension Educator - Small and Latino Farms  
Tara Zimmerman, Associate in Research

**Staff**  
Liz Allen, Associate in Research  
Sonia Hall, Associate in Research  
Elizabeth Kirby, Associate in Research  
Nicholas Potter, Associate in Research  
Kirti Rajagopalan, Associate in Research  
Brooke Saari, Extension Coordinator  
Kate Selting Smith, Extension Educator - Small and Latino Farms  
Tara Zimmerman, Associate in Research

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