WASHINGTON STATE UNIVERSITY

Center for Sustaining Agriculture and Natural Resources

Annual Report 2022

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CSANR faculty and staff gathered together in June 2022 for a Center retreat, focused on improving communication throughout program efforts.

Director's Message

By: Chad Kruger

I've had the privilege of leading the WSU Center for Sustaining Agriculture & Natural Resources for more than 15 years now. I've always believed that our success comes from a vibrant and engaged team of great people – and the CSANR team has always been great. I've also learned over the years that the more intentional I am about investing in the professional growth of the individuals on team, the more successfully we are able to engage as a team, and the more impactful our work.

After a couple of years of pandemic-limited interaction, the CSANR staff gathered in early summer of 2022 for a professional development and planning retreat. I think I can speak for the group that we had a lot of fun connecting with each other, and that it was an important opportunity for the members of our team (old and new). The thematic focus for this retreat was on effectively communicating science – which is one thing all of us can do better. We had several excellent sessions focused on creative and effective strategies for communicating our work in more meaningful ways.

Andy McGuire (@agronomistag) – who has become a very successful and well-known ag science communicator from our team - shared insights on effective science communication that he developed during his recent sabbatical. The most consequential idea Andy left me with was "selection, not compression". As scientists, we tend to think every variable matters. In reality, we're much more effective communicators when we select the most important information to share. I'm still working to implement this principle!

Alex Kirkpatrick, a PhD grad from the Murrow College of Communication who has worked with the Center for several years, impressed upon us the importance of the credibility of the messenger and not just the message. Most importantly, that the credibility of the messenger is based on the relationship that messenger develops with the community of interest. You need to invest in and engage with people before you can impact their decisions.

After some thought-provoking sessions, this incredible team spent time crafting a simple message about what it is that we do. I've been through a lot of sessions over the last 20 years where we tried to come up with a consensus message that describes our work – and I think we finally hit on one:

Inspired solutions for the future of agriculture and the environment

Yeah, that says it all.

Sincerely,

Chad

Production and food science faculty unite to train next generation

By: Doug Collins, Liz Allen, Lynne Carpenter-Boggs, Girish Ganjyal, & Stephanie Smith

WSU extension and research faculty recently wrapped up a multi-year High-Value Horticulture and Processing internship program. In total, 24 interns were hosted by WSU in the summers of 2018, 2019, and 2022. Support for the project came from the National Institute of Food and Agriculture's Research and Extension Experiences for Undergraduates (NIFA REEU) program. This federal program aims to provide undergraduates hands-on experiences that build new skills that will prepare them for the agricultural workforce. Our WSU team worked at the intersection of sustainable food production, processing technology, and food safety to provide undergraduates nationwide with life-changing research and extension experiences.

Diversity of interns and mentors

Interns came from diverse backgrounds, and many traveled long distances for the opportunity. Across the program, 17 out of 24 interns were women, and 50% self-identified as minorities. Seven interns were WSU students, three were from other WA universities, three were from community colleges in WA, and 11 were from universities outside of Washington, including AL, AZ, CA, GA, OR, MA, NY, PA, and VA. 13 different WSU faculty participated as mentors throughout the program. Mentors came from Extension, Crop and Soil Sciences, Viticulture and Enology, Horticulture, Entomology, and the School of Food Science.

Building a horticulture and processing cohort

One goal of our program was to intentionally connect interns in a peer learning community. Half of the interns were hosted at Research and Extension Centers (RECs) in Wenatchee, Prosser, Puyallup, and Mount Vernon or through county offices; half were on the Pullman campus. Since their primary work locations were scattered across the state, our main strategy to provide opportunities for interns to interact with each other and their faculty mentors and form lasting bonds with peers with similar interests was a week-long stay at the Quillisascut Farm School of the Domestic Arts. Quillisascut is a goat dairy farm that, in recent years, has specialized in training chefs in farm-to-table opportunities. The five days spent at Quillisascut were a highlight for most interns. In addition to getting involved in specific farm operations (goat management, milking, cheese-making, vegetable production), we provided core knowledge around agroecology, soils, food safety, and value-added production. All interns participated in the Farm School, and many found the experience enriching and informative. In a follow-up evaluation, one intern noted, "I LOVED the farm school! We learned all about the value of sustainable growing and eating and had a great time getting to know my peers and everyone else." Of the 13 mentors, 8 were able to attend at least some part of the Farm School over the 3 years. Mentors commented that the opportunity was "great", "worthwhile", and "absolutely incredible". One noted, "The interns really opened up as the week went on, so that was a positive result. I thought the open conversations that related to everyone's personal experiences were very beneficial." However, it was challenging for mentors to attend. One mentor noted, "In Extension, our summers are just so busy, running all the time. I wish I could have participated more in the farm visit week at Quillisascut. I like the idea of all the interns and mentors getting together for a week, but it's a bit disruptive when you're trying to do research."

Finding their path, building confidence, and sharing their knowledge

Mentored internships can be excellent opportunities to build confidence and skills among budding scholars. Some interns noted that it can be intimidating to ask questions of their more experienced mentors, but many interns developed strong relationships with their mentors, which opened up new opportunities for continuing in academic research or transitioning to successful careers in industry.

Students learning at Quilisascut Farm School. Photo: Doug Collins

next generation

Many of the participating interns benefited from interactions with a diverse group of colleagues through formal and informal discussions with other faculty, postdoctoral scholars, and graduate students working on related projects. Interns see that everyone is learning, and brings different expertise to collaborative research and extension activities. In an exit interview, one intern reflected on their experience, stating "[The experience taught me to] be open and acknowledge what you do not know. You are surrounded by experienced individuals who are able to help if you just let them know what you don't understand. Often things that are common knowledge to them, you still need to ask questions about. And that is okay. Knowing what you do not know is extremely valuable."

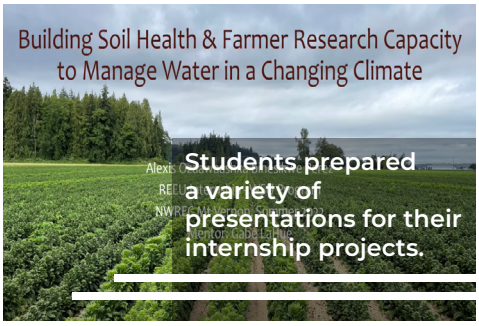
Interns noted that they felt proud of their contributions in their research lab and expected to stay in contact with their mentors. Several noted that their mentor had helped them plan for future internships and job opportunities and actively connected them with resources for continued learning and professional development.

Independent study opportunities are rare for undergraduates but extremely valuable. One student noted, "The REEU experience really gave me a good understanding of what working in research was really like. This was the first time I was so in control of all the aspects of a project from designing the experiment parameters to figuring out the needed supplies. I learned so much more from this than I did from any of my classes about what it really takes to run a project." Many interns and mentors collaborated on publications and other durable products together. Each intern presented their research at a symposium on the Pullman campus for undergraduate research. In addition to these 24 conference presentations, four publications are under review, one new website was created, five blog posts were published, and one intern created a video about her experience.

Several mentors and interns expressed that mentorship programs are vital in increasing the representation of women and minorities in agriculture and food science. Being surrounded by scientists from diverse racial, gender, and cultural backgrounds demonstrates that there is a place for everyone and strengthens the research community. Supportive mentoring can include providing moral and emotional support, expressing confidence in the intern's capacity to learn and grow and master new skills, discussing work/life balance issues, providing advice about career and academic pathways, fostering opportunities to learn and practice leadership skills, and discussing and managing direct and indirect sexism and racism.

Lessons learned and future opportunities

Our program leveraged WSU's previous investments in undergraduate research and added a state-wide and Extension emphasis. WSU has supported undergraduate research internships on the Pullman campus for many years. Interns on the main campus are provided with housing, support, and community. However, tapping into the great research and community involvement happening through WSU across the state required flexibility and problem solving. Housing was one of the biggest challenges since rooms are limited at RECs and are often already booked by graduate students. For our program, CSANR staff worked with interns to help them find short-term housing. In addition to a stipend for their work, the NIFA REEU grant supported interns' travel and lodging costs, which helped with the relatively expensive off-campus housing. Directors at RECs are well aware that ensuring a sufficient supply of available housing can facilitate summer research opportunities for students, and many are working to increase the number of rooms available.



Our interdisciplinary team had a shared vision for providing opportunities for undergraduate students that meshed well with the opportunity provided by NIFA's REEU program. Specialization is rewarded in our academic culture but learning to think holistically and work across disciplines is necessary for transformational change. Interns dove deep into a specialty but took time to learn from their peers working in different disciplines. Interns' experience at Quillisascut Farm was especially impactful in guiding their learning and professional development– Lora Lea and Rick Mysterly, the farmers and instructors at Quillisascut Farm, have a gift for encouraging reflection about agriculture, society, and nature. Students were able to connect their specific research questions with broader themes, such as sustainable food production in a changing climate and food safety and health. Conversations while weeding the vegetables, preparing meals, or breaking bread across the farm table encouraged students to consider themselves important actors in the agricultural workforce.

Lawrence Hickman

Endowed Fellowship in Sustainable Agriculture

In late 2019, Ellen Hickman Williams made a significant donation to WSU CSANR to establish a graduate fellowship in honor of her father Lawrence Earl Hickman to promote conservation and sustainable agriculture throughout dryland farming systems. CSANR is happy to announce the recipients for 2022- Chase Baerlocher and Andrew Herr.

Chase Baerlocher

My name is Chase Baerlocher, and I am currently pursuing a Ph.D. in Molecular Plant Sciences through the Entomology department at WSU. Growing up on the Palouse has exposed me to the variety of issues faced by dryland agriculturalists, such as soil health deterioration, pest pressure, and economic hardship. It has inspired me to pursue an education in an area that I believe holds the key to improving the field of agriculture for both producers and the environment. My work is focused on identifying economically viable alternative crops that impart benefits to the local ecosystem in such a way that disruptive cultivation practices can either be reduced or abandoned altogether. To this end, I have been engaged in research to try to better understand the relationship between the beneficial soil bacteria *Rhizobium leguminosarum* and one of its hosts, winter pea.

With the expansion of winter pea production in Washington following a change in its classification as a food product in 2009, identifying methods of optimizing winter pea growth has been given a greater emphasis in recent years. The crop offers several benefits to agriculturalists on the Palouse including a more diversified cropping system, variability in soil architecture, and a cheap source of nitrogen. It has been long understood that when taken up by the roots of an appropriate host, rhizobia develop the ability to fixate atmospheric nitrogen into the root system of their host. This mechanism also delivers nitrogen directly to the soil when the plant decays, acting as a natural nitrogen input for subsequent crops to access. Identifying the effects of factors such as rhizobia inoculation timing, inoculant concentration rates, and fertilizer application in inoculated fields will help to fill in the gaps of our understanding of how this beneficial bacterium can be more optimally utilized in winter pea production. There is also evidence to suggest that the presence of rhizobia increases the inoculated plant's defense responses and tolerance to environmental stressors including pests and pathogens. Currently, my research involves identifying the interaction between rhizobia-inoculated winter peas and a major pea pest, the pea aphid, as well as the virus Pea Enation Mosaic Virus (PEMV) which the aphid acts as a vector for. By determining how the symbiosis between rhizobia and winter peas improves pea growth and stress tolerance, I hope to be able to create a basis of knowledge that can be used to further promote the implementation of winter peas into the current winter wheat-focused crop rotations utilized on the Palouse.

Beyond graduate school I plan to continue conducting research that promotes the implementation of alternative crops as economically and environmentally viable options for farmers both on the Palouse and abroad. To this end I intend on pursuing a career in academia and agricultural extension in order to keep the interests and concerns of agriculturalists at the forefront of my research. My ultimate goal is to act as a voice for those who serve as stewards of the land and to provide them with the knowledge of how to work more harmoniously with the environment, both for their and future generations' betterment.

Chase Baerlocher, Molecular Plant Biosciences

endowed fellowship

Andrew Herr

I grew up in rural Indiana on a small sheep farm. I was regularly exposed to agriculture through the chores on our hobby farm, my Mom's late nights pulling calves working as a large animal vet, and my Dad working in the USDA helping farmers with federal programs. This childhood of exposure led me to the FFA in high school.

Through FFA, I learned that feeding people involved much more than livestock. There was a much less smelly and annoying aspect of the industry found in row crop agriculture. I was intrigued enough by row crop farming to attend Iowa State University, where I eventually earned a B.A. in Agronomy focused on plant breeding and biotechnology. While in Iowa, I combined my interest in technology and biology by working in a breeding lab where I conducted research using imaging technology to capture corn root architecture characteristics. I enjoyed my research enough that I looked into pursuing higher education.

Here at Washington State, I am working towards my Ph.D. in Dr. Arron Carter's winter wheat breeding lab on using drone-multispectral imaging to improve the wheat breeding program. My project focuses on developing imaging technology for plant breeders to increase genetic gain while using fewer resources. We can do this by imaging plants and evaluating photosynthetic capacity, which provides insight into drought stress and overall plant health. Established imaging research has shown success when making predictions within a year, but little research has been done when predicting large populations across years. Preliminary results from my research show that including drone image data in genomic prediction models improves overall performance in across-year predictions, especially when dealing with off-years with extreme environmental variability.

This research is vital for plant breeders to understand the utility of drone imaging in wheat variety improvement when dealing with abnormal growing seasons and an example of how to implement drone technology while improving current breeding practices. This strategy can allow for the selection of increasingly stable winter wheat varieties, giving farmers a more reliable crop in growingly unpredictable Washington weather conditions.

After earning my Ph.D. in plant breeding, genetics, and hyperspectral imaging, I will focus on the farmer. I plan to either work in the United States studying genetic plasticity to climate change through new high throughput phenotyping methods and use this new technology to develop novel cultivars, despite extreme weather and climate challenges. However, I can see myself working in less developed countries where there is a high need for agricultural and crop genetics improvements. Wherever I end up, I hope to benefit genetic understanding, agriculture, and the farmer by fueling my curiosity and discovering answers to unsolved questions.

Andrew Herr
Crop & Soil Sciences

WSU soil researchers seed long-term projects across Washington

By: Joe Roberts & Chris Benedict

Underfoot, soil supports and sustains us. But there's a fair chance that the average person doesn't think about the critical role of this vital natural resource in our food supply, environment, and economy.

Professor and Washington State University Extension Agent Chris Benedict does. Faculty leader for the Washington Soil Health Initiative, or WaSHI for short, Benedict works with colleagues at WSU's Center for Sustaining Agriculture and Natural Resources (CSANR) to partner with agricultural industries, environmental constituents, and non-governmental organizations (NGOs) to lead the state forward on soil research, outreach, and best practices.

"Improving soil health is universally accepted," Benedict said. "There are few issues where so many stakeholders come together and readily agree."

In 2018, the Washington State Legislature provided funding to develop long-term agroecological research and Extension (LTARE) sites across Washington state, with the first located at WSU's Northwestern Washington Research & Extension Center at Mount Vernon.

WSU, the Washington State Department of Agriculture, and the Washington State Conservation Commission are working closely together to spearhead this tri-agency WaSHI effort.

Currently, the USDA runs 18 long-term agroecological research sites throughout the U.S. With the addition of six new Washington sites (including Mount Vernon), all managed by WSU, the state is now poised to account for a quarter of all sites nationwide.

"These sites will drive our knowledge," Benedict said. "The experimental treatments are based on feedback from various industries. Most agricultural research usually spans 3 to 5 years, but we expect this research to provide the first insights in 5 to 10 at the earliest, depending on the production system and treatments involved."

Moreover, these LTARE sites focus on several of the state's most productive agricultural systems and commodities, including dryland agriculture in eastern Washington, irrigated production in the Columbia Basin, wine grapes, tree fruit, western Washington diversified farming, and northwestern Washington potato.

Research at the LTARE sites will be guided by the already developed Washington Soil Health Initiative Roadmap. "The roadmap identifies where we are currently in our knowledge of soil health and the main problems, then lays out our future goals, objectives, and milestones," Benedict said.

That's important because it's a first in Washington.

"Imagine you'd never been to the doctor and suddenly you get your first bill of health — we will essentially be creating the first ever 'bill of health' for Washington soils," Benedict said.

"And there is still so much we don't know about soils," Benedict said. "Over time, we will see behavior changes from growers, agricultural professionals, conservation district staff, consultants, landowners, environmentalists, and land managers."

A person holds out dark soil for a close-up.

Washington Soil Health Initiative

LTARE SITE NETWORK

Long-term Agroecological Research and Extension (LTARE)

6 WaSHI LTARE Sites Established

Representing **60%** of agricultural acres in Washington

SITE GOALS

- Measure the impact of conservation practices on soil health and farm profitability
- Create cropping system specific guidance on soil health building practices

2019 — WaSHI funded as proviso through state legislature

2020 — Northwestern Washington annual cropping system site established in Mount Vernon

2021 — Diversified organic systems site established

2022 — Dryland and irrigated potato sites funded

2023 — Tree fruit and wine grape sites established

And beyond... — Continual updates to remain relevant to each region

The Washington Soil Health Initiative is an ambitious plan that funds research, extension, and demonstration of soil health best management practices through a network of long-term agroecological research and extension (LTARE) sites across Washington state diverse regions and cropping systems

WASHINGTONSOILHEALTHINITIATIVE.ORG


Columbia River Basin

Implications of shifting timing in water availability in eastern Washington

By: Aaron Whittemore, Sonia A. Hall, and Georgine Yorgey

The 2021 Columbia River Basin Long Term Water Supply and Demand Forecast is the latest iteration in a joint effort to assess eastern Washington's water future. Led by WSU's Washington Water Research Center in partnership with CSANR and the Washington Department of Ecology's Office of Columbia River, the Forecast has been completed by a consistent core team since 2011, producing new results every five years. In the 2021 edition[1] we used an integrated set of computer models to evaluate expected changes in surface water supply and agricultural water demand, and estimated expected changes in residential water demand, hydropower production, and groundwater levels across eastern Washington. Results are presented for two future time periods (2040 and 2070) and for various spatial scopes including the entire Columbia River Basin, the Columbia River mainstem, eastern Washington's Water Resource Inventory Areas (WRIAs), eastern Washington's aquifers, counties, and municipalities.

The 2021 Forecast provides a greater understanding of when and where eastern Washington will face future water vulnerabilities due to the co-occurrence of changes in water supplies and demands as the climate changes, population grows, and agriculture and other sectors respond to changing conditions. Understanding where and when water availability is vulnerable to these changes provides decision makers and managers with critical information to address future water management challenges.

The vulnerabilities that the 2021 Forecast results quantify highlight the complexity of efforts to inform decisions 20 years or more into the future.

In the Columbia River Basin, changes in annual surface water supply are not the main concern; what we need to address is the shifting timing in surface water supply. As temperatures increase, snowpack is predicted to decline as more precipitation will fall as rain, and snowmelt will occur earlier. These changes will translate into higher supply during the wet season and lower supply during the dry season, especially in the snowmelt-dominated Cascades watersheds. Such changes will leave many watersheds without sufficient supply late in the season to meet out-of-stream demands — for agriculture and for some residential users—at times when those demands are highest. Similarly, it is not the current trend in annual out-of-stream water demands that raises concern, but rather there are specific locations and times of the year when these demands are expected to increase, such as portions of the Yakima Valley.

When these results are combined with the state's planned water development projects, which are designed to make additional water available for out-of-stream (as well as instream) uses, multiple areas across eastern Washington are expecting to see concurrent decreases in supply with increases in some demands.

implications

This could lead to more frequent and deeper curtailments of junior out-of-stream water rights under future conditions in rivers with federal or state instream flow rules established to protect flows. And even with these curtailments, rivers may still have insufficient flows to meet their flow rules requirements, established in part because they are critical for meeting the needs for fish and other aquatic species.

We also quantified declining trends in the aquifers we analyzed, suggesting that decision-makers need to explore options other than switching demands from surface to groundwater supplies if they are to prepare for and mitigate the impacts of future changes on supply and demand. Several municipalities included in the study rely heavily on groundwater for meeting residential demand and exist in an area in which groundwater levels are substantially declining.

These findings indicate areas of concern for water managers. By carrying out this Forecast and providing decision makers with the results, appropriate strategies and solutions can be developed to help meet eastern Washington's future water needs. CSANR worked in close collaboration with our research colleagues at the Water Research Center, the Department of Civil and Environmental Engineering, the School of the Environment, and the Center for Environmental Research, Education and Outreach, the University of Utah, Aspect Consulting and with the Office of Columbia River staff to coordinate the modeling and analyses, foster a shared understanding of the management needs and the science, and craft final products that are both accurate and useful to our OCR partners.

In the words of Tom Tebb, Director, and Melissa Downes, Policy Lead at the Office of Columbia River, "Over time, [the] team has built a strong reputation that significantly smoothes the communication process ...which is key for guiding modeling efforts to answer partner questions, [and] has helped shape project outputs into products that are widely accessible and digestible to all types of water users across the state via blogs, reports, and online resources."

"The report also helps OCR plan for future resource needs or infrastructure investments that create a more sustainable and reliable water supply for people, farms and fish for future generations."

Reference

[1]Hall, S.A., Adam, J.C., Yourek, M.A., Whittemore, A.M., Yorgey, G.G., Scarpare, F., Liu, M., McLarty, S., Asante-Sasu, C., McClure, S., Turk, J., Haller, D., Padowski, J., Deshar, R., Brady, M.P., Rajagopalan, K., Barber, M.E., Weber, R., Stockle, C.O., Goodspeed, H.L., Gustine, R.N., Kondal, A., Yoder, J., Deaver, B., Downes, M., Tarbutton, S., Callahan, M., Price, P. Roberts, T., Stephens, J., Valdez, W. 2022. 2021 Washington State Legislative Report. Columbia River Basin Long-Term Water Supply and Demand Forecast. Publication No. 21-12-006. Washington Department of Ecology, Olympia, WA. 284 pp. https://apps.ecology.wa.gov/publications/SummaryPages/2112006.html

Columbia River

Building the case for compost and carbon sequestration

By: Katie Doonan, Georgine Yorgey, Kirsten Ball, and Michael Brady

How can you tell if something works?

A key piece in the puzzle of soil carbon sequestration is the ability to quantify measurements before and after a management practice change, in alignment with the principle of "what gets measured gets managed". Compost is receiving increased attention as a valuable agricultural soil amendment, with the added potential of sequestering carbon. Accounting for these benefits with defensible evidence is one vital component of making meaningful change in the way we manage soils and compost. The beauty of CSANR often lies in its ability to meet challenges like this where they are, to bring science to bear, and provide pathways forward to sustainable solutions.

In 2021, the Washington Legislature enacted two major pieces of legislation: the Organics Management Law (HB 1799) and the Sustainable Farms and Fields Program established under RCW 89.08.615. The Organics Management Law requires that landfilling of organic materials be reduced by 75% by 2030. Meanwhile, the Sustainable Farms and Fields Program provides funding to support the implementation of climate friendly farming practices statewide, including support for the use of compost.

To support the implementation of these policies, the Washington Legislature directed WSU to carry out specific tasks to assess two areas related to compost and compost use: 1) model reliability and applicability of carbon accounting tools to compost applications within agriculture in Washington state and 2) municipal compost buy-back demand. CSANR led the response to this directive.

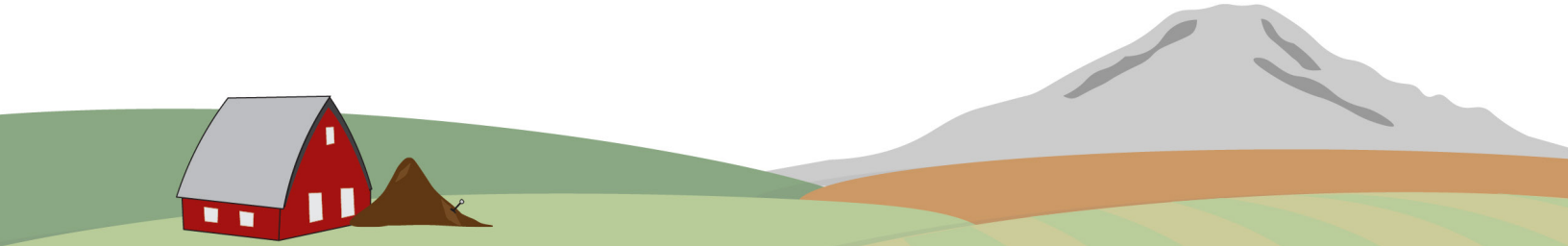
Under the modeling portion of the work, Kirsten Ball, a post-doctorate scholar with CSANR, evaluated four models via two case studies. The first case study used data from a long-term field experiment at Wilke Farm led by Ian Burke, a CSANR Leadership Team member. The field experiment assessed several levels of compost application in dryland systems, including a substantial one-time application. In contrast, the second case study was based on yearly application of compost in conjunction with fertilizer in a westside irrigated vegetable production system. This field experiment was based out of WSU's Puyallup Research and Extension Center, was started by former CSANR affiliated faculty and continued by CSANR's Extension Specialist Doug Collins.

Key findings from this work include:

1) Carbon accounting tools run a spectrum from simple online tools that emphasize ease-of-use, to research grade tools that require a high level of user expertise and greater complexity of input data. For models that require low amounts of input data, increased bias and therefore uncertainty is a tradeoff for ease-of-use.

3) There is a certain level of uncertainty inherent in carbon sequestration modeling. Comparing an accumulation of field data from long-term research to modeling results can help clarify the sources of uncertainty and improve these models over time.

2) Online carbon accounting tools can help estimate carbon sequestration potentials of compost applications but are likely more relevant when applied over larger areas or groups of farms. Users should be cautious in relying on these tools for site-specific estimates.



Compost application is being assessed as a potential carbon sequestion and waste management strategy.

The second component of the proviso aimed to establish a baseline assessment of municipal compost collection, usage, and subsequent demand of compost for municipal projects. Michael Brady, a CSANR Leadership Team member, led this effort. With the Organics Management Law (HB 1799) of reducing organic waste in landfills by 75% and added targets for municipal compost buy-back, an initial understanding of the current state of municipal compost is essential across the state. A survey was conducted of current composters, which helped establish a qualitative understanding of current composting and potential barriers in future collection and use of compost.

Key findings include:

1) Current administrative systems for tracking use and collection of compost need improvement. Historical documentation of compost collection and use is especially limited in smaller municipalities, which may impact assessment of improvement through future practices.

2) There is inconsistency of compost demand between municipalities, especially based on municipality size.

3) A major barrier to compost utilization is contamination of final compost product by non-compostable waste. Improved quality of final product will reduce the barrier to use.

The final culmination of these studies is available as the legislative report entitled "Evaluating Compost Application for Soil Carbon Sequestration on Agricultural Land and Compost Buy-Back Programs in Washington". This effort not only helps inform future legislation, but also helps CSANR prioritize projects to address areas of need.

WSU scientist contributes to important soil carbon sequestration research

By: Angela Sams

Visiting the sea floor as a scuba diving instructor in the Maldives ultimately led Kirsten Ball, who is originally from Australia, to plant soil science at Washington State University.

"I saw the planet's degradation firsthand by diving underwater," said Ball, a post-doctoral researcher with WSU's Center for Sustaining Agriculture and Natural Resources (CSANR) in Wenatchee, Wash. "I was drawn to plant and soil sciences because of the opportunity to make an environmental impact."

Initially trained as an exercise physiologist, Ball returned to school for a second undergraduate degree in environmental science, later completing her PhD at Australia's Western Sydney University and Scotland's University of Aberdeen. She joined WSU in early 2022 after first working in Arizona.

The Washington State Legislature established CSANR at WSU in the early 1990s to address sustainability and environmental challenges such as finding a way to sequester carbon in soil, which could help draw down carbon dioxide levels in the atmosphere.

"CSANR has flourished in the last three decades as it works to address sustainability issues from a research, education, and Extension perspective," said director Chad Kruger. "We know it's beneficial to move compost back to soils. Carbon payment programs could help incentivize this, but we need meaningful, scientific policy analysis."

That's where Ball comes into the picture.

"Kirsten is a unicorn," said Kruger. "She has the right mindset and the perfect mix of experience and training. She has pushed us to examine what contributions we should be sharing in a global setting."

Since joining CSANR, Ball has analyzed data related to dryland systems and carbon sequestration.

Growing food depletes soil of carbon, which can make it difficult to sustain food production. One solution is the application of organic amendments such as compost, which can help replenish soil systems with the carbon necessary for agricultural production over time.

"I've come to understand how little we really know about dryland systems," said Ball. "Most information about sustainable soil management and agriculture comes from more temperate systems, but drylands are important because they're one of the world's fastest growing ecotypes for agricultural development. They are frequently degraded of nutrients but may have the capacity to store carbon more rapidly in the short term than temperate systems."

"Carbon payment programs could help incentivize this, but we need meaningful, scientific policy analysis."


Ball, at work in the field.

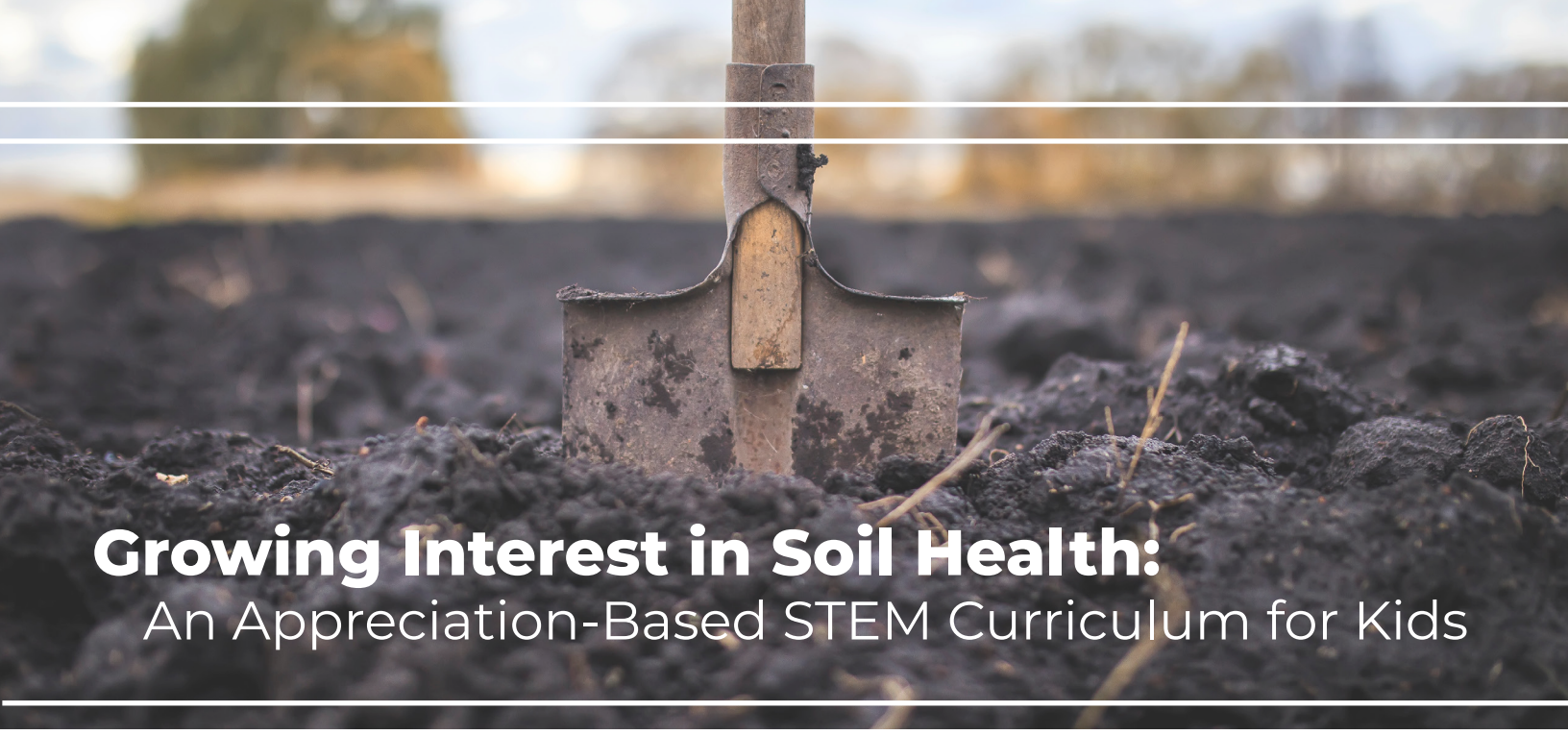
The fruits of Ball's labor are demonstrated in her work on a legislative proviso that was requested by Washington state. The proviso uses state-specific data analysis to demonstrate the short- and long-term potential for organic amendments like compost to improve carbon storage in soils of agricultural systems. It also shows why commodifying compost within the state could be beneficial and reduce greenhouse emissions. This work forms the basis for an upcoming scientific publication. "It's unusual for someone to have deep technical knowledge of how modeling tools work and a good sense of how the legislature is thinking about these issues," said Georgine Yorgey, CSANR associate director and Ball's supervisor. "Kirsten is able to connect the dots between the research and the outcomes that the legislature would like to see."

As a recent recipient of the highly competitive Marie Curie Fellowship, Ball will soon leave CSANR to spend the next few years researching dryland agricultural systems at the University of Aberdeen, conducting field work with the Spanish National Research Council, and working for the Food and Agriculture Organization of the United Nations to help women in dryland regions become better stewards of their land.

An eventual return to WSU is also not out of the question. Whatever the future holds, Ball is dedicated to making a difference.

"At this point in my career, my work needs to be tangible," said Ball. "International capacity building is really where my passion is."


Since joining CSANR, Ball has analyzed data related to dryland systems and carbon sequestration.



Growing Interest in Soil Health:
An Appreciation-Based STEM Curriculum for Kids

By: Molly McIlquham and Tarah Sullivan

Soil health education for youth is vital to change the outlook and attitude of future generations toward soil stewardship.

Soil health is linked to some of the most important issues facing our planet and future generations, from a warming climate and increasing extreme weather events to toxic buildup of waste and contaminants, to fresh air and water, to the very food quantity and quality on our tables each and every day. Yet, unfortunately, most students enter college with little to no understanding of the importance of soil in our everyday lives.

That's why WSU Associate Professor and soil microbiologist Dr. Tarah Sullivan has made it her mission to share her passion for soil with elementary school-aged children. With the help of regional partners at schools, science centers, 4-H Extension developers, and environmental outreach NGOs, Tarah was able to test many different strategies and finally develop a series of simple, soils-based STEM curriculum modules targeting elementary school-age children.

Development of Hands-On Curriculum

Tarah and her team first worked to develop hands-on, easy-to-understand soil health awareness curriculum for school-age children through a partnership with the Palouse Discovery Science Center. Through trial and error, they created the "Earth Explorers" summer camp, where over 30 students learned about geology, soil science, and soil biology. Tarah and partners then established an after-school program for exploring soils, expertly named "Mudskippers," where youth explored soils and biodiversity. In the summer of 2022, the youth got their hands dirty installing a vermicomposting system and raised garden beds at the "How to Grow Your Own Food" summer camp. At camp, they learned best practices to maintain soil and plant health simultaneously through lessons on soil biology as they grew the plants.

These events cultivated enthusiasm amongst the students and adults, so much so that, through a partnership with the Community Action Center, a large greenhouse will be donated to the center to expand the "Grow Your Own Food" programming and share food with our Pullman community.

More Advanced Curriculum

The curriculum for each age group is vastly different. While the topics may be similar, the depth to which each is explored varies. At the Pullman, WA, high school, Tarah partnered with Ms. Olivia Craine-Karas to develop a curriculum on the importance of vermicomposting systems and compost food web. Students designed their own worm composting systems and, as future scientists, took measurements throughout the year, then gave a final report on the success or failure of their system at the end of the year. Through the 2012-2022 school year process, an expert, Tarah, came

growing interest

into the classroom to teach and answer questions about soils, compost, and biodiversity roles in soil health.

In the spring of 2022, Linda McLean of the 4-H Extension at the Coleville confederated tribes teamed up with Tarah to present a hands-on soil biology demonstration booth at the Sunflower Festival for the Salish language school, Paschal Sherman Indian School. This festival brought in hundreds of students and parents, who all had the opportunity to observe compost in each stage of decomposition. At the booth, Tarah then shared information on soil health and allowed everyone to use digital microscopes to view the worms and other important compost food web biology.

3

Educational videos created

5

Valuable partnerships created

>200

Students reached

Soil Health Education Modules

All these experiences culminated in Tarah's partnership with the Lake Roosevelt Forum and PacWest to create the Soil Health Education Modules. You can access the soil educational modules for K-5th graders they created here.

Ultimately, these projects have reached hundreds of elementary school-aged children in Washington with books and educational activities, increasing awareness of soils and soil biodiversity. These tools will inspire the next generation of soil stewards and foster a greater appreciation for soil's vital role in our world. Soil health education for youth is a vital step in addressing global issues related to soil. Through partnerships and collaborations, Tarah and her team have developed hands-on and easy-to-use curriculum for students. This will increase awareness and interest in soil health, leading to a more sustainable future.

Third-grade students viewing worms under a microscope. Photo: Tarah Sullivan

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Impacts 2022

$507,000 invested

$7.5 million leveraged

5 graduate students supported

4 new affiliate faculty

18 outreach events

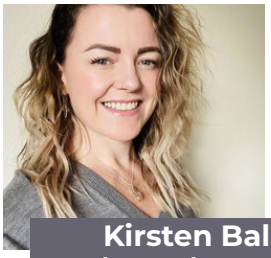
4 journal publications

People

Chad Kruger
Director

Georgine Yorgey
Associate Director

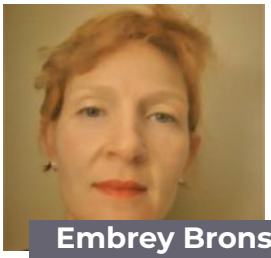
Jim Amonette
Adjunct Faculty



Kirsten Ball
Postdoctoral Researcher

Chris Benedict
WaSHI Lead

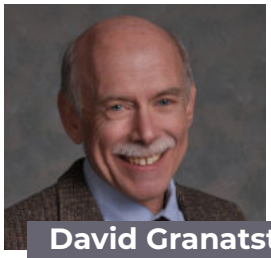
Karie Boone
Research Associate



Embrey Bronstad
Bioenergy Specialist

Doug Collins
Extension Specialist

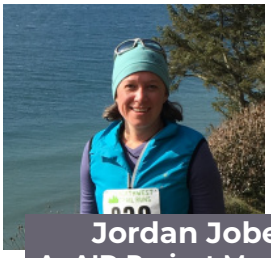
Katie Doonan
Extension Coordinator



David Granatstein
Specialist, Emeritus

Sonia Hall
Research Associate

Karen Hills
Research Associate



Jordan Jobe
AgAID Project Manager

Andrew McGuire
Extension Agronomist

Molly McIlquham
WaSHI Extension Coordinator

Nate Stacey
Adjunct Faculty

Aaron Whittemore
Associate in Research

FACULTY LEADERSHIP TEAM

MICHAEL BRADY
Economic Sciences

IAN BURKE
Crop and Soil Sciences

JIM JENSEN
Energy Program

KRIS JOHNSON
Animal Sciences

STEVE JONES
Crop and Soil Sciences

LAURA LAVINE
Entomology

KEVIN MURPHY
Crop and Soil Sciences

TIM MURRAY
Plant Pathology

KIRTI RAJAGOPALAN
Biological Systems Engineering

MATTHEW WHITING
Horticulture

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Food Science

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