



Department of Biological Systems Engineering 2024 ANNUAL REPORT



WASHINGTON STATE UNIVERSITY
College of Agricultural, Human,
and Natural Resource Sciences

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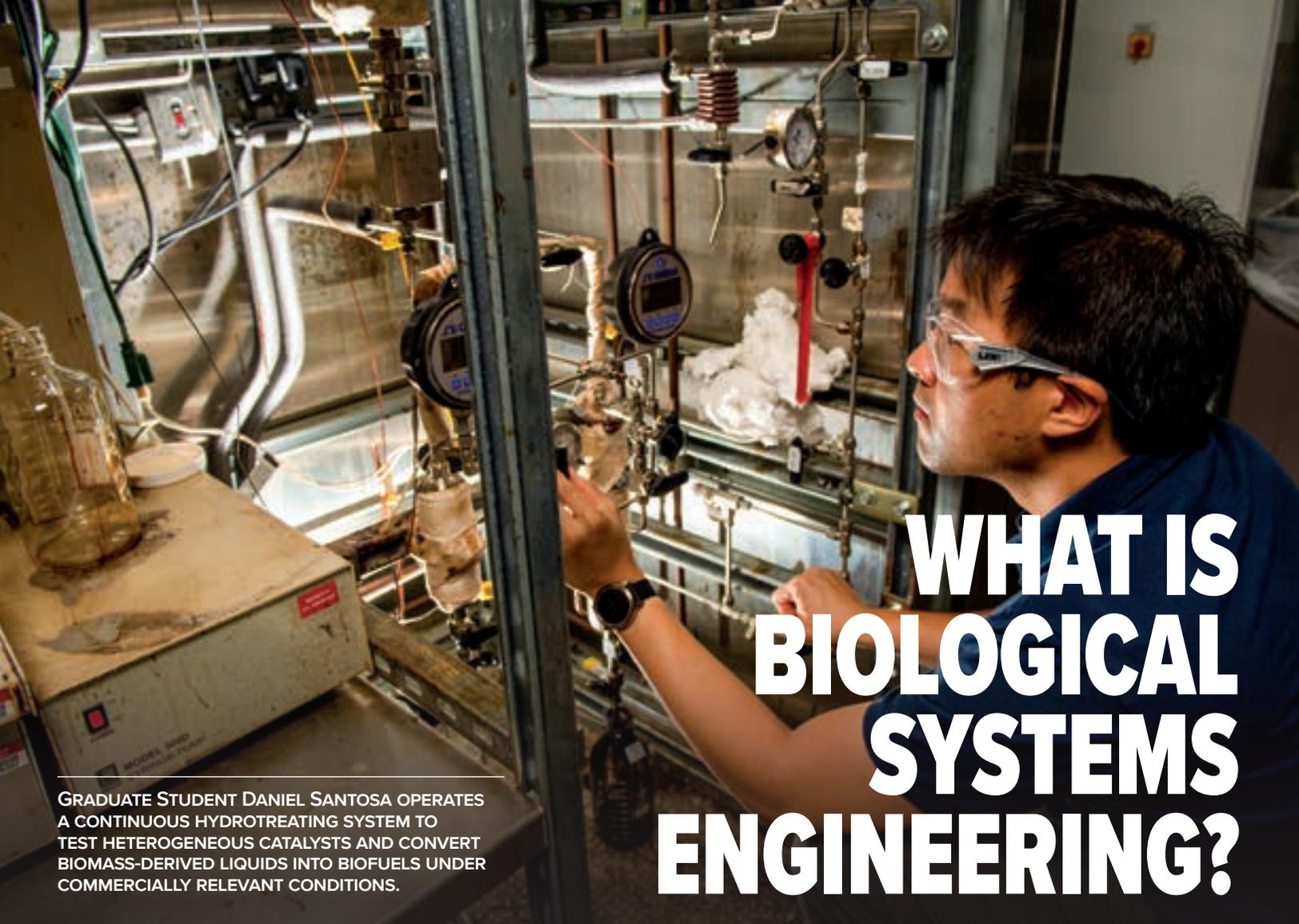
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Above: Graduate Student Worasit Sangjan installing his IoT camera for high-throughput plant phenotyping in a wheat breeding field.

Front cover: "A Mandala of Cougspiration" by Martin Churuvija, BSE Graduate Student, Winner of 2024 BSE's Visionary Roadmap Art Competition.



GRADUATE STUDENT DANIEL SANTOSA OPERATES A CONTINUOUS HYDROTREATING SYSTEM TO TEST HETEROGENEOUS CATALYSTS AND CONVERT BIOMASS-DERIVED LIQUIDS INTO BIOFUELS UNDER COMMERCIALY RELEVANT CONDITIONS.

WHAT IS BIOLOGICAL SYSTEMS ENGINEERING?

Washington State University's Department of Biological Systems Engineering (BSE) trains students and serves society by developing engineering solutions for sustainable agriculture, food, energy, and water. Our internationally prominent programs connect Washington State and the world.

BSE scientists discover and apply engineering principles and methods to the processes of our natural world and provide advanced graduate education to engineering professionals. Faculty and students work primarily in one of four areas:

- Agricultural Automation Engineering
- Bioenergy and Bioproducts Engineering
- Food Engineering
- Land, Air, Water Resources and Environmental Engineering (LAWREE)

Ranked seventh nationally and tenth in the world in research by EduRank, BSE develops engineering solutions to address some of the most pressing contemporary issues: adaptation and resilience to global warming, increasing productivity of agriculture through robotics and digital agriculture, new technologies for food quality and safety, improved nutrition, and a healthier environment.

BSE infrastructure and research teams are based at four locations: WSU Pullman, WSU Tri-Cities, WSU Irrigated Agriculture Research and Extension Center at Prosser, and WSU Puyallup Research and Extension Center. World-class laboratories at each of these locations address key issues facing agriculture in Washington and globally.

LETTER FROM THE CHAIR

Embracing the Future: The Critical Role of Our Department in a Changing Agricultural Landscape

This year marks our fifth annual departmental newsletter, a critical communication tool that keeps our stakeholders informed about the department's activities, achievements, and ongoing efforts to tackle global agricultural challenges. In it, we highlight key milestones, new research developments, and the remarkable work of our faculty, staff and students. I want to start this newsletter by thanking our faculty, staff, and our students for their hard work and unwavering support. As the world faces unprecedented challenges and opportunities in agriculture, our department stands at the crossroads of tradition and innovation. Despite ongoing questions about the value of graduate education in an increasingly tech-driven world, one thing is clear: the expertise we cultivate is more vital than ever. Our department embraces its role as a bridge between agriculture and engineering.

The new developments on applications of artificial intelligence in agriculture, robotics, phenomics, precision agriculture, irrigation, and nutrient management have resulted in farm yields growing at a fast rate. While this success highlights the hard work of farmers and the impact of the work of our scientists and engineers, it also presents a unique challenge: surpluses of agricultural products that must be transformed into other high-value goods. From biofuels and biodegradable plastics to advanced chemicals and novel materials, these surplus crops and

the associated agricultural wastes hold the potential to drive innovation in once unimaginable ways. Important dietary cultural changes and concerns with the impact of food quality on human health are reshaping the food industry with high demand for technologies and formulation of healthier, more nutritious foods. This is where our department steps in. Washington State University's Department of Biological Systems Engineering leads the way in scholarly research, with the highest Scholarly Research Index (SRI) among its peers, according to Academic Analytics. Our department is a recognized leader in addressing critical, global challenges in agriculture and bioresources engineering. Through our work in biomass conversion and bioproducts, land and water resources, ag automation and food engineering, we are reshaping agriculture to be smarter, more efficient, and more sustainable. From precision farming to resource optimization, our innovations are enhancing farmers' lives and ensuring that future agricultural systems are both environmentally and economically sustainable.

In the last three years, our department has seen a retirement or departure of a significant number of faculty members (Drs. Claudio Stöckle, Qin Zhang, Pius Ndegwa, Juming Tang, Manoj Karkee). While their departure mark a significant transition, we have successfully maintained steady productivity and continue their legacy. Department expenditures were \$7.2 million in 2024, reflecting the strength of our research programs. Output remained strong, with close to 110 peer-reviewed publications, while our graduate program remained stable at 61 PhD candidates and



Manuel Garcia-Pérez
Department Chair & Professor

16 MS students. We continue to thrive due to the dedication of our remaining faculty and the strength of our students, who are poised to advance and excel professionally. This year, we are excited to announce the design of two new master's programs: food engineering and sustainable aviation fuels (SAF), which are currently undergoing Senate approval. These programs will enhance our department's ability to offer specialized training to the next generation of leaders in agricultural engineering and are designed to provide students with a comprehensive understanding of both the technical and societal aspects of sustainable agriculture, preparing them for careers in both academia and industry.

In 2024, our department was actively involved in the American Society of Agricultural and Biological Engineers (ASABE) Annual Conference in Anaheim, California, where both students and faculty participated in a wide range of sessions, workshops,

and presentations. The event served as a platform to showcase our cutting-edge research.

Our engagement with stakeholders remains a cornerstone of our mission. We maintain strong partnerships with industry leaders, government agencies, and academic institutions, ensuring that our research is both relevant and impactful. Notable industry partners

include Pfizer, McCormick & Company Inc, Kraft Heinz, Lamb Weston, the US Army Natick Soldier Systems Center, and ExxonMobile, among others. These collaborations enable us to translate research into real-world solutions, bridging the gap between academia and industry.

Our end-of-semester celebrations for Spring 2024 and Fall 2024 were

an excellent opportunity to recognize the hard work and achievements of both students and faculty. These events highlighted the remarkable accomplishments within the department and fostered a sense of community among our members. It is through this collective effort that we continue to push the boundaries of what is possible in agricultural engineering.

2024 OVERALL DEPARTMENT INDICATORS

\$7.2M Overall departmental research expenditures

Average faculty expenditure:

\$423k

(Highest research activity: Agricultural Automation Engineering: over \$828K and Bioenergy & Bioproducts Engineering: over \$523K)

107

Number of peer-reviewed publications

Average publications per faculty member

7

Number of PhD students:

61

(graduated in 2024: 8)

Number of MS students:

16

(graduated in 2024: 3)

Average h-index:

56

According to Google Scholar, **9 BSE FACULTY** are among the

60 most cited researchers at WSU

1,257

Average number of citations per faculty member

In **EduRank**, BSE is ranked **7TH IN THE U.S.** and **10TH IN THE WORLD** for agricultural engineering (edurank.org/engineering/agricultural)

According to the **US News**, BSE program ranks **RANKS 16** among our peers in the US. BSE program is the WSU Engineering program best ranked (Electrical Engineering 58, Civil Engineering is ranked 64, Chemical Engineering 72).



As we look to the future, 2025 will be a year of strategic growth and focused development for our department. Our priorities for the coming year are:

(1) Hiring an Assistant Professor of Smart Machine/Robotics Systems Engineering

We are actively seeking a faculty member to join us in expanding our expertise in smart machine systems and robotics, further strengthening our position as a leader in agricultural automation and AI-driven solutions.

(2) Maintaining Critical Mass in Specialization Areas

We are committed to ensuring that each of our core research areas—automation; food engineering; biomass conversion and bioproducts; and land, air, and water resources engineering (LAWREE)—has at least four faculty members to ensure continued innovation and research leadership.

(3) Creating a Systems Engineering Area of Focus

We are establishing a new area of focus in systems engineering to address the complex, interconnected challenges in agriculture, water resources, and bioengineering, enabling us to offer more holistic solutions.

(4) Streamlining the Graduate Program

To enhance graduate student productivity, we will refine our graduate program, making it more efficient and supportive while maintaining the high quality of research and education.

(5) Launching Online Master's Programs in Food Engineering and Sustainable Aviation Fuels

As part of our commitment to increasing access to graduate education, we are developing online courses for our food engineering and sustainable aviation fuels (SAF) master's programs, allowing students from around the world to benefit from our expertise.

(6) Strengthening Internal and External Partnerships

We will continue to build on our internal WSU strategic partnerships, including collaborations with the Agricultural Technology and Production Management Program (AgTM); School of Food Science; Prosser Irrigated Agriculture Research and Extension Center; Aviation Sustainability Center (ASCENT); Bioproducts, Sciences, and Engineering Laboratory (BSEL); Puyallup Research and Extension Center; Chemical Engineering; Civil Engineering; School of Electrical

Engineering and Computer Science; Animal Sciences; and Crop and Soil Sciences. These partnerships are crucial in fostering interdisciplinary research and expanding our impact.

As we move forward, our department is positioned to continue leading the way in **Food Security and Sustainable Agriculture, Environmental Sciences, and Energy Futures**, all core research strengths of Washington State University. Our work in Agricultural and Bioresources Engineering will play a critical role in shaping the future of global agriculture. Through outstanding faculty contributions and committed involvement of our dedicated students, we are confident that our department will remain at the forefront of agricultural innovation and continue to make lasting, global impacts.

This edition of the **Annual Departmental Newsletter** serves as a testament to the unwavering commitment and continued success of our faculty, staff, and students. We look forward to the next chapter in our journey and the continued growth of our department in 2025 and beyond.

As always, Go Cougs!

2024 HIGHLIGHTS

WSU's Biological Systems Engineers celebrate a century of impact

By Seth Truscott

For more than a century, scientists and teachers at Washington State University's Department of Biological Systems Engineering have transformed Northwest agriculture and the lives of Washingtonians.

On Saturday, March 9, BSE faculty, students, and staff gathered at WSU's Elson S. Floyd Cultural Center to celebrate their accomplishments and reflect on the work and impact of those who came before them. The celebration coincided with the release of retired

professor Larry James' second volume of departmental history, "The Faculty, 1910–2023," detailing 11 decades of work by dozens of professionals across ever-changing disciplines.

"The department is a testament to the talent, hard work, and vision of 90 former and current faculty," wrote James, who laid out its major historical accomplishments.

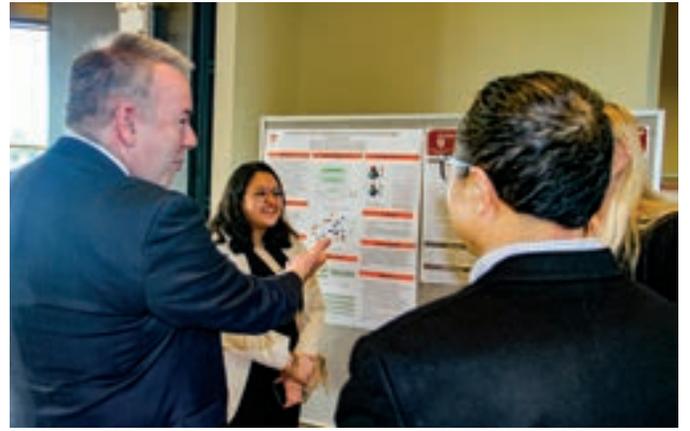
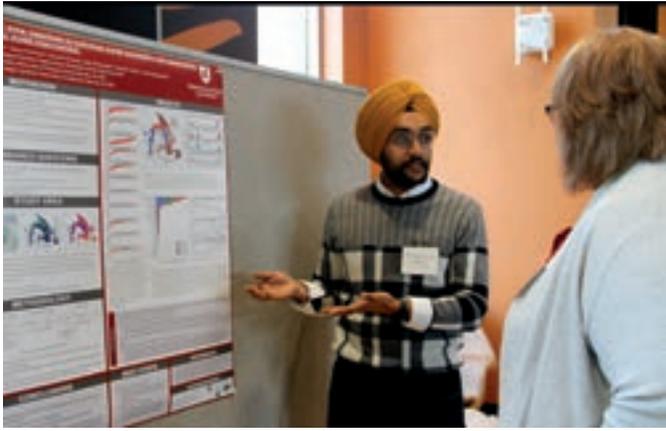
"We led one of the major rural electrification projects in the nation," he said. In 1925, ag engineering chair

L.J. Smith, Washington State College president E.O. Holland, agriculture college dean E.C. Johnson, and engineering dean Hubert Carpenter partnered with farmers and power company representatives to form the Washington Rural Electrification Council, working to remove barriers to electricity use on Northwest farms. Farmers across the state benefited from the project.

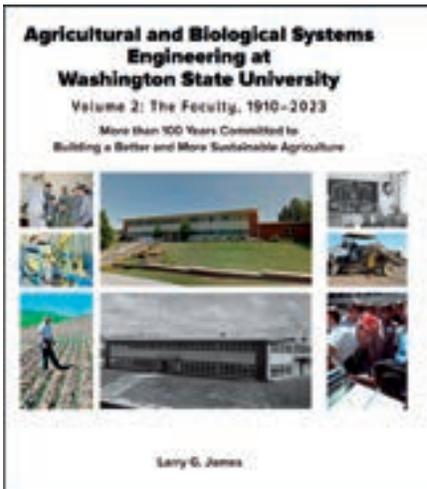
Faculty in BSE spurred irrigation and other advances, reduced erosion



BSE Faculty, Staff, Graduate Students and Alumni attending March 9th Celebration



Doctoral students present their research to guests at the celebration on March 9, 2024, WSU's Elson S. Floyd Cultural Center.



from wind and water, protected the environment, advanced Washington agriculture, and supported their college and the global profession. Several BSE scholars served their country during World War II.

As the years went by, the mission changed. In 1992, the



Larry James accepting the Outstanding Alumnus Award



Current and former BSE faculty in front of the Wall of pictures honoring 20 plus years of faculty contributions. Additional pictures from the event on page 78.

department name changed from “Agricultural Engineering” to “Biological Systems Engineering” to reflect a broader mission serving agriculture and other biology-based enterprises. Since inception, the department has conferred more than 1,100 bachelor’s, master’s, and doctoral degrees.

In a panel discussion, Dr. James, Gustavo Barbosa-Cánovas, and Gary Hyde looked back on their long-running experiences in research and education. The gathering also remembered BSE faculty and staff who have recently passed away, including Alan Pettibone, Day Bassett, Keith Saxton, and Bill Bowe. Students also shared their research posters with visitors, who included Wendy Powers, Cashup Davis Family Endowed Dean of CAHNRS, as well as WSU Assistant Vice Chancellor for Research Jonathan Male.

A special moment came when James and fellow retired faculty

member Denny Davis, a former chair and associate dean, accepted Distinguished Alumnus Awards from current chair Manuel García-Pérez.

“I’m very honored and touched by this award,” said James, a former department chair, campus chancellor, and vice provost. “I’ve seen WSU from all angles, from student and time-slip employee all the way up to chancellor and vice provost. My degree in ag engineering has served me very well: training on how to think and solve problems works not just for engineering but for life.”

“What really spurred me on was action for students learning something they could use and apply,” said Davis. As a faculty member and leader, he watched the department rise in credibility as it documented outstanding performance by students.

“This was an exciting time for me to be in a position where

I could help students,” said Davis, who urges current and future scholars to seek out opportunities that allow them to assist others.

The celebration concluded with the unveiling of photographs of BSE faculty members who have served the department and university for more than 20 years. These photographs are on display in room 259 at the department’s home in L.J. Smith Hall.

Faculty with more than 20 years of service include Joan Wu, Robert Evans, William Symons, Henry Waelti, James Middleton, Ronald Hermanson, Keith Saxton, Larry King, Juming Tang, Gary Hyde, Shulin Chen, and Leslie Smith.

Faculty with more than 30 years of service include John George, Donald McCool, Marvin Pitts, Day Bassett, Denny Davis, Larry James, June Roberts, John Simpson, Gustavo Barbosa-Cánovas, Claudio Stöckle, Ralph Cavaliere, Alan Pettibone, and Albert Powell.

WSU student artists share visions of engineering's impact on our future

By Seth Truscott

Washington State University students used paintings, digital videos, sculptures, and found materials to express how their high-tech field helps humanity and nature in the Department of Biological Systems Engineering's (BSE) recent **Visionary Roadmap Art Competition**.

Launched last fall by BSE chair Manuel Garcia-Perez and student leaders in WSU's Biomass Engineering Club, Agricultural Automation and Engineering Club (AAEC), and American Society of Agricultural and Biological Engineers (ASABE) chapter, the competition was open to doctoral and master's students in the department.

"Our goal was to create a vision that captures who we are as a department, what our aspirations are, and why our work is vital to serving our community, the agricultural industry," said first place winner Martin Churuvija, a BSE doctoral student and AAEC club member.

BSE faculty, staff, and students ranked anonymously posted creations online. All works will be displayed publicly at L.J. Smith Hall on WSU's Pullman campus.

"I wanted students to reflect on the work of the department and create an art piece that touches the heart, and they exceeded my expectations," Garcia-Perez said. "Good engineers use the resources and tools learned in educational settings and in daily experiences



"A Mandala of Cougspiration," a hand-drawn and watercolor artwork by Martin Churuvija.

to solve practical problems. It was wonderful to see them translating their technical and scientific experience into a language that speak to our common humanity."

Churuvija earned \$500 for his artwork, "A Mandala of Cougspiration." Combining hand-drawn forms with watercolor,

it features a view of the Pullman campus' iconic Bryan Hall clock tower as well as a WSU Cougar head logo at the center of an intricate wheel of insects, plants, robots, chemical formulas, and other symbols.

Patterns surrounding the logo represent the interconnectedness

of the department's disciplines, including food engineering, automation, land, air, and water and the environment, and bioenergy and bioproducts. The art, Churuvija said, communicates BSE's dedication to innovation and collaboration that creates a sustainable future through engineering and biological principles.



Martin Churuvija

"This piece is inspired by my exposure to Indian culture, particularly through conversations with my two Indian

roommates," he said.

In India, Mandalas symbolize balance, interconnectedness, and the universe.

"As a researcher in agricultural engineering, I use both science and creativity to develop innovative solutions for complex problems," said Churuvija, who is originally from Argentina. "My life project is to provide means to reduce the cost of healthy meals, which is why I am pursuing my graduate studies in agricultural robotics at WSU."



Anika Afrin

Winning \$400 and second place, Anika Afrin painted "Cornucopia," a colorful composition juxtaposing natural forms

like plants and fruits with geometric shapes and lab equipment. Afrin sought to capture how nature provides us with resources that can

be utilized to build a colorful and vibrant future.

"My doctoral work inspires me to build a sustainable future full of life and color," she said. "Through this artwork, I tried to portray the future that I envision — using my research as a gift to the generations that follow."

Hailing from Bangladesh, Afrin expects to graduate in spring 2025.

"My research focuses on unveiling the complex chemical nature of bio-oils, much-needed sustainable alternatives to fossil fuels," she said.

Self-taught in art, Afrin had only made paintings to decorate her home or as gifts for family and friends.

"This time, I took a bold step and wanted to showcase my art to a broader audience," she said. "I challenged myself to sharpen my skills and produce something related to my other passion: the research I do in BSE."



Created by Anika Afrin, the painting "Cornucopia" a colorful composition that conveys how nature provides us with resources that can be utilized to build a colorful and vibrant future.

Winning third place and a \$300 prize, doctoral student Valentina Sierra created a mixed-medium sculpture titled "Harvesting Hope: Advancing Sustainability Through Unity." The sculpture shows clasped human hands — resin casts of Sierra's hand and her husband's — emerging from a layer of leaves, which she gathered in a diversity of colors and shapes from October through December in Pullman.

Originally from Medellín, Colombia, Sierra will graduate in May 2025. She studies ways to enhance carbon conversion from biomass, improving the efficiency of the process and producing biochar that can be used in many applications, from soil amendments to wastewater treatment.

"I aimed to highlight how women and men collaborate within the department to drive progress in the field, working together to enhance agriculture, ensure food security on multiple levels,



“Harvesting Hope: Advancing Sustainability Through Unity,” a mixed-medium sculpture made from found materials by Valentina Sierra.

and improve the development of sustainable fuels,” Sierra said. “I envision a future where art and engineering continue to merge to foster innovation and a deeper understanding of agricultural and biological systems.”



Valentina Sierra

For the piece’s base, she sculpted rolling hills of the Palouse in clay. The hands support an arch of repurposed metal coated in clay, which Sierra pressed with an assortment of grains to make a textured, organic surface. Hands and base are colored using paints left over from other projects,

reinforcing her theme of sustainability and resourcefulness.

Other entrants received \$100 prizes for their paintings and displays, including Dawood Ahmed, Mohammad Mezbah Hoque, Atif Asad, Micaela Peralta, and Syed Usama Bin Sabir.

Other entrants received \$100 prizes for their paintings and displays. Entries in the BSE Visionary Roadmap Art Competition: “Future of Orchards: Autonomous Robot Operations in Summer and Winter,” a 3-D artwork by Dawood Ahmed; “Waves of Palouse” by Mohammad Mezbah Hoque; “Digital Viticulturist” by Atif Asad; “Cougar’s Balance: Engineering Nature’s Harmony” by Micaela Peralta; A screenshot from “Little Cozmo and Its Sibling,” a video by Syed Usama Bin Sabir.



BIOLOGICAL SYSTEMS ENGINEERING RESEARCH

Scientists and learners from all corners of the United States and the world come together at BSE. Research in our department generates knowledge and develops technologies for environmental stewardship,

renewable energy, productive and sustainable agriculture, and safe and nutritious foods. The following section showcases current advances and milestones, faculty success stories and awards, and more.



ZIXUAN HE DESIGNED AND DEVELOPED A ROBOTIC HARVESTING SYSTEM FOR STRAWBERRIES WHILE EARNING HIS PHD AT WSU (PHOTO BY XIANGLING KONG).

Latest WSU guides tighten pear irrigation, shed light on wheat, buckwheat production

January 16, 2024 By Seth Truscott



BUCKWHEAT PRODUCTION WEST OF THE CASCADES IS LESS COMMON THAN EAST OF THE MOUNTAINS, BUT PROMISING BECAUSE OF THE FAVORABLE CLIMATE.

WSU scientists share free guides monthly that help Pacific Northwest agriculture and home growers. The latest online publications offer irrigation tips and evaluation for pear growers, review past production at WSU's Wilke Farm as well as buckwheat west of the Cascades, and share scientifically sound approaches to home-garden companion plants.

Buckwheat Production West of the Cascades (PNW732)

Naturally gluten-free, buckwheat has a variety of culinary uses regionally and internationally. Learn about market opportunities, how to establish a strong stand, and the best management and harvest practices for this tasty, nutritious crop. Authors are Rachel Breslauer, Justin O'Dea, Stephen Bramwell, and Kevin Murphy.

WSU Wilke Research and Extension Farm Operation, Production, and Economic Performance for 2022 (TB95E)

For farmers and consultants in eastern Washington's intermediate

rainfall zone, this annual publication documents production and operations on WSU's Wilke Farm near Davenport. It also helps faculty with small-plot research experiments. Wilke Farm remains in a direct-seed cropping system using no-till fallow, winter wheat, spring cereals, and broadleaf crops. Broadleaf crops are used in place of spring and winter cereals when weed pressures and market prices create opportunities for profitable production. Authors are Aaron Esser and Derek Appel.

Gardening with Companion Plants (Home Garden Series) (EM128E)

Pseudoscientific claims abound in recent, popular literature regarding the benefits of companion planting, creating confusion for home gardeners. This publication encourages the use of scientifically sound companion planting practices, which improve plant health and productivity, decrease damage from insects and disease, and decrease the need for pesticides and fertilizers. It is authored by Linda Chalker-Scott.

Improving Irrigation Efficiencies in Pears Case Studies (TB97E)



A WASHINGTON PEAR ORCHARD.

Hot summers and cork spot can present significant challenges for pear growers in central Washington. Irrigation frequency and timing can affect tree growth, productivity, and fruit quality in pears. This guide offers case studies that illustrate common irrigation system challenges in Washington pear orchards, as well as the results of upgrades designed to address site-specific problems. Authors are Lee Kalcsits, Tianna DuPont, and Troy Peters.

Evaluating Your Pear Irrigation System (FS385E)

Common challenges in central Washington pear orchards include over- and underwatering, irregular water distribution, and low holding capacity in sandy soils. Learn about the potential solutions and tools that can boost fruit quality and growers' profits in this guide by Tianna DuPont and Troy Peters.

View more new Extension guides at the [Online Bookstore Updates](#) webpage.

WSU research addresses climate change on multiple fronts

January 30, 2024 By Addy Hatch, WSU Marketing and Communications

At Washington State University, more than 60 departments are active in climate-related research, work that in many cases has been under way for decades.

Editor's note: This is the first in a series of monthly articles through 2024 about WSU's research and other efforts to confront climate change

Here's a question with a thousand answers: How do we create a livable future amid climate change?

Such a big challenge demands an equally expansive approach to solutions.

At Washington State University, more than 60 departments are active in climate-related research, work that in many cases has been under way for decades. It's a priority rooted in the university's land-grant mission of service informed by its science.

"Climate change isn't going to be solved by one person, institution, policy, or nation," noted Deepti Singh, assistant professor in the School of the Environment who leads the Climate Extremes Lab at WSU. "It's such a pervasive issue, affecting every aspect of our lives that it needs individual and collective action on many fronts."

In agriculture and natural resources, for example, WSU

scientists participated in the first comprehensive report on likely areas of climate risk in the state, said Chad Kruger, director of the Center for Sustaining Agriculture and Natural Resources. WSU has developed technologies and strategies to help growers reduce greenhouse gas emissions, restore carbon to the soil, and replace fossil fuels with biofuels.

Singh's Climate Extremes Lab at WSU Vancouver advances scientific understanding of drought, wildfire, extreme temperatures, heavy precipitation, and the effects these events have on people's lives and the resources they depend on. Understanding the risk can help people predict and prepare for such hazards.



The university has been at the forefront in developing sustainable fuels. Most recently, the U.S. Department of Energy tapped a consortium including WSU to develop a regional green hydrogen economy.

WSU is looking at the effects of higher heat on public health, from urban heat islands to farmworkers.

“The environment is one of the handful of major social problems that have huge ramifications for almost everybody. Dylan Bugden, Boeing Distinguished Assistant Professor in Environmental Sociology Washington State University”

Scientists are developing environmentally friendly concrete, green infrastructure, smart buildings, and fiber and material recycling.

Other research explores the societal effects of climate change, including politics and policy.

“It’s an overarching issue that affects the quality of your life, it affects the economy in profound ways, and how we organize our

society,” said Dylan Bugden, the Boeing Distinguished Assistant Professor in Environmental Sociology in WSU’s Department of Sociology. “The environment is one of the handful of major social problems that have huge ramifications for almost everybody.”

Adaptation is a common thread in WSU’s climate work.

Singh said she was drawn to climate extremes research after living in Mumbai, India, where historic flooding in 2005 resulted in disruption, numerous fatalities, and disease outbreaks.

“It got me thinking that we are not really adapted to the climate we’re experiencing today, and that’s changing,” she said.

Singh and another WSU climate scientist, Kirti Rajagopalan, contributed key portions of the 5th National Climate Assessment, the U.S. government’s authoritative report on climate risks, impacts and responses.

WSU also focuses on the disproportionate impact of climate

change on vulnerable communities, whether those are Native American tribes threatened by sea-level rise or farmworkers laboring in ever-hotter temperatures.

“Communities of color, older adults, low-income communities, children. Climate change stacks the cards against them,” noted Elizabeth Schenk, assistant research professor at the College of Nursing.

Climate-focused activity at WSU is likely to expand as the challenges mount. Universities are integral to the innovations, adaptations, and mitigations climate change requires, with research that underpins technologies and informs policies, said Michael Wolcott, WSU’s interim vice president for research.

The problems of climate change are daunting. But, said Singh, “What gives me hope is that there’s so much more attention to the topic of climate change. You see people talking about it a lot more, and not just talking about it, they’re trying to do something about it.”



USDA undersecretary encounters research for specialty crops at Prosser

February 2, 2024, By Seth Truscott

Scientists at WSU's Irrigated Agriculture Research and Extension Center (IAREC) at Prosser welcomed Jenny Lester Moffitt, USDA Under Secretary for Marketing and Regulatory Programs, alongside WSDA Director Derek Sandison and Wendy Powers, the Cashup Davis Family Endowed Dean of CAHNRS, Wednesday, Jan. 31, 2024.

The undersecretary's visit highlighted WSU research supported by USDA's Specialty Crop Block Grant Program and its impact on Washington agriculture. Faculty briefed Moffitt on block-grant funded efforts at the center, including smart technology and automation, virus-free plants, biotic and abiotic stresses, and training the next generation of scientists and professionals, and discussed climate and crop resiliency.

"Through support from the Specialty Crop Block Grant Program, the center is helping grow Washington's economy and global competitiveness and preparing the competent next-generation workforce to meet the needs of modern agriculture," said center Director Naidu Rayapati. "This is a critical program for Washington's agricultural resiliency, and IAREC will continue seeking funds from this program for impactful contributions to irrigated agriculture that benefit the many communities we serve."

Center faculty are highly successful at putting block grant



BASED AT IAREC'S CPAAS LABORATORY, PROFESSOR MANOJ KARKEE DEVELOPS AGRICULTURAL ROBOTS, SUCH AS PRUNERS AND HARVESTERS.

funding to work in research that crosses disciplines and in stakeholder partnerships, Rayapati added. During the visit, he shared the history and mission of IAREC, founded in 1919, its ongoing university, state, and federal collaboration, and continuing partnerships with Hispanic student-serving institutions in the Yakima Valley, among other endeavors.

IAREC mission

An estimated two-thirds of the agricultural production in the state comes from irrigated land. IAREC is in service to this economic dynamo, housing and supporting research and outreach in food science, entomology, horticulture, plant

pathology, crop and soil science, and biological systems engineering.

At the center, a team of WSU faculty, staff, and students from diverse cultures and nationalities works alongside USDA-Agricultural Research Service and WSDA scientists to tackle complex agricultural challenges. The campus is home to the Center for Precision & Automated Agricultural Systems, spurring advances in robotics, precision agriculture, and automation; the Clean Plant Center Northwest, helping maintain disease-free crops for a sustainable future; and AgWeatherNet, a statewide real-time monitoring system that aids agricultural decision-making.

Honey bees at risk for colony collapse from longer, warmer fall seasons

March 25, 2024, By Sara Zaske, WSU News & Media Relations

WSU researchers and students collect samples and perform honey bee colony health assessments in orchards near Modesto, CA. Photo by Brandon Hopkins

Flying shortens the lives of bees, and worker honey bees will fly to find flowers whenever the weather is right, regardless of how much honey is already in the hive. Using climate and bee population models, researchers found that increasingly long autumns with good flying weather for bees raises the likelihood of colony collapse in the spring.

The study, published in the journal *Scientific Reports*, focused on the Pacific Northwest but holds implications for hives across the U.S. The researchers also modeled a promising mitigation: putting colonies into indoor cold storage, so honey bees will cluster in their hive before too many workers wear out.

“This is a case where a small amount of warming, even in the near future, will make a big impact on honey bees,” said lead author Kirti Rajagopalan, a Washington State University climate researcher. “It’s not like this is something that can be expected 80 years from now. It is a more immediate impact that needs to be planned for.”

For this study, researchers ran simulations through a honey bee population dynamics model using climate projections for 2050 and the end of the century at 2100. They found that honey bee colonies that spend the winter outside in many areas of the Pacific Northwest



PULLMAN, WASH. — THE FAMOUS WORK ETHIC OF HONEY BEES MIGHT SPELL DISASTER FOR THESE BUSY CROP POLLINATORS AS THE CLIMATE WARMS, NEW RESEARCH INDICATES.

would likely experience spring colony collapses in both the near- and long-term scenarios. This also occurred under a simulation where climate change continued as it is progressing now and one where greenhouse gas emissions were reduced in the near future.

Worker honey bees will forage for food whenever temperatures rise above about 50 degrees Fahrenheit. When it gets colder, they cluster in the hive, huddling with other bees, eating honey reserves and shivering, which helps keep the bees warm. In the spring, the adult worker bees start flying again. That means they also start dying. If too many older worker bees die before their replacements emerge ready to forage, the whole colony can collapse. Scientists have estimated this happens when there

are fewer than 5,000 to 9,000 adult bees in the hive.

This study found that colonies wintering outside in colder areas like Omak in the far north of Washington state might still do all right under climate change. But for honey bee colonies in many other places, like Richland, Washington near the border of Oregon, staying outside in the winter would mean the spring hive population would plummet to fewer than 9,000 adults by 2050 and less than 5,000 by the end of the century.

The authors note that the simulations just looked at seasonal factors like temperature, wind and the amount of daylight, making them fairly conservative models.

“Our simulations are showing that even if there is no nutritional stress, no pathogens, no pesticides

— just the conditions in fall and winter are enough to compromise the age structure of a colony. So when the hive comes out of winter, the bees are dying faster than they're being born," said co-author Gloria DeGrandi-Hoffman, a research leader at the U.S. Department of Agriculture's Carl Hayden Bee Research Center.

The researchers also simulated a potential mitigation, placing honey bee hive boxes in cold storage so the bees start to cluster earlier and save workers. For instance, in the

Richland scenarios, by the end of the century, having bees in cold storage from October to April would boost the spring hive population to over 15,000 compared to around 5,000 to 8,000 if they were kept outside.

A relatively new practice, cold storage is gaining popularity among commercial beekeepers to help manage bee health and for the logistics involved in moving hives to California to pollinate almond trees in February, an event that draws more than two million hives from across the country.

"A lot of beekeepers are already practicing this management technique of storing bees indoors because it has a lot of immediate potential to help in a number of ways," said co-author Brandon Hopkins, a WSU entomologist. "These findings demonstrate that there are additional benefits to this practice for the survival of colonies in a changing climate." This research received support from the Washington Department of Agriculture's Specialty Crop Block Grant.

Outdoor workers feeling the heat

by Becky Kramer

Many of us spend our summer days in air-conditioned offices or homes, where heat and wildfire smoke are nuisances but rarely life-threatening.

For outdoor workers, however, heat and smoke have become inescapable parts of summer shifts. When temperatures climb and air quality drops, roofs are still shingled, concrete is poured, garbage is collected, trees are trimmed, houses are painted, and fruits and vegetables are harvested by hand.

Combining physical exertion, time-sensitive work, and heat can have deadly results—and agricultural workers are at particular risk. Heat-related illnesses and deaths are more prevalent among farmworkers than any other US occupation, including construction.

"Farmwork involves direct sun exposure and high workloads," says Mayra Reiter, project director

for occupational safety and health at Farmworker Justice, a Washington, DC-based nonprofit. "Many workers get paid on a piece-rate basis, which creates incentives to work harder, work faster, and work longer before taking breaks, and some employers discourage breaks."

Across the West, climate change has made working outdoors riskier. In 2021, two Northwest agricultural workers died after working in triple-digit heat—one at an Oregon blueberry farm and another in a hops field in Yakima County. By mid-century, the average number of days US agricultural workers spend laboring in unsafe heat conditions is projected to double.

That's a challenging reality for Washington's multibillion-dollar agricultural industry. And it's an area where Washington State University researchers are working to provide information to industry leaders and policymakers, with

a focus on practical solutions for protecting employees.

Mobile text alerts in English and Spanish will be available this summer, warning supervisors and outdoor workers when heat poses "moderate, high, or severe" risks. People can sign up for the free alerts through WSU's AgWeatherNet service, which provides localized weather data and forecasts through a network of 368 WSU-operated and private stations across the state.

AgWeatherNet launched a Worker Heat Awareness portal and is working on the alerts with the Pacific Northwest Agricultural Safety and Health Center, which is run by the University of Washington, says Lav Khot, AgWeatherNet director and an associate professor of biological systems engineering.

Besides the warnings, the mobile alerts provide information about safety-related precautions to take on hot days.

“We’re getting the word out that this exists and it’s free to use,” Khot says. “The alerts will also be helpful for people in construction and other outdoor jobs.”

Other WSU health-related work focuses on understanding the combined threat that heat and smoke pose for the heart and lungs, and how socioeconomic factors heighten health risks for farmworkers.

“In the Northwest, we have the most farmworkers out in the fields during periods when they’re exposed to both heat and wildfire smoke,” says Julie Postma, associate dean for research at WSU College of Nursing. “After work, they’re not necessarily going to a place where they can recover. If you’re living in a trailer or low-income housing, you probably don’t have air-conditioning and air filters.”

Postma is part of the National Institute of Health’s 2024 Climate and Health Scholars cohort, which aims to increase climate change resiliency among individuals and communities.

About 160,000 people work in the agricultural and food industry in Washington, where industry officials have been active in discussions about worker health. Growers are used to contending with heat, says Jon DeVaney, president of the Washington State Tree Fruit Association.

“Heat has always been a consideration for growers—for the safety of their workforce and for the quality of the fruit,” he says. “What is changing is that weather patterns have been less predictable. We’ve had some of these high heat days in June or early July when they aren’t as expected.”

Most of the state’s tree fruit crop is grown in semi-arid central Washington. Cherries are picked at the height of summer. Apple harvest starts in early August with Galas and Honeycrisps and extends through fall with later varieties.

Fruit harvest typically starts at daybreak to take advantage of the cooler parts of the day, but some growers have switched to nighttime harvest under artificial lights, DeVaney says. Scheduling night shifts helps reduce heat exposure for workers and damage to fruit, but many growers make night shifts optional, he says.

“Some workers really like it, but others find it too disruptive for their families,” DeVaney says. “Think about how hard it is to get childcare. It’s harder at night.”

Washington is among a handful of states that mandate temperature-related breaks, access to shade and cool drinking water, and heat awareness training for workers. The state’s smoke rule requires distribution of respirators when air quality crosses certain thresholds.

Washington rules also require close observation of employees during heat waves and when they aren’t used to physical activity at high temperatures.

Even healthy workers are at risk for heat-related illness or death, according to health officials. Heat generated by exertion—combined with hot air temperatures—can overwhelm the body’s ability to maintain a normal core temperature.

“Dehydration really matters in terms of tipping someone over the edge to heat stress or heat exhaustion,” Postma says. Being on medication can have the same effect.



LAV KHOT BY WEATHER MONITORING EQUIPMENT FOR WSU AGWEATHER-NET (COURTESY WSU COLLEGE OF AGRICULTURAL, HUMAN, AND NATURAL RESOURCE SCIENCES)

Physical activity on hot days can damage the heart, lungs, and kidneys. And a rare but serious condition called rhabdomyolysis develops when damaged muscle tissue releases proteins and electrolytes into the bloodstream.

When workers acclimatize to heat by gradually ramping up their activity levels, they sweat more efficiently and more blood flows to the skin, enhancing cooling through evaporation. They also work at lower heart rates and with lower core body temperatures.

But acclimatization can take up to two weeks to develop, and it’s short-lived. Employees lose their acclimatization after a week away from working in a hot environment, Postma says.

Climate change will continue to increase the hazards of outdoor work. It’s a public health issue for agricultural communities, particularly where crops require

high inputs of human labor, she says.

“I come at this as an advocate for workers’ health, but I feel for our growers,” Postma says. “They’re trying to abide by state regulations, keep their workforce healthy, and get their crops to market.”

LONGER WILDFIRE SEASONS...

...have also increased health risks for outdoor workers. The combination of extreme heat and air pollution is an emerging public health concern, with evidence of compounding impacts to heart and lungs and increased mortality rates.

For Julie Postma, the 2015 wildfire season was an eye-opener. More than a million acres burned across Washington that year,

blanketing the skies with smoke from late June to September.

“The smoke was so pervasive; there was no getting away from it,” Postma says. “Heat and wildfire smoke were happening at the same time in a population with very little control over their workplace and few resources to deal with things.”

In 2021, Postma and WSU doctoral student Molly Parker interviewed a dozen agricultural employees in central Washington about their working conditions. Many reported staying on the job through heavy smoke that made them cough and their eyes burn. Some talked about long lines for drinking water and little access to shade. They worried that reporting

unsafe conditions to supervisors would jeopardize their employment.

AgWeatherNet is working to get more localized air-quality information out to the public. A state grant helped pay for 21 sensors that track air pollution, including fine particulates from smoke and ozone levels. People can access that information through a free registration with AgWeatherNet.

In addition, a “Be Smoke Ready” campaign helps people protect their health on smoky days. AgWeatherNet developed and distributed the outreach materials in cooperation with the Pacific Northwest Agricultural Safety and Health Center and the Washington State Tree Fruit Association.

WSU professor receives Fulbright-Tocqueville Distinguished Chair Award to build bioeconomic partnerships

May 13, 2024, By Seth Truscott, College of Agricultural, Human, and Natural Resource Sciences

Collaborating with European scientists to develop ideas, fuels, and products that solve global environmental and energy challenges, Washington State University Professor Bin Yang is headed to Toulouse, France, as the newly announced recipient of the Fulbright-Tocqueville Distinguished Chair Award.

The award will fuel Yang’s work alongside colleagues at the Toulouse Biotechnology Institute, INSA Toulouse, expanding international partnerships for development of global decarbonization and biofuels and bioproducts production.

“I am grateful to the Fulbright Program for allowing me to expand on ideas and broaden ties between Washington state, the U.S., and France,” said Yang, a professor at WSU’s Department of Biological Systems Engineering. “It’s a great honor to work with European leaders in technology and sustainability at Toulouse and other partner institutions.”

The six-month exchange begins in spring 2025 and builds on existing collaboration between Yang and scientists at Toulouse, part of the France’s Institut National des Sciences Appliquées (INSA).

“Innovating together is the key to a better future for the world.”

—Bin Yang, professor
Washington State University

Working with European colleagues in the bioeconomy — economic areas embracing technologies like biomass to produce fuels and chemicals — Yang seeks to make advances in energy and sustainability while promoting WSU research to the international scientific community.



PROFESSOR BIN YANG WILL WORK IN TOULOUSE, FRANCE, IN 2025 THROUGH A NEWLY ANNOUNCED FULBRIGHT-TOCQUEVILLE DISTINGUISHED CHAIR AWARD.

“Innovating together is the key to a better future for the world,” he said. “My ultimate goal is to develop a roadmap for the decarbonization of the bioeconomy between the United States and France, as well as the manufacture of products that serve the visions and goals of both countries.”

Yang’s laboratory at WSU Tri-Cities focuses on development of renewable energy technologies, with an emphasis on production of biofuels and chemicals from cellulosic biomass: plant materials grown as crops or harvested as agricultural waste. He recently pioneered new pretreatment and manufacturing technologies to process biomass into jet fuel, bioplastics, carbon fiber, hydrogen carriers, and other bioproducts.

This is Yang’s second Fulbright Distinguished Chair award. In 2019,

he traveled to Helsinki, Finland, as the first professor at WSU to be selected for the Fulbright Distinguished Chair in Energy and Sustainable Use of Natural Resources Award.

“Bin Yang’s accomplishments have made him an international leader for development of the bioeconomy,” said Jean Marie François, professor of industrial microbiology and biotechnology and Yang’s host at Federal University Toulouse. “Recent awards recognize his pioneering contributions to the next generation biorefinery, sustainability, and green technologies that can overcome climate change. His upcoming visit is a great opportunity for students in our biochemical engineering and international master in bioeconomy programs and will significantly

improve cooperation between our two institutions.”

The Fulbright Program awards distinguished chairs to renowned scholars set apart by significant experience and extensive publications in their fields. Yang is the first professor at WSU to receive the Fulbright-Tocqueville Distinguished Chair Award.

The most prestigious award offered by the Fulbright France bilateral program, this distinguished chair was created in 2005 to mark Senator J. William Fulbright’s centennial and Alexis de Tocqueville’s bicentennial. Funded by the French Ministry of Higher Education and Research and the Fulbright Program, it reinforces collaborative research between France and the United States on topics of major significance for the future of both societies.

Engineers will explore green future for food processing at WSU-hosted conference

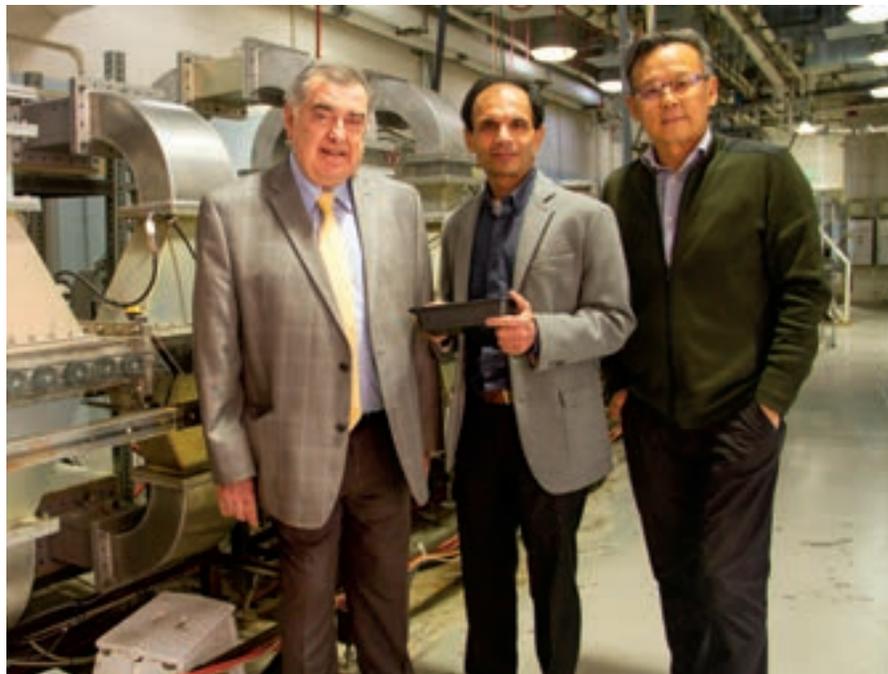
May 16, 2024, By Seth Truscott, College of Agricultural, Human, and Natural Resource Sciences

Food engineers from Washington State University will host the upcoming Conference of Food Engineering (CoFE 24), Aug. 25–28 in Seattle, Washington, to spark new ideas for a more efficient, sustainable global food industry.

Launched in 1991, the biannual conference brings together food engineers and technologists from across industries, academic institutions, and government to discuss emerging challenges and potential solutions for delivery of safe, nutritious, and sustainable foods. The WSU-hosted event is CoFE's first visit to Washington.

“When you make food on an industrial scale, you need a wide range of technologies, from drying and freezing to pasteurization and packaging, to bring it from the field to final product to the consumer,” said CoFE 24 co-organizer Shyam Sablani, professor at WSU's Department of Biological Systems Engineering. “Food engineers create these technologies for everything from dairy products to pasta to ready-to-eat meals.”

This year's conference, to be held at Seattle's Westin Hotel, explores a green future for the food industry, including the goal of achieving zero net emissions, under the theme “Advancing Science and Engineering for Sustainable Food Manufacturing and the Supply Chain.” Experts from within and beyond the engineering community will discuss university and industry developments that boost efficiency, minimize emissions



Organizing the 2024 Conference of Food Engineering (CoFE '24), Professor and CoFE '24 Chair Gustavo Barbosa-Canovas; Project Leader and Co-Chair Shyam Sablani; and Regents Professor and Co-Chair Juming Tang develop technologies for a more efficient, sustainable food industry. They are pictured at WSU's food processing pilot plant.

and waste, and are on the road to adoption.

“Products are generally sold in large quantities in retail markets, and the profit margins for the food industry are low per item,” Sablani said. “But consumers are increasingly more willing to pay for healthier and more environmentally friendly products. That could help offset the costs of adopting new machines and materials.”

Food companies have begun the transition from fossil-fuel-driven steam boilers to electric devices that can be powered from renewables. Sablani and colleagues around the world are experimenting with electricity based technologies such as microwaves and electric pulses,

instead of using natural gas, that can more efficiently cook or pasteurize products with minimal loss of eating quality.

At WSU, Sablani studies coatings, films and semi-rigid packaging that combine biodegradable materials. Utilization of high oxygen barrier polymers and incorporation of oxygen-scavenging chemicals into packaging could reduce the volume of synthetic packaging. Other coatings help paper and cardboard cups, trays, and meal boxes stand up to hot beverages or moist foods.

“Diet is part of our health,” Sablani said. “If we develop more efficient technologies, we can produce foods with minimal processing that are free of

chemical preservatives. That could contribute to better health for all people.”

Organizing the conference, Sablani, conference chair Gustavo Barbosa-Canovas, fellow WSU food engineer Juming Tang, and Oregon State University colleague Yanyun Zhao won a \$50,000 grant from the USDA National Institute of Food and Agriculture’s Agriculture and Food Research Initiative (AFRI) to enhance the upcoming event.

Grant funding will pay for travel by national and international experts in sustainability, circular economies, public policy, nutrition, and other fields.

The grant also funds travel by students and early career scientists, allowing these learners to take part in the discussion.

“This conference is our platform to discuss major needs, current developments, and solutions for tomorrow,” Sablani said. “It’s a

way for food engineers to promote research across our different disciplines and inspire the next generation to pursue new ideas. We are excited to make this first CoFE experience in Washington happen.”

To learn more about CoFE 24, contact Shyam Sablani, professor, WSU Department of Biological Systems Engineering, at ssablani@wsu.edu or visit the conference website.

2024 Conference of Food Engineering

The organization of this conference was one of the most significant extracurricular initiatives led by faculty from our department in 2024. Below are highlights from the **16th edition of the Conference of Food Engineering (CoFE '24)**, held in Seattle, Washington, from **August 25th to 28th, 2024**.

My colleagues **Professors Juming Tang** and **Shyam Sablani** first approached me with the idea of hosting a CoFE meeting on the

US West Coast—something that had not occurred since 2005, when the conference was held in San Francisco. Initially, I was hesitant to take on such a commitment, but their enthusiasm and dedication soon convinced me. One of our first steps was to invite **Professor Yanyun Zhao** from **Oregon State University**, whose remarkable talent and commitment greatly enriched our organizing team. Her involvement transformed this

event into a true **Pacific Northwest collaboration**, rather than one solely led by Washington State University.

Our goals were ambitious: to collaborate closely with the **Society of Food Engineering (SoFE)**; to host the conference in a cosmopolitan city; to ensure strong student participation; to develop a first-class technical program; to recognize excellence; and, in the spirit of the Olympic Games, to set



BSE FACULTY, GRADUATE STUDENTS, AND ALUMNI ATTENDING COFE 2024.

a few new records in professional achievement. I am proud to say that our **CoFE '24 team** achieved all of these objectives.

Seattle was selected as the host city—a dynamic and innovative metropolis that continues to thrive thanks to major international companies, such as **Microsoft, Amazon, Boeing, Starbucks, and Expedia**. To encourage student participation, we secured generous funding from **USDA-NIFA**, for which we are deeply grateful. This support enabled a number of outstanding students to attend and contributed to the success of CoFE '24.

The strong **SoFE–CoFE '24 partnership** was fundamental to the conference's success. Together, we developed **21 oral sessions** featuring a balanced blend of classical and emerging topics that reflected the ongoing evolution of food engineering. Each session included five speakers, and each participant delivered only one lecture throughout the program. All abstracts were peer-reviewed by at least two experts, ensuring a robust and high-quality

scientific program for both oral and poster presentations. Due to an overwhelming response—nearly **270 submissions**—we expanded the oral sessions to **26**. Notably, all organizers and attendees (except students) participated **without financial support from SoFE**, demonstrating extraordinary commitment to the profession.

To further enrich the program, we included **three plenary sessions**, featuring not only distinguished food engineers but also leaders from other industrial sectors who shared cross-disciplinary perspectives to inspire new directions in food engineering. Additionally, **four preconference workshops** were organized on cutting-edge topics currently attracting strong research and industrial interest.

Beyond the technical sessions, CoFE '24 offered ample opportunities for networking and professional exchange through the **opening mixer, gala dinner, coffee breaks, and lunches**—all designed to foster collaboration and strengthen community ties.

We are particularly grateful to the **SoFE Student Division** for organizing a special session featuring speakers from the food industry who shared their real-world experiences. Many student members, along with graduate students from several universities, also served as **conference volunteers**, playing an essential role in the smooth execution of the event. Their enthusiasm, professionalism, and dedication reaffirmed that the **future of food engineering is in excellent hands**.

Our department provided exceptional administrative support, which included the preparation of printed programs, badges, pins, posters, and other essential materials that contributed to the success of the conference.

It was truly a rewarding experience to collaborate with outstanding colleagues from across the country in organizing CoFE '24 and to see our collective efforts culminate in such a resounding success.

Gustavo V. Barbosa-Cánovas
Conference Chair, CoFE '24

Lav Khot appointed to new Office of Research working group for AI

May 22, 2024

The Office of Research gathered researchers across the system to be part of the Advancing AI Research Working Group to define the current and emerging strengths in AI research at WSU. Led by Assefaw Gebremedhin, associate professor in the School of Electrical Engineering and Computer Science, the working group will convene meetings,

symposia, and other forums to engage faculty across disciplines to understand the breadth and depth of research areas. The group will also draft a roadmap for enhancing and building AI research at WSU in key growth areas with the potential for far-reaching benefits and impacts.

The Advancing AI Working Group was established to build

upon current strengths at WSU and identify emerging areas of high priority and impact. The group held its first meeting on March 27. Gebremedhin currently serves as the lead PI and director of the CySER Institute and has led the effort to establish the Artificial Intelligence @ WSU web resource.

Washington State University's Shyam Sablani Named 2024 IFT Fellow

PUBLISHED ON JUNE 4, 2024



"THE ACHIEVEMENTS THAT BRING ME THE MOST SATISFACTION ARE SEEING STUDENTS SUCCEED ACADEMICALLY AND ACHIEVE THEIR CAREER AND LIFE GOALS AS WELL AS SEEING ENGINEERING CREATIONS FIND PRACTICAL APPLICATION IN THE REAL WORLD," SAID SABLANI OF THE PROFESSIONAL ACCOMPLISHMENTS THAT HELPED HIM RECEIVE THIS DISTINCTION. (PHOTO: LOGAN MORENO GUTIERREZ, UNSPLASH)

CHICAGO, Ill. — The Institute of Food Technologists (IFT), a nonprofit scientific organization committed to advancing the science of food and its application across the global food system, is pleased to announce that Shyam Sablani, PhD, Professor of Food Engineering at Washington State University, has been selected as a 2024 IFT Fellow, one of the highest honors bestowed upon a member of the science of food community. Being recognized as an IFT Fellow is a unique professional distinction given to an IFT member who has achieved career excellence in addition to providing significant service and leadership to both IFT and the science of food profession.

Specifically, all nominees must demonstrate professional

leadership through leading conferences, presentations, and other training and development programs; service and leadership to external advisory committees or boards; ongoing volunteer service to IFT; honors, awards, and other recognition within the science of food profession, as well as advancements to the science of food in industry, academia, government, or related organizations.

This year's IFT Fellows will be celebrated at the Fellows Recognition Forum at IFT FIRST: Annual Event and Expo, which is being held July 14-17, 2024, at McCormick Place in Chicago. Only 10 IFT members out of more 11,000 received this prestigious recognition this year.



Dr. Shyam Sablani (Courtesy Photo)

"The achievements that bring me the most satisfaction are seeing students succeed academically and achieve their career and life goals as well as seeing engineering creations find practical application

in the real world,” said Sablani of the professional accomplishments that helped him receive this distinction.

Sablani joined Washington State University in 2007 as an Assistant Professor while also serving as an Associate Department Chair and Interim Chair of WSU’s Department of Biological Systems Engineering. His research at WSU focuses on innovative packaging solutions to improve food safety and quality. Before joining WSU, he was an Associate Professor at Sultan Qaboos University in Muscat, Oman. He is a recipient of the 2021 Frozen Food Foundation Freezing Research Award, as well as IFT’s Collaborative Research Grant in honor of Marcel Loncin, where he received \$50,000 to support a research project.

He received his undergraduate degree from the National Institute of Technology Raipur in Chhattisgarh, India, before earning his Master of Science degree in Mechanical Engineering from the Indian Institute of Technology, Madras in Chennai, India. He went on to receive his PhD in Food Engineering from McGill University in Montreal, Canada. Sablani is a member of the Cascadia Section of IFT. He currently resides in Pullman, Washington.

To view the 2024 IFT Fellows, click [here](http://www.ift.org/community/awards-and-recognition/ift-fellows) or go to www.ift.org/community/awards-and-recognition/ift-fellows.

About Institute of Food Technologists

The Institute of Food Technologists (IFT) is a global organization of

over 11,000 individual members from more than 90 countries committed to advancing the science of food. Since 1939, IFT has brought together the brightest minds in food science, technology and related professions from academia, government, and industry to solve the world’s greatest food challenges. IFT works to ensure that its members have the resources they need to learn, grow, and innovate to advance the science of food as the population and the world evolve. IFT believes that science and innovation is essential to ensuring a global food supply that is sustainable, safe, nutritious, and accessible to all. For more information, please visit ift.org.

— Institute of Food Technologists

Robotic gripper for automated apple picking developed

By Tina Hilding, Voiland College of Engineering and Architecture

The innovative gripper is part of a robotic set-up that the researchers are hoping will someday do fruit picking and other farm chores for Washington farmers to help alleviate ongoing labor shortages. The researchers recently published their work on the gripper in the proceedings of the IEEE 7th International Conference on Soft Robotics.

“We’re hoping that we can help a lot of people with this project,” said Chris Ninatanta, a Ph.D. student in the WSU School of Mechanical and Materials Engineering and first author on the paper. “Labor shortages in

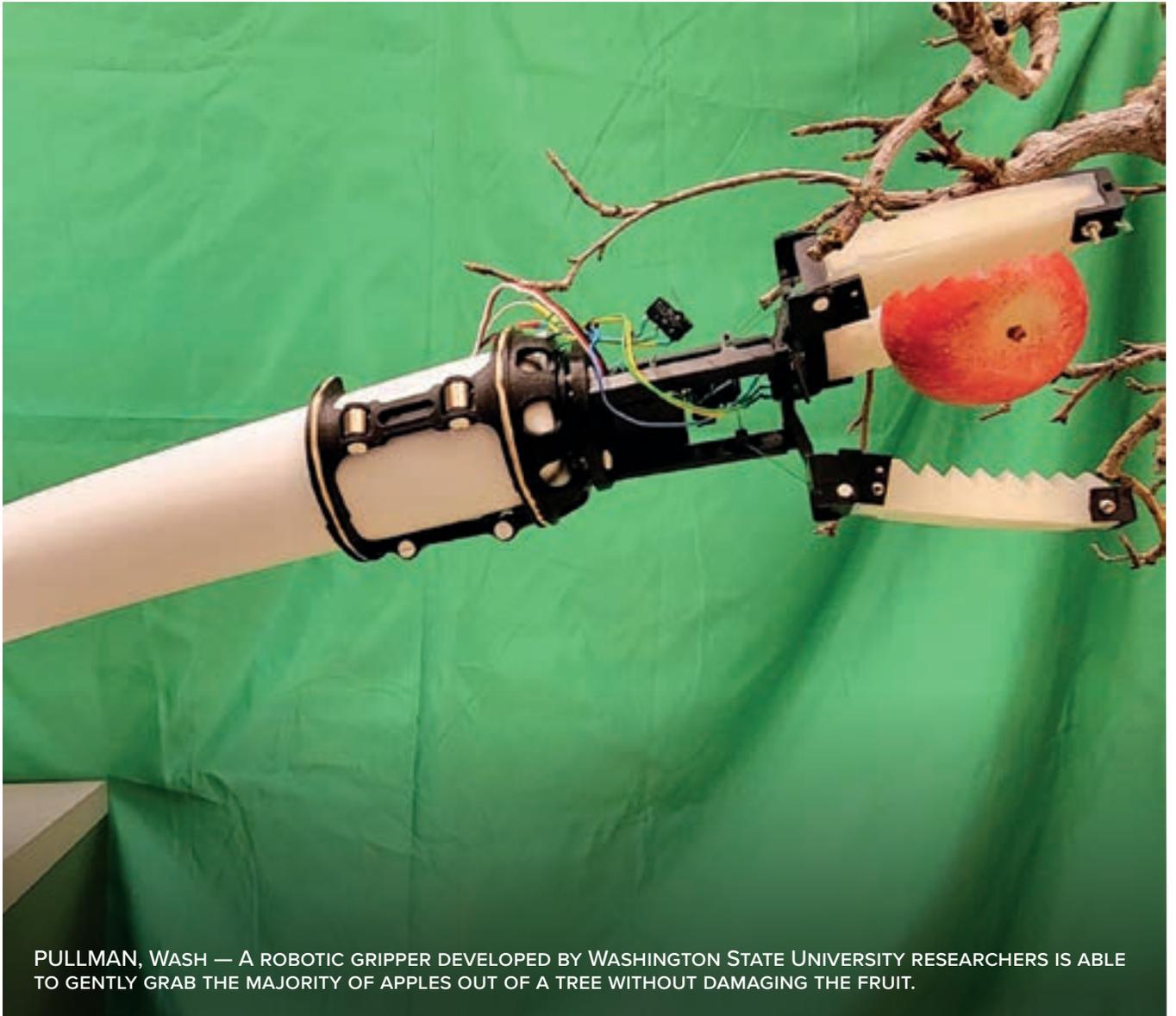
Washington can be very hurtful to orchards.”

Weighing about two-thirds of a pound, the gripper uses three cables to move 3D-printed hard plastic and silicone rubber-tipped fingers. The fingers have to be gentle enough that they don’t damage the apples but strong enough to pull the apple off the tree. At a cost of about \$30 to produce, the gripper includes a switch to grasp the apple and let go. It was able to successfully grab more than 87.5% of the apples in an orchard without damaging them.

“We’re always aiming to increase that with new designs,” said Ming

Luo, Flaherty Assistant Professor in the School of Mechanical and Materials Engineering. Luo and Manoj Karkee, professor in the Department of Biological Systems Engineering and director of WSU’s Center for Precision & Automated Agricultural Systems, led the work.

Washington state leads the nation in apple production, and in 2022, the industry contributed more than two billion dollars to the U.S. gross domestic product. Throughout Washington, farms employ anywhere from a dozen to hundreds of workers each year for orchard operations, including for pollination, pruning, flower thinning



PULLMAN, WASH — A ROBOTIC GRIPPER DEVELOPED BY WASHINGTON STATE UNIVERSITY RESEARCHERS IS ABLE TO GENTLY GRAB THE MAJORITY OF APPLES OUT OF A TREE WITHOUT DAMAGING THE FRUIT.

and fruit harvesting. With an aging population and a decrease in migrant farm workers, however, farmers have struggled to meet their needs for workers during harvest season.

In recent years, researchers have started developing robotic apple harvesting systems, but the ones that have been developed are expensive and complex to use in orchards.

Ninatanta, who grew up in Yakima, Washington, picked fruit alongside his parents during his childhood. When he began his work with Luo on a robotic apple gripper,

he had his parents videotape their work, so he could model his gripper on their handiwork.

“So some of the design for this is actually inspired by my parents,” he said.

The WSU team will next connect their light-weight gripper to a low-cost robot system that they are developing. Similar to inflatable tube-people often used in outdoor advertising at car dealerships, the robot arm is made of a soft fabric filled with air that is similar but stiffer than the car dealership version.

As part of the project, the researchers are also working to add an onboard camera to their system that can precisely guide the arm as well as a gripper that can twist, similar to a human hand’s rotation to reduce the damage of the apple stem. They expect to try the system out in their lab and then farm fields later this year.

The work was funded by the National Science Foundation, National Institute of Food and Agriculture and Washington Tree Fruit Research Commission.

Making CAHNRS better: Awards go to outstanding faculty and staff

April 26, 2024, By Seth Truscott

Great teachers and advisors, forward-thinking researchers, inspiring Extension specialists, and an impactful team in the College of Agricultural, Human, and Natural Resource Sciences were honored by colleagues during the annual Faculty and Staff Awards, April 11 at Ensminger Pavilion.

Supervisors as well as current and past co-workers joined members of the CAHNRS administration to reflect on the achievements of 11 awardees and groups.

Drs. Lav Khot and Shyam Sablani were honored at the ceremony.



Early Career award winner Lav Khot, center, poses with Manuel Garcia-Perez and Leslie Edgar

Early Career Excellence Award Lav Khot, Director, WSU

AgWeatherNet and Professor, Department of Biological Systems Engineering

The early career award acknowledges outstanding contributions in research, teaching and/or extension in any CAHNRS discipline during the early phases of a faculty member's academic career.

Lav Khot, Director, WSU AgWeatherNet and Professor, Department of Biological Systems Engineering

Khot grew up in a small village in central India, surrounded by sugar cane fields. Growing up in a farming family, he worked on farms and aspired to be an agricultural engineer to help mechanize laborious farm operations.



Shyam Sablani, Faculty Excellence in Research Award winner, with BSE chair Manuel Garcia-Perez and CAHNRS Associate Dean for Research Leslie Edgar.

He is currently an associate professor of precision agriculture and serves as director of one of the largest agricultural weather sensing networks in the U.S. His

program is focused on developing site-specific crop monitoring and management technologies through crop, environmental sensing, and automation. He balances a

presence at Prosser and Pullman to fulfill programmatic and young family needs.

He holds degrees from MPKV-India; the Asian Institute of Technology, Thailand; Iowa State University; and North Dakota State University.

Faculty Excellence in Research Award

Shyam Sablani, Professor, Department of Biological Systems Engineering

This award honors faculty members for high-quality research or creative scholarship over the past three years, or in recognition of a continuous record of scholarly accomplishments.

Sablani's research program is built around applications of materials science to develop innovative packaging solutions and improve the safety and quality of foods. He has received the prestigious Marcel Loncin Research Prize from the Institute of Food Technologists, Outstanding Researcher Awards from Sultan Qaboos University, and the Certificate of Merit and George F. Stewart International Research paper award from the Institute of Food Technologists.

Sablani holds a doctorate from McGill University, Montreal. He has published more than 250 scientific journal articles, 33 book chapters, four book reviews, and edited a handbook on food and bioprocess modeling techniques. He is currently the Scientific Editor of the Journal of Engineering.



Lav Khot, Michelle Moyer, Gwen Hoheisel

Team Interdisciplinary Award

Perennial Crops Spray Application Technology Team

This award is presented to a group of faculty, staff, or students who have made significant contributions through an application of interdisciplinary scholarship in research, teaching, and potentially, extension.

The Perennial Crops Spray Application Technology Team has collaborated for more than 10 years to address important challenges faced by perennial specialty crop growers. Traditionally, pest management education and extension has focused on the what and when to spray; the how to spray is overlooked. Combining expertise in horticulture, plant pathology, entomology, and agricultural engineering, this team provides research and translational extension education on “how, what, and when” aspects of spray application technology. Their efforts also help improve agricultural workers' health, safety, and associated socioeconomics in rural communities.

Members include Biological Systems Engineering Professor

Lav Khot (mentioned above for the Early Career Excellence Award); Michelle Moyer, Professor, Department of Viticulture and Enology; and Gwen-Alyn Hoheisel, Professor and Regional Extension Specialist.

Moyer is based at WSU Prosser IAREC and has research and Extension responsibilities in wine and juice grapes, with an emphasis on integrated pest management. She is originally from a small town in southern Wisconsin, growing up working in her family's wholesale and retail ornamental plant nursery and landscaping company. Moyer holds degrees from the University of Wisconsin-Madison and Cornell University.

Hoheisel holds Extension responsibilities in grapes, tree fruit, and small fruit, conducting applied research and education to meet planned goals, and focuses on sustainable pest management, blueberry horticulture, and application technologies. Doubling as Benton County Extension Director, she divides her time between two county offices and IAREC. Hoheisel earned degrees at the University of Maryland and Pennsylvania State University.

Smart Orchard field day draws a crowd in Central Washington

About 200 people turned out on July 26 to check out the latest in sensors, robotics and irrigation automation at the Smart Orchard field day near Mattawa, Washington...

“Great to see so many people,” said Keith Veselka, managing partner of NWFM, a farm management company that operates the orchard. “I think that’s an event that will continue to grow.”

The Smart Orchard is a commercial farm set aside as a testing grounds for agricultural technology companies conducting research projects with the Washington Tree Fruit Research Commission. The Mattawa location, featuring a block of WA 38 and Cripps Pink apples, is the third location of the ongoing effort.

Lav Khot, the project’s principal researcher from Washington State University, called the field day a success.

“A few ag-tech developers called me to say they had good, direct feedback from growers on ways to move their solutions forward,” Khot said.

At the field day, the group split into three tracks to hear five-minute presentations from more than 20 vendors with technologies ranging from an above-canopy evapotranspiration meter to an automated, tree-by-tree fertilizer



LAV KHOT, LEFT, OF WASHINGTON STATE UNIVERSITY GREETES GUESTS ON JULY 26 AT THE SMART ORCHARD FIELD DAY IN MATTAWA. ABOUT 200 PEOPLE ATTENDED THE EVENT THAT SHOWCASED THE HIGH-TECH TOOLS OF MORE THAN 20 VENDORS. (ROSS COURTNEY/GOOD FRUIT GROWER)

applicator to an electric weed zapper. Demonstrations from self-driving equipment, such as the Prospr automated sprayer from Robotics Plus and the electric, driverless tractor from Monarch, were included.

Though the Smart Orchard features a wide variety of technology, Khot’s first focus will be irrigation and heat mitigation, he said. Numerous companies have tools that aim to better measure tree and soil water needs and then tie those measurements to devices that will automatically turn valves on and off.

“Those are things I think we’re going to learn,” said Veselka, also a member of the research commission.



AN EVAPOTRANSPIRATION METER FROM LI-COR WORKS 6 FEET ABOVE A WA 38 CANOPY, DESPITE SHADE NETTING, SAID SASHA IVANS, SENIOR PRINCIPAL ENVIRONMENTAL SCIENTIST FOR THE NEBRASKA COMPANY. (ROSS COURTNEY/GOOD FRUIT GROWER)

WSU faculty elected to Washington State Academy of Sciences

August 1, 2024, By Communications staff, Washington State University

Almost a third of the 36 new members of the Washington State Academy of Sciences are from Washington State University. The ten WSU faculty elected to the WSAS come from a range of disciplines including animal science, cropping systems, engineering, information ethics, genome engineering, and psychology.

WSAS President John Roll, also a WSU professor, welcomed all the new members who were elected in recognition of their scientific achievement and willingness to work on behalf of the academy for the benefit of the state.

“We are thrilled to honor these scientists, engineers, and leaders in the public, non-profit and private sectors for their distinguished and continued achievements,” said Roll. “We look forward to tapping their expertise and knowledge to advance the Academy’s mission of science in the service of Washington State.”

In addition, WSU education Professor Brian French, was elected as a new WSAS board member, and engineering Professor Susmita Bose was re-elected to serve for a second term on the board. Professor Jonathan Yoder of WSU School of Economic Sciences, will serve as the board’s treasurer.

New members will be inducted at the Annual Members’ Dinner following the WSAS Symposium at the Museum of Flight in Seattle on Sept. 25.

Manuel Garcia-Perez



Professor and Chair, Biological Systems Engineering

Garcia-Perez is recognized for his leadership in sustainable agriculture systems and bio-energy research. His creative research advances our understanding of complex thermochemical reactions so that they can be controlled to obtain green products—such as bio-oils, biochar, and sustainable aviation fuel—to combat global warming and provide environmental services.

Michael Wolcott



Engineering and Interim Vice President for Research for WSU

Wolcott is recognized for his exemplary scientific contributions and policy development to enable biobased materials, chemicals, and fuels leading to the development and commercialization of advanced materials and fuels, improving performance while reducing costs and environmental burdens.

Students and faculty participate in 2024 ASABE annual international meeting (AIM)



FACULTY, GRADUATE STUDENTS AND ALUMNI OF WSU BIOLOGICAL SYSTEMS ENGINEERING DEPARTMENT ATTENDING THE ASABE AIM 2024.

This year, the ASABE AIM was held in Anaheim, California on 28–31 July 2024. Several graduate students participated and presented their work in this event. In addition to active participation in several leadership roles (technical committee, technical community, moderation, volunteering, career fair, etc.), BSE faculty and students made 19 oral and 6 poster presentations in different technical sessions within diverse communities. Drs. Manuel Garcia-Perez, Kang Huang, Lav Khot, Manoj Karkee, and Sindhuja Sankaran represented WSU at the AIM.

Dr. Lav Khot and Dr. Manoj Karkee were Guest Speakers in Special Sessions on ‘Agricultural Autonomy’ and ‘Cybersecurity, Social Impacts and Risks of Merging Information Systems’, respectively. Dr. Lav Khot received the Blue Ribbon Award for Ongoing Communication (Take a Deep Dive into Digital Water – Special Issue July/August 2022 Resource Magazine). Dr. Manoj Karkee’s research also received the 2024 ASABE Superior Paper Award (for paper: Xinyang Mu, Magni Hussain, Long He, Paul Heinemann, James Schupp, Manoj Karkee, Minghui

Zhu, 2023. An Advanced Robotic System for Precision Chemical Thinning of Apple Blossoms. *Journal of the ASABE*. 66(5): 1125-1134; doi: 10.13031/ja.15678). Ranjan Sapkota and Kesevan Veloo received third place in Ethics Essay Award and Boyd-Scott Graduate Research Award, respectively. We congratulate the award recipients and appreciate all graduate students and faculty members for their participation and presence at 2024 ASABE AIM.

Teaching, learning about Thai eco-friendly food packaging on tap for WSU Fulbright Scholar

August 20, 2024, By Scott Weybright

Shyam Sablani grew up in India and has lived in Canada, Oman, and the U.S. His familiarity with living in different cultures will serve him well as he embarks on a new adventure: serving as a Fulbright U.S. Scholar in Thailand for six months.

Sablani, a professor in WSU's Department of Biological Systems Engineering, studies and teaches about food packaging and food safety. In Thailand, he will teach graduate level courses, guest lecture in some undergraduate classes, and continue his scientific work by coordinating with researchers in his host country.

"Thailand has a culture of using more eco-friendly materials in food packaging," Sablani said. "I'm excited to learn more about this culture and hopefully bring some good information back. That's the focus of the Fulbright program, exchanging knowledge and ideas. I will teach, but also learn."

Sablani will be in Thailand from December until June of 2025. He will be based in the Department of Packaging and Materials Technology at Kasetsart University in Bangkok, but he will travel to other institutions in Thailand and other Southeast Asian countries.

"I learned after being accepted that the Fulbright program



Shyam Sablani

encourages scholars to visit nearby countries to further the impact of culture and educational exchange," Sablani said. "I'm hoping to briefly visit institutions where I can learn about their programs and talk about the strengths of WSU."

He will spend 40% of his time teaching and 60% researching eco-friendly and sustainable food packaging.

Fulbright Scholar Awards provide opportunities for scholars

to teach and conduct research abroad. Fulbright scholars also play a critical role in U.S. public diplomacy, establishing long-term relationships between people and nations.

The Fulbright U.S. Scholar Program is primarily funded by Congress with additional funding from participating governments and host institutions, corporations, and foundations in foreign countries.

Manure management research seeks to cut greenhouse gases, boost dairy farm economics

August 28, 2024, By Leslie Streeter, WSU Tri-Cities



PHOTO BY WILLY MOBILO ON ISTOCK

The Washington State Conservation Commission has awarded researchers from Washington State University Tri-Cities \$200,000 to test a new process for managing manure. It has the potential to decrease greenhouse gas emissions, while also making the process more economical for dairy farmers and improving cow health.

“The research funded by this grant will emphasize improvements in local and global agriculture by improving manure management,” said Birgitte Ahring, professor at WSU Tri-Cities, and an expert in biomass conversion and anaerobic digestion. “We are hoping with this research we can show value and solve some problems for dairy farmers.”

Methane from cow manure is a major contributor to greenhouse gases emitting both carbon dioxide and methane to the atmosphere. Currently many dairies manage manure by adding it to ponds or

lagoons so it can be spread over crops as fertilizer during growing season. This method results in emission of greenhouse gases, and further lead to contamination of streams, rivers, and lakes.

Some large dairies recycle the manure solids by separating the solids before adding it to lagoons using a screw pressing process. These solids are then used as a bedding material for the cow sheds. However, this method has the potential to cause infection in the animals which decreases the quality and quantity of milk they produce.

Using anaerobic digestion to create biogas is another solution that some farmers have tried. While this method reduces the impact of the manure on the environment and creates a useful bioenergy source, the manure contains high levels of certain organic material, called recalcitrant lignocellulosic material, that impedes the amount of biogas that can be produced. Consequently, this affects the economics of anaerobic digestion and the efficiency of using it for managing manure, keeping many farmers from adopting it.

In the project Ahring and her research team will use an existing pre-treatment technology to open the biomass material and enhance the carbon conversion efficiency of anaerobic digestion. The expectation is that up to 100% more biogas will be produced resulting in up to 80% carbon conversion efficiency compared to maximum

50% for conventional anaerobic digestion. It is expected that this pre-treatment process will further sanitize the manure solids and make it safe as a bedding material. For testing the effect of pretreatment on infectious microbes, Ahring has partnered with Craig McConnell, associate professor at WSU Pullman and the director of the veterinary medicine extension.

The hope is that this solution for manure management will not only reduce methane and greenhouse gasses by producing renewable natural gas for the natural gas grid, but further enhance the economics of milk production by improving the health of cows and reducing infection in dairies, where manure solids are used as bedding.

As directed by the grant, Ahring and McConnell will disseminate the results from the project in June 2025 to Washington dairies, industries providing AD plants etc.

“It is our hope that if they can see how this new technology positively impacts their core business and offers both economic and environmental benefits, they will be positive toward future demonstrations and implementations,” Ahring said. The Washington State Conservation Commission works to conserve natural resources on all lands in Washington state, through voluntary and incentive-based programs, in collaboration with conservation districts and other partners.

Project aims to better understand water demands from extreme heat

August 28, 2024, By Sara Zaske, WSU News & Media Relations

Editor's note: This is part of an ongoing series of monthly articles through 2024 about WSU's research and other efforts to understand and confront climate change.

Gentle mist floating over orchards may not seem to amount to much water, but those fine droplets can add up to big trouble when extreme heat means a lot of misting — and potentially greater conflict over water use.

A project to better understand, and help balance, future water

demands during high temperatures recently received a \$650,000 grant from the U.S. Department of Agriculture. The project funds a Washington State University-led team to use Columbia River basin watersheds as case studies to model potential water demand for multiple uses. These are generally categorized as “out-of-stream withdrawals” for agricultural uses and “in-stream flow” needs for ecosystems, endangered fish species, and even hydroelectric power.

The hope is that science-backed information can help create

constructive conversations now to prepare for a hotter climate in the future.

“We live in this area where there are limited water resources that we’re trying to use efficiently across a whole range of uses, so we want to make sure that moving forward in a climate change scenario, we have sustainable water resources to meet all of the needs,” said Kirti Rajagopalan, a WSU biological engineer and principal investigator on the project.

One part of the project is to better quantify the need for “evaporative cooling,” such as



The need to use of misters to prevent sunburn on apples and other fruit increases during long hot spells (photo by Bob Hubner, WSU Photo Services).

“We are potentially quite significantly underestimating the amount of additional water that’s needed in the future for agriculture, and obviously we don’t want to be in that situation.”

—Kirti Rajagopalan, biological engineer and principal investigator, Washington State University

the misting often necessary to save tree fruit like apples as well as grapes and other berries from getting burnt by the sun.

Many growers employ cloth netting to shade the fruit when it gets hot, but as an earlier WSU study has shown — that netting won’t be enough when future climate conditions send temperatures higher for longer periods of time.

“Shade netting wasn’t as effective in reducing fruit surface temperatures, requiring more reliance on evaporative cooling,” said Rajagopalan. “We are potentially quite significantly underestimating the amount of additional water that’s needed in the future for agriculture, and obviously we don’t want to be in that situation.”

The research team will be talking directly with growers and

irrigation district officials to make sure the modeling reflects real world situations.

Better quantifying the problem is one aspect of the project. Another big part is to come up with potential solutions that can meet water needs across a broad range of in-stream and out-of-stream uses. For that, the team will be holding a lot of conversations not just with growers but also with agencies such as the state’s Department of Ecology, and the Department of Fish and Wildlife as well as nonprofits like Trout Unlimited.

The WSU-led team will be looking for adaptations that will benefit all sides. On the agricultural side, that means potentially finding other cooling strategies that require no water or less water, and on the in-stream side, perhaps looking at specific practices and timing when keeping water levels high is most

important to the ecosystem and for fish.

“Understanding where those opportunities might lie really depends on talking to folks who are involved with that aspect of the work,” said Sonia Hall with the Center for Sustaining Agriculture and Natural Resources.

Hall and Rajagopalan are part of a collaborative team of WSU researchers including Lee Kalcsits, Mingliang Liu, Troy Peters Georgine Yorgey, and Matt Yourek. The interdisciplinary team will help integrate the scientific quantification of the problem with the on-the-ground experience of the various interest groups. While the project is currently localized to the Columbia River watershed, the findings could help inform approaches in irrigation areas across the West that face similar water use issues. “If we all share an understanding of what the problem is, its extent, and possible opportunities for solutions that help the whole system — then science can help set the stage for more productive conversations,” said Hall.

New grant will help researchers protect apples, pears from extreme climate events

September 17, 2024, By Scott Weybright, College of Agricultural, Human, and Natural Resource Sciences

WENATCHEE, Wash. — Washington State University scientists will lead nationwide research addressing the impact of extreme temperatures on apple and pear crops.

Lee Kalcsits, associate professor and Endowed Chair of Environmental Physiology for Tree

Fruit, heads a team of 21 scientists from seven institutions working to mitigate stresses on pome fruits and develop strategies that limit future risks.

“This is a great team that will share existing knowledge and develop new ideas to support apple and pear growers dealing

with extreme temperatures,” Kalcsits said.

Funded by the USDA National Institute of Food and Agriculture’s Specialty Crop Research Initiative, the \$6.75 million project will run for four years.

Among research goals, the team will focus on extreme cold and



WSU PROFESSOR LEE KALCSITS AND GRADUATE STUDENT HARRIET AMPOFO WORK ON A PROJECT TO HELP MITIGATE IMPACTS ON POME FRUITS FROM EXTREME CLIMATE EVENTS AT WSU'S SUNRISE ORCHARD NEAR WENATCHEE, WASHINGTON (PHOTO BY WSU PHOTO SERVICES).

heat, studying a variety of issues including cold hardiness patterns for new apple and pear cultivars; flowering and the emergence from dormancy during spring; and how to mitigate sunburn and enhance red color during extreme heat.

"In Washington state we typically deal less with cold stress, but in 2023 and 2024 we had higher losses than normal due to cold," said Kalcsits, an associate professor of horticulture based at WSU's Wenatchee Tree Fruit Research and Extension Center (TFREC). "In the eastern U.S., the risk of cold damage is higher, so we can use some knowledge from scientists located there. They aren't as used to extreme heat on the East Coast, so we can share some of our strategies more easily with them, thanks to this project."

Economists on the team, including a climate change economist, will collaborate with other specialists to examine the current risk of extreme climate

issues, study historic impacts of extreme temperatures, and create models that will allow growers to more reliably assess risk.

Team members will also look at the cost and benefit of different mitigation strategies to see if they're worth the cost of implementation.

Finally, the team aims to develop a coordinated, nationwide Extension strategy for mitigating fruit losses. Researchers plan to host a series of field days and fruit schools online and in person to provide growers with training that helps reduce losses due to temperature extremes.

"When you look at the statistics, extreme temperatures are the leading cause of reductions in yield and packout," Kalcsits said. "Even with our current strategies, losses occur. We need to develop a better understanding of the biological factors leading to those losses, and growers also need more effective options."

“It's about developing new strategies for issues the industry already experiences. It's not just climate change but understanding exposure to extreme temperatures and how that will change in the future.”

—Lee Kalcsits, associate professor and Endowed Chair of Environmental Physiology for Tree Fruit Washington State University Extension

The project's overarching objective is to make more apples and pears available for consumers.

"It's about developing new strategies for issues the industry already experiences," Kalcsits said. "It's not just climate change but understanding exposure to extreme temperatures and how that will change in the future. It will be great to have additional tools available now and to understand risks 20 or 50 years down the road."

Other WSU scientists on the project include WSU Pome Fruit Breeder Kate Evans; Biological Systems Engineering Assistant Professor Kirti Rajagopalan; School of Electrical Engineering and Computer Science faculty members Ananth Kalyanaraman and Paola Pesantez-Cabrera; and Sonia Hall, researcher at WSU's Center for Sustaining Agriculture and Natural Resources.

Other institutions involved in this project include Cornell University; the University of Maine; Michigan State University; Penn State University; Oregon State University; and the USDA Agricultural Research Service.

New continuous reaction process can help turn plant waste into sustainable aviation fuel

September 26, 2024, By Seth Truscott, College of Agricultural, Human, and Natural Resource Sciences

RICHLAND, Wash. — Washington State University scientists successfully tested a new way to produce sustainable jet fuel from lignin-based agricultural waste.

Published in the journal *Fuel Processing Technology*, the team’s research demonstrated a continuous process that directly converts lignin polymers, one of the chief components of plant cells, into a form of jet fuel that could help improve performance of sustainably produced aviation fuels.

“Our achievement takes this technology one step closer to real-world use by providing data that

lets us better gauge its feasibility for commercial aviation,” said lead scientist Bin Yang, professor in WSU’s Department of Biological Systems Engineering.

A class of structural molecules that make plants tough and woody, lignin is derived from corn stover — the stalks, cobs and leaves left after harvest — and other agricultural byproducts.

The team developed a process called “simultaneous depolymerization and hydrodeoxygenation,” which breaks down the lignin polymer and at the same time removes oxygen

to create lignin-based jet fuel. At their Richland facility, the scientists introduced dissolved lignin polymer into a continuous hydrotreating reactor to produce the fuel.

Global consumption of aviation fuel reached an all-time high of nearly 100 billion gallons in 2019, and demand is expected to increase in the coming decades. Sustainable aviation fuels derived from plant-based biomass could help minimize aviation’s carbon footprint, reduce contrails and meet international carbon neutrality goals.

Lignin-based jet fuel could make sustainable fuels cleaner and



JOSHUA HEYNE, DIRECTOR OF THE WSU BIOPRODUCTS, SCIENCES, AND ENGINEERING LABORATORY, AND RESEARCH ASSISTANT CONOR FAULHABER, EXAMINE SWELLING RESULTS FROM A MATERIAL COMPATIBILITY TEST RELATED TO SUSTAINABLE FUELS.



WORKING AT RICHLAND, WASH., DANIEL SANTOSA, A WASHINGTON STATE UNIVERSITY DOCTORAL STUDENT AND SCIENTIST AT PACIFIC NORTHWEST NATIONAL LABORATORY, TESTS A WSU-DEVELOPED CONTINUOUS PROCESS THAT TURNS LIGNIN, A POLYMER FOUND IN PLANTS, INTO JET FUEL.

more easily usable in jet engines. Thanks to their density, efficiency, and seal-swelling characteristics, hydrocarbons catalyzed from lignin could effectively replace fossil fuel-derived compounds called aromatics. Associated with contrails and climate impacts, aromatics remain in use because they enhance fuel density and help swell O-rings in metal-to-metal joints.

This research marked the team's first successful test of a continuous process, which is more feasible for commercial production. The project also used a less processed, less expensive form of lignin derived from corn stover, dubbed "technical lignin," contrasting

similar research using extracted lignin bio-oil.

The team's findings suggest lignin is a promising source of aromatic-replacing cycloalkanes and other useful fuel compounds.

"The aviation enterprise is looking to generate 100% renewable aviation fuel," said Josh Heyne, research team member and co-director of the WSU-PNNL Bioproducts Institute. "Lignin-based jet fuel complements existing technologies by, for example, increasing the density of fuel blends."

Offering reduced emissions, lignin-based fuel could ultimately make sustainable aviation fuels fully "drop-in" capable, meaning

they can be used with all existing engines, infrastructure and aircraft like existing fossil-derived aviation fuel.

"We're working to create an effective, commercially relevant technology for a complementary blend component that can achieve the 100% drop-in goal," Heyne said.

The research was supported by the U.S. Department of Energy's Bioenergy Technologies Office, the Pacific Northwest National Laboratory, the National Renewable Energy Laboratory and Advanced Refining Technologies LLC.

The team is now working to refine their process for better efficiency and reduced costs.

Fulbright student contributes to sustainable aviation fuel research

November 12, 2024, By Tom Holm, International Programs

A process developed to make aviation fuel from wet organic waste could provide a more sustainable alternative to conventional manufacturing processes.

The advance, which is published in the journal *Bioresource Technology*, was made in part by a Washington State University Fulbright scholar Budi Harahap.

The Fulbright Program awards about 4,000 scholarships yearly to foreign students to study in the U.S. This year 15 Fulbright students from eight different countries are studying system-wide at WSU.

This educational exchange provides an opportunity for domestic researchers to gain a global perspective. The journey Harahap, a biological systems engineering PhD student at WSU Tri-Cities, took to get to WSU and his research published in a scientific journal was a long but ultimately rewarding one.

Harahap was supposed to leave his home country of Indonesia to attend WSU in August 2020 after earning a Fulbright scholarship, but the COVID-19 pandemic disrupted his plans. He was eventually able to travel to the U.S. in January 2021 and begin researching a topic that he's passionate about.

"I wanted to have a new experience that aligns with what I really want to do. When I looked for the campus, I found Professor Birgitte Ahring's work on what I am interested in. She is a world-class professor, expert at biomass and waste bioconversion," he said. "I'm really grateful to get the Fulbright

scholarship from this country. It allows me great flexibility in my research, as long as my advisor approves, and the necessary facilities are available in her lab."

Harahap, under the guidance of Ahring, developed a way to convert food and garden waste into precursors for sustainable aviation fuel production.

For the study, Harahap, under the guidance of Ahring — who is the corresponding author of the publication — developed a way to convert food and garden waste into medium-chain carboxylic acids, especially caproic acid, which is a precursor for sustainable aviation fuel. Their research offers a more efficient way, compared to available ways, to produce the precursors (caproic acid and hydrogen) for sustainable aviation fuel production.

Ahring said she has had many Fulbright scholars collaborate with her in the past and that Harahap brought a lot of value to her research.

"The good news for me is when you have a Fulbright student you can test new things and get something new up and going," she said.

Harahap will defend his PhD thesis in November and is applying for post-degree academic training to stay in the U.S. upon completing his PhD.



BUDI HARAHAP PROVIDING THE SUBSTRATE (FOOD AND GARDEN WASTE) TO ENRICH ANAEROBIC MICROORGANISMS THAT PRODUCE SHORT- AND MEDIUM-CHAIN FATTY ACIDS, WHICH SERVE AS PRECURSORS FOR SUSTAINABLE AVIATION FUELS (SAF).

Coming from the densely populated country of Indonesia to the rural region of the Tri-Cities could have been a shock, but Harahap said he came to Richland with no preconceptions.

"This is the first time I've gone abroad," he said. "Some students here have some expectations when they come to WSU Tri-Cities. They think this campus is as big as the campus in Pullman, but for me, I had no expectations because I never had the experience to study abroad, so I was so excited the first time I came here."

Ahring said that the four years of work Harahap has produced under her advisement is now coming to fruition.

"It's good to see a PhD student accomplish something that is significant," she said.

INTERNSHIP OPPORTUNITIES

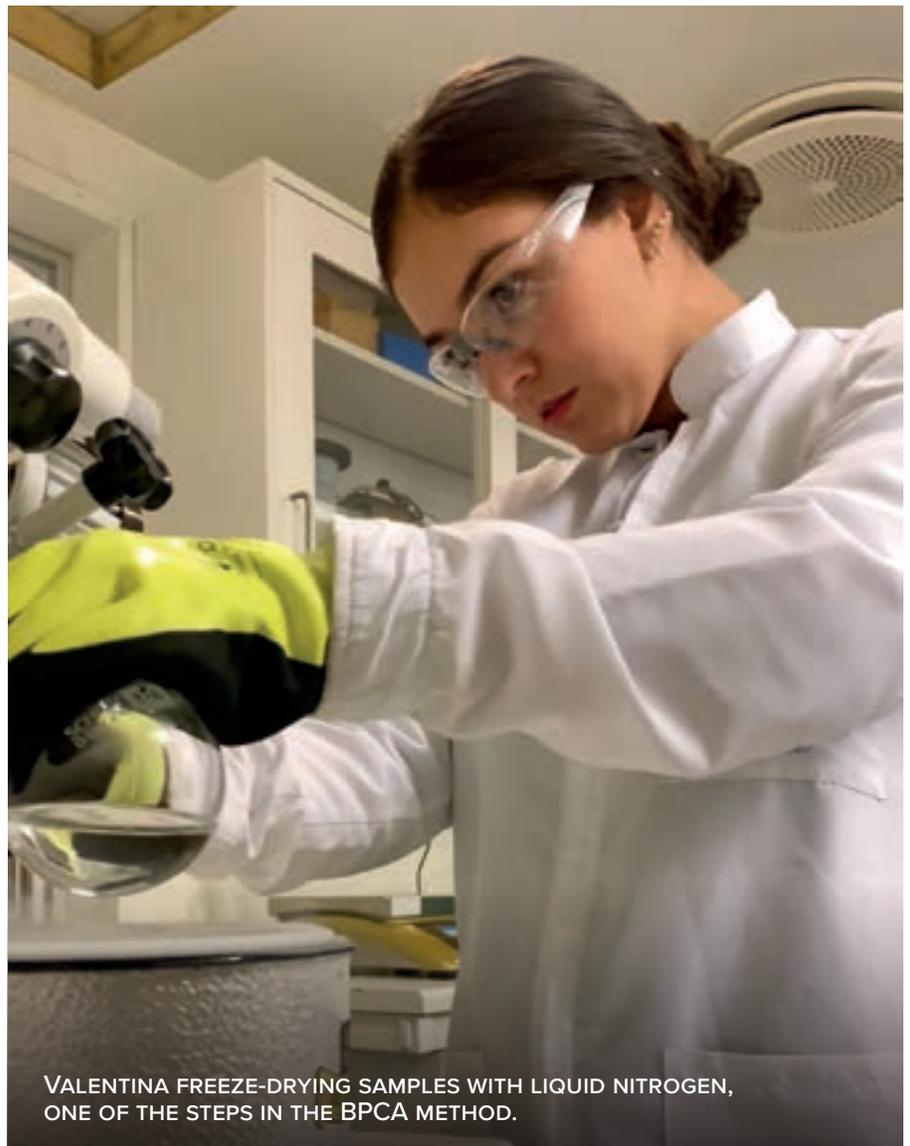
International Research Experience

By Valentina Sierra-Jimenez

As part of her PhD program, Valentina Sierra-Jimenez had the opportunity to complete two international research internships that significantly advanced her work in biochar modeling. In 2023, she spent three months at the University of Lorraine in France, funded by an Erasmus+ scholarship. She returned in 2024 for a six-month stay, this time supported by the Chateaubriand Fellowship Program, an initiative of the Embassy of France in Washington, D.C.

During her time in France, Valentina collaborated with Dr. Anthony Dufour, CNRS Research Director, who served as her host. This partnership was highly productive, allowing her to bring samples of the biochar produced at Washington State University to France for in-depth characterization. With access to state-of-the-art facilities and expert support, she was able to perform critical analyses essential to her computational modeling work.

Among the techniques she conducted were Electron Spin Resonance, solid-state ^{13}C Nuclear



VALENTINA FREEZE-DRYING SAMPLES WITH LIQUID NITROGEN, ONE OF THE STEPS IN THE BPCA METHOD.

Magnetic Resonance, Raman Spectroscopy, X-ray Photoelectron Spectroscopy, skeletal density analysis, and H₂ and N₂ adsorption-desorption isotherms. While in Metz, France, she also explored different setups for matrix-assisted laser desorption/ionization (MALDI) Fourier-transform ion cyclotron resonance mass spectrometry (FT-ICR-MS). Additionally, she visited the Institute of Molecular Sciences at the University of Bordeaux, where she worked with Dr. Jean-Marc Leyssale to gain insights into various modeling strategies.

Expanding the international scope of her research even further, Valentina spent one month at the Norwegian Institute of Bioeconomy Research (NIBIO), where she collaborated with Dr. Alice Budai. There, she learned the benzene polycarboxylic acid (BPCA) method, an advanced analytical technique used to deconstruct the polycyclic aromatic structures characteristic of biochar.

Her experiences culminated in presentations of her ongoing research at two international seminars: the “Séminaire 2023 Groupement de Recherche THERMOBIO—Conversion Thermochimique de la Biomasse et des Déchets” in France, and “Biochar Utilization Methods for Improved Nutrient Management” in Norway.

These international collaborations not only expanded her scientific skillset but also deepened her understanding of advanced characterization techniques. Most importantly, they enhanced her ability to integrate diverse data into atomistic models of biochar to more accurately represent its structural complexity.



VALENTINA SIERRA-JIMENEZ IN FRONT OF THE ARC DE TRIOMPHE, PARIS, FRANCE.



VALENTINA PRESENTING HER RESEARCH.

Valentina expressed that these relationships have been especially valuable for students like herself. Pursuing a PhD while working with diverse research groups across different systems has broadened her perspective, offering insights into how various researchers approach similar challenges. These experiences have taught her to think more innovatively and approach problems from new angles.

She is deeply grateful for these opportunities and for the generous support she received, not only from her international hosts but also from the Department of Biological Systems Engineering at Washington State University, which played a key role in facilitating her internships abroad. This support has been instrumental in her development as a researcher and in shaping the global scope of her doctoral work.

WSU researcher enhances tree-pruning robot with Australian university partnership

October 24, 2024, By Tom Holm, International Programs

Martin Churuvija partnered with Australian researchers this summer to integrate artificial intelligence (AI) into his prototype tree-pruning robot.

The Washington State University biological systems engineering PhD student had the opportunity to work with scientists at the University of Technology Sydney (UTS) thanks to a partnership between WSU and the Australian university focused on robotics.

He spent two months in Sydney this summer working with UTS experts to figure out how to get his robot’s operating system to recognize and accommodate deformations in apple trees, which can affect how the trees are pruned.

Under the advisement of UTS Professor Alen Alempijevic, Churuvija updated the operating system of his robot to the latest software, enabling it to work with a newer camera system. Churuvija said the algorithms developed by UTS help his robot accommodate for minor tree movements while it scans.

Alempijevic said Churuvija had great technical abilities and was pleased to see the research start to make inroads into agriculture automation.

“Working together with Martin, and WSU, allows us to develop systems more rapidly,” Alempijevic said. “Being in opposite hemispheres — UTS in Australia, WSU in the USA — has the advantage of more deployment

opportunities which are critical to increasing the robustness of systems.”

Churuvija’s original system assumed a static tree structure — which worked in a controlled lab environment at the Irrigated Agriculture Research Extension Center in Prosser. Occasionally though, scans in the orchard would show odd, 3D pictures of a tree branch in a cone shape due to the wind disturbing a scan. Adding AI elements helps the robot piece together missing information and brings it closer to real-world development.

“Using robots in orchard environments is extremely challenging,” Churuvija said. “Unlike indoor settings, outdoor conditions bring a range of obstacles. For example, our vision system — which uses cameras to perceive the world in 3D like humans — must recognize tree structures despite inconsistent lighting and wind.”

Churuvija’s work, which is guided by his PhD advisor Professor Manoj Karkee, is still in the research stage, but his ultimate goal is to help develop robots that can pick fruit as well as prune plants. He is currently focused on finalizing the development of the pruning robot and plans to run trials this winter.

Churuvija’s trip to Australia wasn’t solely centered on lab time. He got to visit several Sydney landmarks such as the opera house and the zoo. Even though it’s on the other side of the globe from his lab



MARTIN CHURUVIJA AT THE UNIVERSITY OF TECHNOLOGY SYDNEY.



A 3D SCAN CREATED OF AN APPLE TREE.

in Prosser, Sydney felt comfortable, and it reminded Churuvija of his home city of Buenos Aires, Argentina.

“Luckily the weather is similar to the weather from the place where I have lived the most,” he said. “It’s a big city so I got to interact with people from all over the place and visit the iconic places.”

Empowering the Next Generation in Agriculture - High School and Undergraduate research Interns at Biological Systems Engineering

At the heart of our department's mission is a commitment to nurturing emerging talent through mentorship. Our faculty members have been mentoring high school and undergraduate students in developing their research and communication skills, offering a glimpse into the rigors and rewards of academic pursuit, and fostering a spirit of curiosity and ambition among these emerging talents. Several students (listed below) engaged in a one-on-one collaboration with faculty

members on research projects associated with agricultural technology, climate change, and sustainable agriculture. Drs. Manoj Karkee, Kirti Rajagopalan, Lav Khot, and Sindhuja Sankaran are a part of the AgAID, AI Institute for Agriculture, Undergraduate Research Internship (URI) program. Dr. Sindhuja Sankaran also leads a USDA-NIFA Research and Extension Experiences for Undergraduates (REEU) program on Agricultural Data Science.

WSU AgWeatherNet, directed by Dr. Lav Khot, also offers up to four paid internships on an annual basis. These programs offer co-mentorship opportunities to graduate students, developing their leadership skills.

In addition, faculty members work with undergraduate capstone project teams, primarily from computer science and other engineering disciplines, to develop technological or data-driven solutions for agricultural and biological applications.



USDA NIFA REEU AND AGAID RESEARCH INTERNS' VISIT TO TREE FRUIT RESEARCH ORCHARD IN WENATCHEE, WA

High School and Undergraduate Research Interns

Student Name	School/Institute	Mentor
Vy Kha Pham	Washington State University Animal Science	Drs. Shulin Chen & Liang Yu
Jayden Scott	Washington State University School of Food Science	Dr. Kang Huang
Evan Haag	Iowa State University (AgWeatherNet)	Dr. Lav Khot & Nathan Santo Domingo
Julizza Gomez	Yakima Valley College	Dr. Lav Khot
Megan Smith	Western Washington University (AgWeatherNet)	Dr. Lav Khot & Jonathan Contezac
Rahat Bhatia	Eastern Washington University (AgAID)	Dr. Lav Khot & Srikanth Gorthi
Thai Li	Oregon State University (AgAID)	Dr. Lav Khot & Dattatray Bhalekar
Brandon Xu	Washington State University (AgAID)	Dr. Kirti Rajagopalan & Amin Norouzi Kandelati
Jamie Jacob	Washington State University (AgAID)	Dr. Kirti Rajagopalan & Supriya Savalkar
Raksha Ravishankar	Liberty High School	Dr. Kirti Rajagopalan & Amin Norouzi Kandelati
Mary Nansikombi	Oregon State University (AgAID)	Dr. Sindhuja Sankaran, Lochana Marasingha & Chamaporn Paiboonvorachat
Trevor Buchanan	Washington State University (AgAID)	Dr. Sindhuja Sankaran, Lochana Marasingha & Chamaporn Paiboonvorachat
Vishal Jeyam	University of Arkansas (REEU)	Dr. Sindhuja Sankaran & Lochana Marasingha
David Wang	University of Washington	Dr. Joan Wu
Carlos Ramos	WSU Undergraduate (TRIO Student Support Services)	Dr. Bin Yang
Jessica Lopez	WSU Undergraduate (TRIO Student Support Services)	Dr. Bin Yang
Jordy Bautista	WSU Undergraduate (TRIO Student Support Services)	Dr. Bin Yang



Trevor Buchanan

Our featured 2024 intern is Trevor Buchanan, an AgAID intern who worked with graduate students

Chamaporn Paiboonvorachat and Lochana Marasingha in Sankaran’s lab in the Summer and Fall of 2024. He was an undergraduate student in Mathematics and Computer Science at Washington State University. His research involved the development of machine learning models for evaluating time-series vegetation indices data acquired from AGIcam (Ag IoT camera) sensor system to predict grain yield in wheat. His curiosity and commitment to the project opportunities were commendable. He was a great team player – who always listened



TREVOR BUCHANAN, TOKY ANDRIAMIHAJASOA AND LOCHANA MARASINGHE PARTICIPATING IN FIELD DATA COLLECTION IN WHEAT BREEDING TRAIL USING THE LICOR PHOTOSYNTHETIC SYSTEM.

attentively, was open-minded to suggestions, and adapted his techniques by integrating others’ ideas. He was collaborative, willing to compromise, and always ready to help with tasks beyond his own. All lab members appreciated

his questions and his genuine interest in advancing science. We wish Trevor Buchanan the best in his personal and professional endeavors. Trevor is currently working as an Associate Trader at Russell Investments in Seattle, WA.

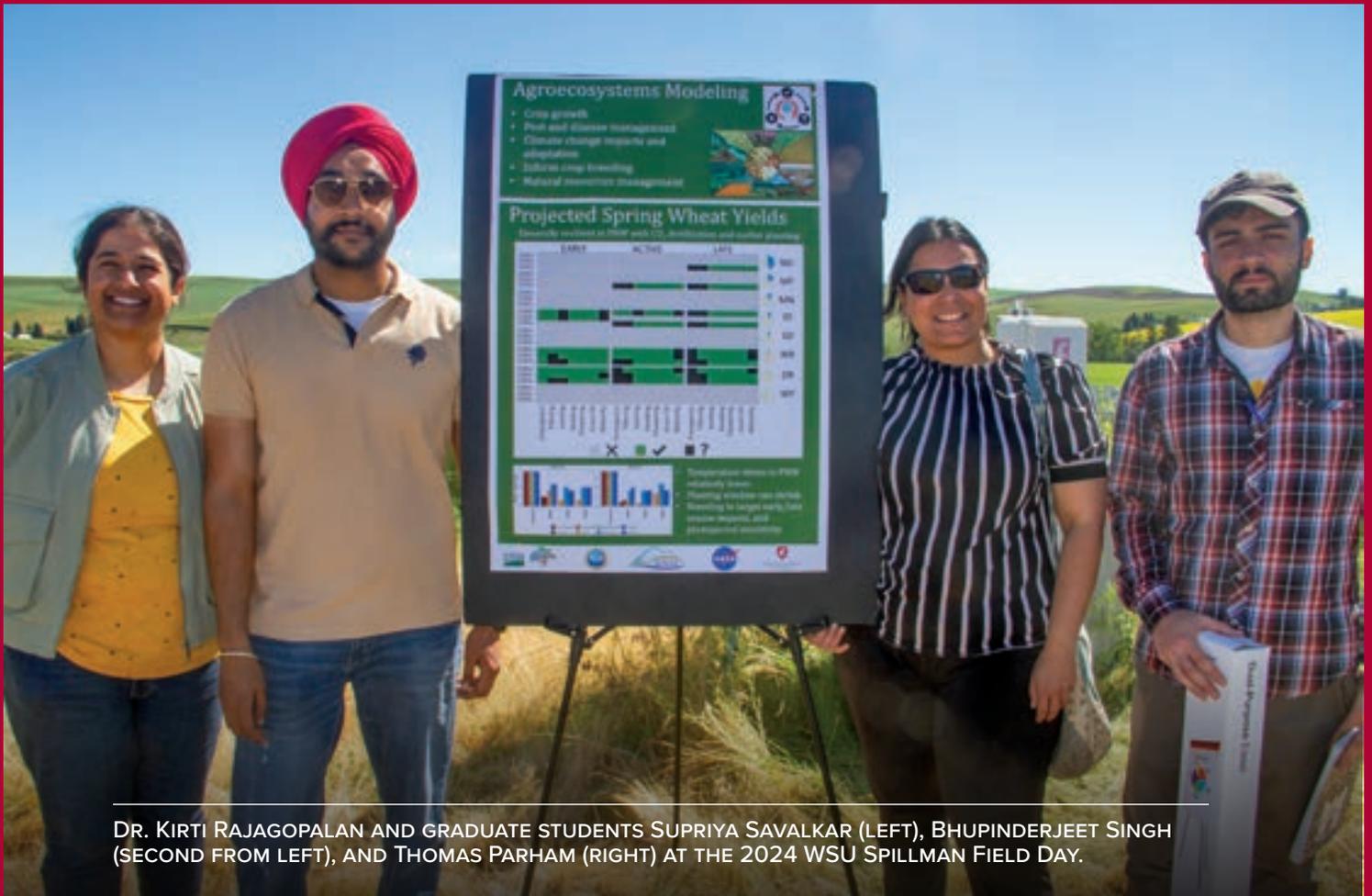
OUTREACH & PARTNERSHIPS

Scientists in BSE work across the state of Washington and partner with global minds and industries to advance the state of our profession.

We are cross-disciplinary collaborators, editors, ambassadors, and mentors. Through societal involvement and fruitful collaboration with peers at the U.S. Department of Energy's

Pacific Northwest National Laboratory, Massachusetts Institute of Technology, the U.S. Army's Natick Soldier Center, and other institutions here in Washington and far afield, we share ideas and spark discovery.

Ahead, learn about some of our department's latest efforts to serve and connect to our colleagues and stakeholders.



DR. KIRTI RAJAGOPALAN AND GRADUATE STUDENTS SUPRIYA SAVALKAR (LEFT), BHUPINDERJEET SINGH (SECOND FROM LEFT), AND THOMAS PARHAM (RIGHT) AT THE 2024 WSU SPILLMAN FIELD DAY.

Birgitte Ahring

Dr. Ahring is a leader in the field of anaerobic processes. Since 2017 she has been serving on the advisory board for the Energy Systems Technology of the Walla Walla Community College, and she is a board member of NXTClean Fuels. Research expenditure: ca. \$5.5 million over the last five years. So far, Dr. Ahring has graduated 54 PhD students, 18 of whom graduated since she joined WSU. She has published 393 peer-reviewed publications, 35 book chapters, and has acquired 10 patents. Of all WSU faculty who are indexed in Google Scholar, Dr. Ahring ranks 9th in WSU citations (38,142, h-index 102). Major technical and scientific achievements for 2021 include: (1) technology to increase the carbon conversion efficiency of sewage sludge by anaerobic digestion, (2) technology to convert CO₂ into CH₄, (3) bio-augmentation to reduce CH₄ emission from ruminants, (4) in-situ bio-reductive dechlorination, and (5) production of acetic acid from CO₂.

In 2024, Dr. Ahring expanded the work done on sewage sludge into the area of manure manage-

ment, showing the same amazing effects as seen for sludge. Her research further focused on the reduction of pathogens as a result of the pretreatment. This work is part of a new collaboration with Professor Craig McConnel at WSU's College of Veterinary Medicine. Manure fibers are often re-circled as bedding without any treatment, leading to udder diseases and reduction in milk production.

Dr. Ahring has received multiple awards, including the Chancellor's Distinguished Research Excellence Award (2021); the Washingtonian of the Day award by Washington State Governor Jay Inslee (2022); and the Anjan Bose Outstanding Researcher Award (2023).

In 2024, Dr. Ahring was awarded the WSU Research Excellence Catalyst Award for her research, innovations, leadership, and collaborative approach to thermochemical conversion processes to reduce waste volume and enhance methane yield through a pre-digestion process, which has major impacts in the areas of renewable energy production and greenhouse gas reduction.



Birgitte Ahring
Professor

Gustavo Barbosa-Cánovas

Dr. Gustavo V. Barbosa-Cánovas is a renowned leader in the field of food engineering, widely recognized for his pioneering contributions to education, research, and professional development. He holds an Honoris Causa Doctorate from the Polytechnic University of Cartagena, Spain. He is the author and editor of numerous textbooks and reference books used worldwide for teaching and research in food processing, particularly in nonthermal technologies. Many of these books have been translated into Spanish, Chinese, Russian, and Arabic, extending their global impact. In 2021, Dr. Barbosa-Cánovas was appointed Distinguished International Professor by the Monterrey Institute of Technology (Mexico). Earlier, in 2009, he founded the journal *Food Engineering Reviews*, published by Springer, and continues to serve as its editor in chief. Under his leadership, the journal has become one of the leading outlets in the field, currently ranked 17th

out of 250 journals in food science and technology. For more than two decades, he has also served as editor in chief of the Springer Food Engineering Book Series, which has published more than 75 titles to date.

Dr. Barbosa-Cánovas has played a central role in advancing professional organizations in food engineering. He is a founder and current executive secretary of the Ibero-American Society of Food Technology (SIBIA) and also a founding member of the Society of Food Engineering (SoFE) and the International Society of Food Engineering (ISFE). He chaired the Conference of Food Engineering (CoFE '24), held in Seattle in August 2024, which was a major success. Currently, he serves as president of the International Association for Engineering and Food (IAEF) and is organizing the 15th International Congress on Engineering and Food, to be held in 2027.



Gustavo Barbosa-Cánovas
Professor

Shulin Chen

Dr. Chen is well known for his contributions to biomass biochemical conversion technologies (e.g., algae, anaerobic digestion). Since 2020, he has been acting as leader of the biomass conversion and bioproducts research area. In his tenure in the department, to date Dr. Chen has graduated 39 PhD students and 27 MS students. His publications are highly cited, with an h-index of 89 and more than 24,000 citations. Dr. Chen ranks 21st among the most-cited WSU researchers. His contribution to the area of commercialization was recognized via the WSU 2022 Innovation and Entrepreneur-

ship Award. In 2023 he was named as a senior member of the National Academy of Inventors. Dr. Chen serves on the editorial board of the *Journal of Energy* and the *International Journal of Green Technology*. He also serves as the technical advisor for the spin-off company Integrated Lipid Biofuels, LLC. In 2024, Dr. Chen was awarded the WSU Impactful Contribution to Society Award for his groundbreaking methods of converting waste into valuable compounds, enabling production at a lower energy cost, moving towards a cleaner, more sustainable future.



Shulin Chen
Professor

Manuel Garcia-Perez

Dr. Garcia-Pérez is the current BSE chair and former director of Bioproducts, Sciences, and Engineering Laboratory (BSEL). His current research focuses on the fundamentals of biomass thermochemical conversion to maximize bio-oil and carbon yields, bio-oil chemistry, refining and hydrotreatment, biochar chemistry, and the development of engineered biochar for environmental services and sustainable aviation fuel technologies. Dr. Garcia-Pérez has published close to 220 peer-reviewed manuscripts and graduated 37 MS and PhD students. In 2024, he advised 9 PhD students (1 graduated) and supervised 4 visiting scholars from Germany, France, and the Philippines, 3 postdocs, a research engineer, and a lab manager. Dr. Garcia-Pérez also

advised a capstone project with five undergraduate students from WSU's chemical engineering department. His publications have been cited 18,293 times (2,263 in 2024) and he has an h-index of 74. In 2024, Dr. Garcia-Pérez organized the first global lecture series on sustainable aviation fuels focusing on Latin American stakeholders, where leading world researchers in Sustainable Aviation Fuels SAF participated and lectured. One-hundred-one SAF roundtable participants from Colombia, Ecuador, Costa Rica, and the Dominican Republic registered for this lecture series. He is also the chief editor of the *Journal of Biomass and Bioenergy* and reviewer editor for the *Journal of Analytical and Applied Pyrolysis*.

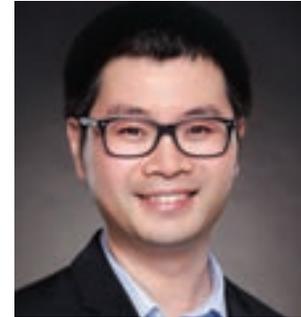


Manuel Garcia-Perez
Professor and Chair

Kang Huang

Dr. Huang's research in food and biomaterials engineering addresses key challenges at the intersection of food, microbes, and materials within agricultural and food systems. His approach integrates multidisciplinary methods from food process engineering, material science, mathematical modeling, microbiology, molecular imaging, and high-speed photography to tackle essential scientific questions. Over recent years, he has developed innovative technologies, including novel biobased antimicrobial formulations, multifunctional materials, and AI-enabled detection systems suitable for both preharvest and

postharvest applications. Dr. Huang has published over 69 peer-reviewed journal articles and one book chapter, in collaboration with numerous institutions worldwide. He has been leading multiple grants funded by USDA, Washington Tree Fruit Research Commission (WTFRC), and private foundations. In 2024, Dr. Huang published 10 peer-reviewed manuscripts with an h-index of 26. Dr. Huang supervised two PhD students, a postdoctoral associate, an undergraduate student intern, and has served as an advisor for the Food Engineering Club.



Kang Huang
Assistant Professor

Lav R. Khot

Dr. Lav R. Khot is the Director of AgWeatherNet and professor of Precision Agriculture at Washington State University. Under his leadership, AgWeatherNet is undergoing a major infrastructure upgrade to establish a mesoscale weather sensing network in the state of Washington. This network provides crucial weather data and decision support, enhancing the resilience of Washington's agriculture, animal, and human health systems. His research and Extension program in precision agriculture focuses on integrating advanced sensing and automation technologies to improve the efficiency of irrigated and tree fruit crop production. He has advised over 30 graduate students, postdocs, Fulbright and international scholars, as well as over 20 undergraduate interns. His program has published over 200 peer-reviewed research and Extension articles, and he has been cited 5,957 times, with an h-index of 35. In 2024, he advised seven students (six PhD and one MS), two postdoctoral fellows including a

Fulbright scholar, and co-mentored five undergraduate interns.

Dr. Khot is playing a leadership role in bringing AI-driven tools to Washington agriculture. He is WSU's lead of the USDA-NIFA-funded AgAID Institute and co-leads the Farm Operations Intelligence thrust efforts. He is also leading collaborative efforts that established a first-of-its-kind, public-private-partnership-driven "Smart Apple Orchard Testbed" in commercial settings for effective, smart ag-tech evaluation and grower education. Dr. Khot continues to serve as an associate editor of the *Journal of the ASABE*. He co-organized a special session at the IEEE MetroAgriFor the past few years. His programmatic efforts at WSU were recognized with the 2024 Early Career Excellence Award and the 2024 Team Interdisciplinary Award, as well as the ASABE Educational Aids Blue Ribbon Award, Outstanding Associate Editor, Superior Paper Awards, among others.



Lav R. Khot
Professor and Director of AgWeatherNet

Youngsoo Lee

Dr. Youngsoo Lee is a trained food engineer with more than 20 years of experience in education and research. His teaching and research focuses are food processing and engineering, specifically encapsulation, drying, and material science. His current research focuses on nano- and micro-encapsulation of bioactive compounds, pre- and probiotics using biopolymers. He is also interested in improving various drying processes for enhanced

food quality and reduced energy consumption. He has been collaborating with colleagues in academia as well as industry. He served the National Science Foundation (NSF) Industry-University Cooperative Research Centers (IUCRC) Program's Center for Advanced Research in Drying (CARD) as the site director. He is currently the associate editor of *Journal of Food Science* and *Food Science and Biotechnology*.

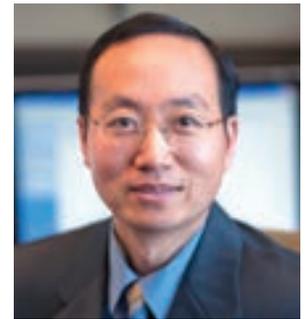


Youngsoo Lee
Associate Professor

Hanwu Lei

Dr. Hanwu Lei serves as division editor for the *International Journal of Agricultural and Biological Engineering* and academic editor for both *Journal of Global Ecology and Environment* and the *International Journal of Environment and Climate Change*. He is a member of the editorial boards of *Nature Partner Journal (NPJ) Materials Sustainability*, *International Journal of Agricultural and Biological Engineering*, *Journal of Sustainable Bioenergy Systems*, and *Annals of Material Science and Engineering*. Dr. Lei has been working with biomass-derived carbon, activated carbon, nanocellulose, nanocarbon, carbon catalyst production, carbon and zeolite catalysis, syngas and hydrogen production, bioaromatics, and bio-jet fuels. His research investigates the mechanisms responsible for the generation of fuel components and high-value chemicals and bioproducts from biomass and municipal solid wastes and addresses fundamental and applied questions in conversions. Dr. Lei's jet fuel research has made headlines worldwide. Dr. Lei is a top 1%

cited author (Web of Science, as of March/April 2025) in engineering and chemistry, with over 180 peer-reviewed articles to his record, a total of 14,921 citations (2,347 in 2024), and an h-index of 69 in Google Scholar (September 3, 2025). Dr. Lei is among 13 researchers earning high marks at WSU for chemistry's ranking of best scientists, 182nd in the world and 58th nationally (<https://research.com/university-rankings/chemistry/us>). Some of his students and postdocs are now professors at esteemed international universities, including Université Catholique de Louvain, Central Luzon State University, Tongji University, China Agricultural University, and East China University of Science and Technology, among others. Dr. Lei is an invited panel member of the US Department of Energy, the National Science Foundation, and the USDA National Institute of Food and Agriculture grant programs. He is an invited grant reviewer for international research programs in the Netherlands, Chile, Canada, Czech Republic, Israel, Hong Kong, and France.



Hanwu Lei
Professor

Troy Peters

Dr. Troy Peters is the director of the Center for Precision and Automated Agricultural Systems, a research group that does agricultural engineering research on advanced technologies, including field robotics, remote sensing, plant and soil status sensors, automation hardware, data connectivity to remote locations, and management algorithms. Dr. Peters works in all crops and across a wide variety of climates and rainfall areas in Washington State. He is a world-renowned researcher and Extension educator in the area of irrigation engineering. He is a licensed professional engineer and is located at the Irrigated Agriculture Research and Extension Center in Prosser, Washington. He teaches an average of more than 30 Extension workshops each year to educate growers and other irrigation professionals. The irrigation scheduler mobile app that he developed is being used in 12 western US states and in two Ca-

nadian provinces. This application has been used at more than 10,000 fields for irrigation scheduling. Peters also created and maintains an irrigation website (irrigation.wsu.edu) that is widely used for its irrigation calculators. It includes tools to estimate crop water use and irrigation system design capacity based on historical average evapotranspiration (ET) for many different areas and crops. He has published over 100 peer-reviewed journal papers and Extension publications. He advises graduate students and publishes an average of five peer-reviewed journal publications per year. A major focus of his Extension program is low elevation spray application (LESA), a modification to center pivots that increases irrigation application efficiency by 15%–20% and uses significantly less pumping energy. Thanks to his efforts, these systems are being installed throughout the west. Peters is also researching the use of artificial



Troy Peters
Professor and Extension
Irrigation Specialist
Director of CPASS

Troy Peters (continued)

intelligence and machine learning to interpret soil moisture sensor signals for irrigation automation, quantifying ET suppression caused by sprinkler water losses, irrigation water quality measures, remote detection of water stress, and ET using satellites and drones. His latest work focuses on heat stress

modeling and mitigation using overhead sprinklers in tree fruit and cane berries, water stress detection, consumptive use estimation methods, and irrigation efficiency. His graduate students have gone on to lead teaching, research, and Extension programs at universities all over the world.

Kirti Rajagopalan

Dr. Rajagopalan's Sustainable Environments and Agricultural Ecosystems (SEAS+) program undertakes model development and application to enhance our understanding of the dynamic relationships between natural resource use, agricultural practices, and ecosystem health to ensure a sustainable future for agriculture and the environment. Its focus is developing advanced modeling approaches to support data-driven scientific inquiry and fostering interdisciplinary partnerships through a systems-level perspective, ensuring practical relevance by developing strong partnerships with stakeholders. Research questions include: What factors control the ability of the agroecosystem to provide services such as irrigation, flood control, and environmental flows? How is this changing? What are the tradeoffs in the system? How can agroecosystems be managed to optimize

ecosystem services? Dr. Rajagopalan's lab works closely with natural resource managers, policymakers, other researchers, and industry groups.

The lab works on large-scale, remote sensing applications to characterize land use patterns and change with associated uncertainty quantification. As part of the AgAID agricultural AI institute, the lab has been developing biophysics-guided AI models of streamflow prediction, snowpack prediction, and explainability frameworks to understand the behavior of complex hydrology and crop models and to inform model improvements. The lab also works on quantifying the skill and value of seasonal forecasts in informing water leasing decisions and exploring agricultural water market opportunities to augment streamflow for environmental purposes at critical times of the year.



Kirti Rajagopalan
Assistant Professor

Shyam Sablani

Dr. Sablani's current research interests are in developing sustainable and ecofriendly packaging for food applications, food supply chain technologies, food safety technologies, and educational tools for enhanced food engineering education. His research has informed the development of next-generation barrier packaging, which incorporates ethylene vinyl alcohol, metal oxide-coated polyethylene terephthalate, and oxygen scavengers. His research has contributed to an improved understanding of the relationship between state/phase transitions and physico-chemical stability, which helps with the design and formulation of

dehydrated and frozen foods with a higher nutritional content and a longer shelf life. Sablani is a recipient of the 2024 Yang Liu Award for Teaching International Students, the 2024 CAHNRS/WSU Faculty Excellence in Research Award and 2018 Faculty Excellence in Advising Award, the 2021 Frozen Food Foundation Freezing Research Award, and the 2016 Institute of Food Technologists (IFT) Marcel Loncin Research Prize. Recently, he was named 2024 IFT Fellow and selected for the Fulbright US Scholar Award to Thailand in academic year 2024–25. Sablani is currently the scientific editor of the *Journal of Food Engineering*.



Shyam Sablani
Professor

Sindhuja Sankaran

Dr. Sankaran is a leading expert in the nascent and evolving field of phenomics. This involves the design, development, integration, testing, and deployment of a range of cutting-edge sensor technologies to advance crop phenotype monitoring—an important component of plant breeding, crop science, and precision agriculture research and applications. The sensor technologies span both proximal (internet of things [IoT]-based sensor systems) and remote sensing (unmanned aerial vehicle and satellite) approaches and the emphasis is on automated, noninvasive, rapid, and continuous monitor-

ing of plant responses to the environment as well as abiotic and biotic stressors on a scale previously unattainable and contributing to addressing pressing challenges in global food security and sustainable agriculture.

Dr. Sankaran is an active member of the American Society of Agricultural and Biological Engineers (ASABE), the National Association of Plant Breeders, and the North American Plant Phenotyping Network. She is an associate editor for societal journals, the *Journal of the ASABE* and *The Plant Phenome Journal*. She has received the Early Career Excellence



Sindhuja Sankaran
Professor

Sindhuja Sankaran (continued)

Award from the College of Agricultural, Human, and Natural Resource Sciences at WSU, the Outstanding Associate Editor award from the *Journal of the ASA-*

BE and *The Plant Phenome Journal*, an ASABE Leadership Citation, and an International Society of Horticultural Science (ISHS) Medal, among other awards.

Juming Tang

Dr. Tang has trained more than 50 PhD students, 20 postdoctoral fellows, and 50 visiting students and scholars. He has published more than 400 peer-reviewed scientific papers. His research has resulted in 16 US and international patents, all licensed through WSU Office of Commercialization. Dr. Tang has led two industrial consortia on advanced thermal processing technologies, with membership representing the US Army Natick Soldier Systems Center and more than 20 companies. His laboratory developed 915 MHz microwave assisted thermal sterilization (MATS) technology, with acceptance from the US Food and Drug Administration and non-objection from the USDA Food Safety and Inspection Service. He directed a Center of Excellence for Food Safety, supported by the USDA National Institute of Food and Agriculture, on the application of microwave assisted pasteurization systems (MAPS) for control of bacterial and viral pathogens in ready-to-eat meals. Both MATS and MAPS are licensed for global commercialization.

Contamination and survival of bacterial pathogens, such as *Salmonella*, in low-moisture foods, including spices, peanut butters, baby formula, wheat flours, and dry fruits, are emerging food safety concerns. These pathogens are extremely heat tolerant in low-moisture environments, creating challenges

for the food industry in developing and validating effective thermal control treatments. Over the past ten years, Dr. Tang's team has systematically studied the fundamental mechanisms for the increased thermal resistance of *Salmonella* in low-moisture foods and developed a qualitative relationship between thermal reduction of the bacteria and water activity of low-moisture foods. Based on those findings, during 2023 new strategies were proposed in several published papers and validated on pilot-scale devices for thermal control of pathogens in different food systems. These main findings and case studies are summarized in a review article "Developing Thermal Control of *Salmonella* in Low-Moisture Foods Using Predictive Models" in *Food Safety Magazine* (August/September issue of 2023). These results have positively influenced the R&D activities at food companies, based on feedback and free consultation inquiries from food companies.

Dr. Tang is a highly cited researcher (1 in 1,000) from among 7,125 worldwide selected by Clarivate. He was elected to the Washington State Academy of Sciences in 2019 and the US National Academy of Engineering in 2021. He is a fellow of the International Microwave Power Institute, ASABE, the IFT, and the US National Academy of Inventors.



Juming Tang
Regents Professor, Member of the U.S. Academy of Engineering

Joan Wu

Dr. Joan Wu's research focuses on hydrologic modeling for conservation of land and water resources. She collaborates extensively with researchers at the USDA Agricultural Research Service, US Forest Service, and other institutions to continually develop and apply the Watershed Erosion Prediction Program (WEPP) model. In a current study, Dr. Wu and her team are applying the WEPP model to simulate effects of implementing conservation tillage on erosion reduction, especially from the "hot spots" in wheat-based cropping systems in the inland Pacific Northwest. Programs that have incentivized the adoption of agricultural conservation practices need ways of quantifying and prioritizing the resulting benefit. The findings from this study will provide insights into how to maximize conservation practice effectiveness by targeting the erosion hot spots. In another study funded by the US

Environmental Protection Agency through the Puget Sound Partnership, Dr. Wu and team are improving the Hydrologic Sensitivity Index approach for optimizing the placement of Green Stormwater Infrastructure (GSI). The improved method can help practitioners and regulatory staff to make informed decisions about placing GSI to mitigate the adverse impacts of urban stormwater runoff.

Dr. Wu teaches BSE 512 Research and Teaching Methods, a core course for all BSE graduate students, and two additional hydrology (surface water, groundwater) classes. She is the department liaison to WSU ADVANCE, an NSF-sponsored program with a mission to foster an inclusive research environment. She also serves on the Advisory Committee on Agricultural Best Management Practices, Washington State Department of Ecology.



Joan Wu
Professor

Bin Yang

Dr. Bin Yang is a professor in the Department of Biological Systems Engineering and the Bioproducts, Sciences & Engineering Laboratory. Dr. Yang's research interests include understanding fundamental mechanisms and advancing cutting-edge biomass processing technologies for advanced biofuels and bioproducts, facilitating the commercialization process as well as improving our knowledge of emerging technologies to meet near and long-term needs worldwide. Dr. Yang has pioneered new biomass pretreatment technology and manufacturing technologies to process biomass into new bioproducts, including jet fuel, bioplastics, carbon fiber, supercapacitors, hydrogen carriers, and others. He has authored

more than 140 peer-reviewed papers, ten book chapters, and has six issued patents. He also serves on several advisory boards and editorial teams for leading biorefinery journals. Dr. Yang was elected to the Environmental Molecular Sciences Laboratory (EMSL) User Executive Committee Chair in 2025. The significance of his accomplishments has been amply documented by his recent awards, including the Fulbright-Tocqueville Distinguished Chair Award (2024-2025), Fellow of the American Institute of Chemical Engineers (2023), the Fulbright Distinguished Chair in Energy and Sustainable Use of Natural Resources (2019-2020), and the DARPA Young Faculty Award of 2011.

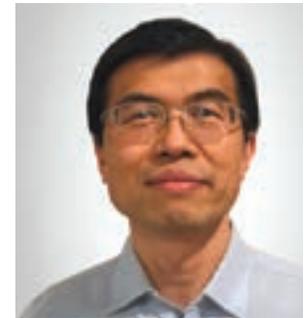


Bin Yang
Professor

Liang Yu

Dr. Yu is a licensed professional engineer (PE) in the state of Washington, guest editor for the *Journal of Fermentation* entitled Energy converter-anaerobic digestion, a faculty senator for the non-tenure track faculty, an Anti-Hazing Advisory Committee member and a member with the Undergraduate Research Scholarship Review Committee at WSU. Dr. Yu's research primarily revolves around the development of biorefinery-based industrial symbiosis and the circular economy. To achieve this goal, he employs multiscale mathematical modeling techniques, including but not limited to molecular simulation, computational fluid dynamics (CFD), bioprocess control, optimization, integration, techno-economic analysis (TEA), life cycle assessment

(LCA), and machine learning. Specifically, Dr. Yu is working on the development, optimization, integration, and scaling-up of an advanced anaerobic digestion-based biorefinery with hydrothermal pretreatment to convert animal manure, food waste, biosolids, and other organic wastes into renewable natural gas (RNG), organic fertilizer, clean water, and other high-value bioproducts. Dr. Yu's research has been supported by the Department of Energy (DOE) and the Department of Agriculture (USDA). He has published more than 60 papers in high-quality, peer-reviewed scientific journals, such as *Applied Energy*, *Bioresource Technology*, *Chemical Engineering Science*, *AIChE Journal*, among others, and holds five patents.



Liang Yu
Assistant Professor

Professors Emeriti



Claudio O. Stöckle, Ph.D.
Years of Service: 1989-2022



Denny C. Davis, Ph.D.
Years of Service: 1976-2012



Ralph P. Cavalieri, Ph.D.
Years of Service: 1985-2016



Larry G. James, Ph.D.
Years of Service: 1977-2013



Pius Ndegwa, Ph.D.
Years of Service: 2004-2023



Qin Zhang, Ph.D.
Years of Service: 2009-2023

Visiting Scholars

Students and researchers from all over the world are attracted by BSE’s world-renowned faculty, expertise, and laboratory research experiences. BSE receives numerous visiting scholars from different countries who are supported by their respective universities and governmental agencies. This year, we welcomed and trained the following scholars:

Visiting Scholar Name	Title	Country	Inviting BSE Faculty
Manon Bechikhi	Visiting Scholar	France	Garcia-Pérez
Sifolo Seydou Coulibaly	Visiting Faculty	Ivory Coast	Garcia-Pérez
Alliah Irish De Guzman	Visiting Scholar	Philippines	Garcia-Pérez
Marilyne Farhat	Visiting Scholar	France	Garcia-Pérez
Mireia Mora i Sanjuan	Visiting Scholar	Spain	Garcia-Pérez
Myriam Rojas Salas	Visiting Scholar	Colombia	Garcia-Pérez
Nisit Pukrongta	Visiting Scholar	Thailand	Khot
Yash Shah	Visiting Scholar	China	Tang

Our Affiliated Faculty

Affiliated Faculty Name	Current Title	Email
Elizabeth Beers	Professor at Wenatchee Tree Fruit Research and Extension Center	ebeers@wsu.edu
Ting Chi	Chair and Professor of Apparel Merch Design and Textile (AMDT)	tchi@wsu.edu
Markus Flury	Professor at Puyallup Research and Extension Center	flury@wsu.edu
Girish Ganjyal	Professor at School of Food Science	girish.ganjyal@wsu.edu
Joshua Heyne	Director of Bioproducts Science and Engineering Lab (Tri-Cities)	joshua.heyne@wsu.edu
Anand Jayakaran	Professor at Puyallup Research and Extension Center	anand.jayakaran@wsu.edu
Hongfei Lin	Professor at Voiland School of Chemical Engineering and Bioengineering	hongfei.lin@wsu.edu
Hang Liu	Associate Professor at CAHNRS Office of Research	hangliu@wsu.edu
Jonathan Male	Assistant Vice Chancellor at the Office of Research	jonathan.male@wsu.edu
Jean Sabin McEwen	Associate Professor at Voiland School of Chemical Engineering and Bioengineering	js.mcewen@wsu.edu
Jenifer McIntyre	Associate Professor at Puyallup Research and Extension Center	jen.mcintyre@wsu.edu
Peter Pfromm	Professor at Voiland School of Chemical Engineering and Bioengineering	peter.pfromm@wsu.edu
Michael Wolcott	Interim Vice President for Research	wolcott@wsu.edu
Vikram Yadama	Director and Professor of Civil and Environmental Engineering	vyadama@wsu.edu
Georgine Yorgey	Director of Energy Extension Program	yorgey@wsu.edu

Our Adjunct Faculty

Adjunct Faculty Name	Current Title	Email
Pavlo Bohutskyi	Chemical Engineering Scientist	pavlo.bohutskyi@pnnl.gov
David Brown	Meter Group Inc. Scientist	dave.brown@wsu.edu
Joaquin Casanova	Engineering Consultant	joaquincasanova@protonmail.com
Farid Chejne	Professor at Universidad Nacional de Colombia	fchejne@unal.edu.co
William Elliot	Research Engineer	belliot@wsu.edu
David Gustafson	Chemical Engineering Scientist	david.i.gustafson@wsu.edu
Gerrit Hoogenboom	Professor at University of Florida	gerrit.hoogenboom@wsu.edu
Francisco Leal-Yepes	Assistant Professor at Cornell University	f.leal-yepes@wsu.edu
Jian Liu	Senior Research Engineer at Pacific Northwest National Laboratory	jian.liu@pnnl.gov
Mariefel Olarte	Chemical Engineer	mariefel.olarte@pnnl.gov
Nigel Pickering	Water Resources Specialist	nigel.pickering@wsu.edu
Wei-Jun Qian	Bioanalytical Chemist	weijun.qian@pnnl.gov
Peter Robichaud	Research Engineer	probichaud@fs.fed.us
M. Jacob Schrader	Agricultural Research Technician	jake.schrader@usda.gov
Juming Tang	Frank Jungers Endowed Chair & Professor	jtang@wsu.edu
Vicki Thompson	Distinguished Staff Engineer	vicki.thompson@inl.gov
Melvin Tucker	Senior Researcher	melvin_tucker@nrel.gov
Shaojin Wang	Professor at Northwest A&F University (China)	shaojinwang@nwsuaf.edu.cn
Mark Wigmosta	Environmental Engineer at Pacific Northwest National Laboratory	mark.wigmosta@wsu.edu
Vivian Wu	Research Leader at USDA	vivianchwu@gmail.com
Ren Yang	Assistant Professor of Food and Biomass Engineering at South Dakota State University	ren.yang@sdstate.edu
Xu Zhou	AIFS Post Doctoral Researcher at UC Davis	pxshou@ucdavis.edu



Mariefel V. Olarte, a WSU adjunct professor and Senior Research Chemical Engineer, prepares catalyst for loading into a continuous flow reactor to hydrotreat bio-oils and biocrudes to produce biofuel.

Success stories from alumni

Sohrab Haghghi Mood

I have been working on biomass conversion at Washington State University for several years, but my interest in this field began well before that. Earlier in my career, I worked on converting biomass into bioethanol through biochemical processes, an experience that deepened my commitment to renewable energy and sustainability and ultimately inspired me to pursue a PhD in the Department of Biological Systems Engineering at Washington State University. During my doctoral studies under the supervision of Dr. Garcia-Pérez, I primarily focused on developing and characterizing engineered biochar for nutrient recovery and contaminant removal from agricultural wastewater, blending fundamental research with practical applications to address global environmental challenges.

Since receiving my PhD in December 2022, I have been a postdoctoral research associate in the BSE department, where I continue this work in collaboration with faculty, students, and industry partners. Much of my current research is dedicated to scaling up a nutrient recovery system from agricultural runoff and anaerobically digested effluents using engineered biochar. Alongside my research, I mentor students and explore commercialization opportunities that can move these technologies from the lab into real-world practice. I strive to advance sustainability practices that can be applied in everyday systems, turning concepts into practical solutions and technologies. My goal is to help create innovative biomass-based systems that improve water quality, advance renewable energy, and support a sustainable circular economy.



Sohrab Haghghi Mood



Sohrab Haghghi Mood performing inductively coupled plasma mass spectrometry (ICP-MS) analysis of biochar to measure its metal content, such as Ca, Mg, and Fe.

John Paulo C. Sacdalan

I completed my PhD in the Department of Biological Systems Engineering, WSU in December 2022. After graduation, I returned to my home university, Central Luzon State University, Philippines. Currently, I am the head of the Department of Agricultural and Biosystems Engineering in the same university. The education I received from WSU is what I am sharing now with my students in the undergraduate and graduate program. To date, I am leading instructions and conducting research and Extension outreach in the field of agricultural and biosystems engineering. I am grateful for the knowledge that WSU's BSE department imparted to me and which I am now sharing with my students today. I am

especially thankful for Dr. Troy Peters for his guidance and support during my PhD journey in the land, air, water resources and environmental engineering specialization, particularly in regard to using soil moisture sensors and interpreting the data outputs—timely and relevant toward modernizing agriculture.

Additionally, I am now serving as the president of the Philippine Society of Agricultural and Biosystems Engineers (PSABE) for FY 2025–26, which aims to advance and enhance the agricultural and biosystems engineering profession to better develop and modernize the agricultural and fisheries industries in the Philippines.



John Paulo C. Sacdalan



Dr. Sacdalan with his MS student researching “Design, Fabrication, and Performance Evaluation of an Automatic Overhead Sprinkler Irrigation System”

Rajeev Sinha

I started my career as an application technology scientist at Corteva Agriscience, where I lead application technology initiatives within crop protection R&D, where a key focal point in portfolios includes row crop herbicides and insecticides. My work spans the development of complex herbicide formulations, design and fabrication of critical lab capabilities for formulation characterization, design and execution of commercial spray trials, and risk assessment protocols that directly impact product launch decisions. I have been instrumental in advancing technologies for encapsulated acetochlor products and developing strategies for evaluating new technologies like drones for pesticide application.

Taking a global leadership role as vice-chair of the Unmanned Aerial Pesticide Application System Task Force’s (UAPASTF) technical team, I contribute to the overall objective of the UAPASTF to enable the safe, effective, and globally accepted use of unmanned aerial spray systems (UASS) for pesticide applications by generating regulatory-grade data and best practice guidance. I am part of a group of global experts who combine efforts to develop empirical drift models and UAV (Unmanned Aerial Vehicle) spray protocols that address regulatory gaps and future-proof agricultural practices.



Rajeev Sinha



Dr. Sinha with Corteva Agriscience’s R&D formulations team, conducting formulation characterization using commercial sprayers

Rongge (Nikki) Zou

Since graduating in May 2024 (under the guidance of Dr. Hanwu Lei), I have been working as a post-doctoral researcher at Oak Ridge National Laboratory in the Chemical Sciences Division. My research focuses on developing innovative catalytic systems and non-equilibrium heating methods—such as

mechano-catalysis and joule heating—for conversion of biomass and waste plastics into value-added products. This work allows me to continue pursuing sustainable energy solutions while collaborating across disciplines to tackle challenges in resource utilization.



Rongge (Nikki) Zou

University Initiative Partners

Bioproducts, Sciences, and Engineering Laboratory (BSEL):

This laboratory provides space for critical research in identifying pathways to convert lignocellulosic materials into fuels, chemicals, and materials. BSEL opened in May 2008 as a 57,000 sq. ft. research and teaching laboratory operated jointly between WSU and Pacific Northwest National Laboratory. BSE faculty working at BSEL include Dr. Birgitte Ahring, Dr. Bin Yang, and Dr. Hanwu Lei who work with biofuels, biochemicals, biomaterials, and bioprocesses. Dr. Joshua Heyne, affiliate faculty at the Department of Biological Systems Engineering, is the BSEL director. Learn more about BSEL <https://tricitie.wsu.edu/research/bSEL>.

The Aviation Sustainability Center (ASCENT):

This cooperative aviation research organization is co-led by WSU and the Massachusetts Institute of Technology. ASCENT works to create science-based solutions to the aviation industry's biggest challenges. The center focuses on meeting environmental and energy goals of next-generation air transportation systems. BSE contributions include exploring ways to produce sustainable aviation fuels at the commercial scale as an engine for rural economic development and job creation. Michael Wolcott directs the center. Learn more about ASCENT <https://ascent.aero>.

WSU-PNNL Bioproducts Institute:

The institute is a joint research collaboration of WSU and the US Department of Energy's Pacific Northwest National Laboratory (PNNL). This institute leverages cutting-edge science, engineering, and analysis to transform engineering plants, turn industrial, agricultural, and municipal waste into valuable materials and chemicals, and develop a pipeline of talent to meet future workforce needs. It also aims to be a leader in education, research, and innovation for production of high-value engineered materials and chemicals from underutilized waste materials. The institute coordinates all activities in biomass processing and bioproducts with PNNL. Current co-directors of the WSU-PNNL Bioproducts Institute are: Joshua Haynes and Corrine Fuller.: Learn more at <https://natlab.wsu.edu/bioproducts>.

Center for Precision and Automated Agricultural Systems (CPAAS):

This center offers a framework for precision/smart agriculture and automation efforts at WSU. Its mission is to develop a world-preeminent and Washington-relevant research and educational program in agriculture automation and precision farming. The center has three core faculty from BSE who specialize in mechatronics and automation, machine vision and agricultural robotics, and precision/smart agriculture. The center has recruited affiliated faculty from seven other departments. Professor Troy Peters is the current director of CPAAS <https://cpaas.wsu.edu>.

WSU Puyallup Research and Extension Center:



Located near the Seattle metropolitan area, this center creates opportunities for research, Extension outreach, and teaching for the increasingly urbanized Puget Sound region. Programs focus on watershed science, horticulture,

Graduate Student, Prabesh Khanal, collecting soil samples from peri-urban farms near Puallyup REC to analyze the physical, chemical, and biological properties of the soil and to understand how farms in the urban fringe are functioning. Photo: Courtesy of Mugal S. Dahal

production agriculture, forestry, and community health in the urban-rural interface. The center currently stands at the intersection of rural and urban communities bridging pristine and developed ecosystems. Todd Murray is the director. Learn more: <https://puyallup.wsu.edu>.

WSU Prosser Irrigated Agriculture Research and Extension Center:

An estimated two-thirds of the state’s agricultural production comes from irrigated land. The WSU Irrigated Agriculture Research and Extension Center (IAREC), the world’s largest such center, focuses its basic as well as applied research on agricultural commodities and production systems relevant to the Columbia Basin and the Yakima Valley. This center partners with growers and commodity commissions to turn research-based knowledge into practical applications. IAREC is home to 16 WSU faculty scientists, 10 USDA-ARS scientists, and 1 WSDA scientist. The research activities stem from over 30 graduate students, multiple postdocs, visiting scientists, and over ten undergraduate interns from local community colleges. IAREC is the home of the Clean Plant Center Northwest, the Center for Precision and Automated Agricultural Systems (CPAAS), and Agricultural Weather Network (AgWeatherNet; AWN). The research at IAREC resulted in the creation of the Washington wine industry. The center solves many relevant and pressing issues related to water conservation, pests, diseases, and cropping systems. New crops are tested and developed, while artificial intelligence in agriculture is also being developed and tested at IAREC’s smart farm testbeds. Dr. Naidu Rayapati is the director. Learn more: <https://iarec.wsu.edu>.

AgWeatherNet:



Dr. Lav Khot and Dr. Basavaraj Amogi in front of the Pullman station tipping bucket rain gauges that quantify rainfall, part of the weather station within AgweatherNet. Two rain gauges cross compare each other to provide reliable data.

The WSU’s AgWeatherNet (AWN) is the first and one of the largest agricultural weather networks in the United States. AWN provides a diverse group of stakeholders with accurate and precise weather observations and station-specific forecasts, while also maintaining a set of decision support tools for precision agriculture, animal production management, and ag worker health and safety. Washington State public and state agencies also benefit from quality AWN weather data and climatology. Excellence is achieved in AWN’s weather data products through an end-to-end quality assurance system. AWN has over 360 public and private stations recording air temperature, relative humidity and solar radiation at 1.5 meters, wind speed at 2 meters, primary and secondary precipitation at 0.6 meters above ground level (AGL), and soil temperature and water potential at 5 cm and 20 cm depths. AWN is going through major infrastructure upgrades with about 50 (target 100) World Meteorological Organization (WMO) standard Tier 1 mesonet towers, all built in the last three years. Besides weather sensing at 1.5 to 2 meters, these stations also monitor wind speed and direction at 10 meters and

air temperature at 9 meters AGL. Such data and associated products flow through a free-to-use public web portal (weather.wsu.edu) and is accessed by over 24,900 registered users on a daily basis. The AWN portal receives an average of 50,000 views per day. The web portal has several decision support tools that address crop irrigation scheduling, crop phenology assessment, cold/heat stress management in horticultural crops, worker heat stress awareness, and cattle comfort and planning, among others. AWN also has piloted the integration of air quality index (AQI) sensors into the network stations, with 50 stations currently collected AQI data that are critical for human and animal health systems. Dr. Lav Khot is the current director.

ACADEMICS

Students in BSE become scientific leaders who improve agriculture, food safety and security, and the global economy. Our students achieve advanced engineering degrees in food, land, air, water and environment, agricultural automation, bioproducts, and bioenergy. BSE enjoys an excellent track record in placing our graduate students at universities, national laboratories, and global companies.



Graduate Student, Budi Harahap analyzes samples collected from the bioreactor to determine the amount of short- and medium-chain fatty acids.

Students Awards and Recognitions

Dr. Worasit Sangjan selected as winner of the 2024 North American Plant Phenotyping Network's Graduate Student Award

February 16, 2024



Dr. Worasit Sangjan has been selected as this year's winner of the North American Plant Phenotyping Network Graduate Student Award. He was recognized at the Award Session at the NAPP Annual Meeting February 15.



Congratulations to Dr. Worasit Sangjan and his advisor, Dr. Sindhuja Sankaran!!

Three Minute Thesis — Ranjan Sapkota (PhD) and Hasan Rahat (MS) win the BSE Competition

March 5, 2024

On behalf of Dr. Manuel Garcia-Pérez, we want to thank Supriya, Angana, Priyanka, Dawood, Martin, Shafik, Milton, Achyut, Ranjan and Hasan for competing in the BSE's 3MT Thesis Competition! Also, a big thanks to our faculty judges and the audience!



The winners in the PhD category moving on to the CAHNRS competition are **Ranjan, Milton and Supriya**. **Hasan** is moving on to the CAHNRS competition in MS category.

CAHNRS Three Minute Thesis — Hasan Rahat wins People’s Choice Award

March 18, 2024



Hasan Rahat presenting his research at the CAHNRS Three Minute Thesis Competition

On behalf of Dr. Garcia-Pérez, we would like to congratulate Hasan Rahat, MS graduate student advised by Dr. Shulin Chen, for winning the People’s Choice Award at the CAHNRS Three Minute Thesis Competition MS category for his presentation: ADBA: Kinetic Modeling of Algae Mixotrophic Growth in AD Wastewater.

Graduate School 2024/25 Scholarship Winners

April 4, 2024

Four BSE graduate students have been awarded the 2024/2025 Graduate School’s Scholarships. They were selected from a competitive group of nominees from across the University so this is a great achievement. These students were honored during the Graduate School’s Evening of Excellence on April 10th.

Bhupinderjeet Singh, advised by Dr. Kirti Rajagopalan, was awarded the Anne and Russ Fuller Fellowship for Interdisciplinary Research/ Scholarship in the amount of \$4,000.

Supriya Savalkar, advised by Dr. Kirti Rajagopalan, was awarded the Richard R. and Constance M. Albrecht Scholarship in the amount of \$1,500.

Martin Churuvija, advised by Dr. Manoj Karkee, was awarded the Sidi Mohammed Khalil Cherif Louazani



Teaching Assistant Scholarship in the amount of \$1,500.

Milton Valencia Ortiz, advised by Dr. Sindhuja Sankaran, was awarded the Richard R. and Constance M. Albrecht Scholarship

for the 2024/25 academic year in the amount of \$1,500.

Our heartfelt Congratulations to Bhupi, Supriya, Martin and Milton and to their mentors, Drs. Rajagopalan, Karkee and Sankaran!

2024 Distinguished Leader Award

April 23, 2024 Bethany.Shepler



Martin Churuvija at the Chancellor's Awards Ceremony in Pullman.

Martin Churuvija, a PhD student working with CPAAS Director Dr. Manoj Karkee, received the 2024 Distinguished Leader Award. Martin was recognized, along with other awardees, during the Chancellor's Awards for Leadership Ceremony held last week in Pullman.

Congratulations Martin!!!



Mezbah carefully installs a Dynamic Mechanical Analyzer to explore how biochar additives influence the viscoelastic and thermal behavior of reinforced polymer composites

Mohammad Mezbah Hoque wins the 2024 Deborah Lambert Memorial Scholarship from the Solid Association of North America (SWANA) WA EVERGREEN CHAPTER

Mohammad Mezbah UI Hoque, PhD candidate, advised by Dr. Manuel Garcia-Perez and Dr. Vikram Yadama, focuses on the thermochemical conversion of agricultural waste and forest residue into biocarbon, which is used to develop tailored, high-performance, lightweight polymeric composite materials for the automotive industry. This work aims to enhance efficiency and carbon sequestration. Additionally, he is collaborating on a USFS-funded project with UC Davis to develop zero-emission concrete pavement incorporating biochar filler derived from forest residue. Before joining WSU, Mohammad earned his bachelor's degree in chemical engineering from the Bangladesh University of Engineering and Technology. He then gained experience as a process engineer in the oil and gas industry across South and Southeast Asia. He is dedicated to advancing sustainable energy solutions, developing efficient materials with increased carbon storage, and reducing the carbon footprint across various industries.

Congratulations, Mezbah!

Departmental Awards and Recognition for Students

Event	Student	Advisor
BSYSE 512 Spring 2024 Poster Award	First Place: Divyanth Loganathan Girija Second Place: Cheng You Wu Third Place: Susmita Dahal	Dr. Manoj Karkee Dr. Juming Tang Drs. Anand Jayakaran & Joan Wu
BSYSE 598 Fall 2024 Graduate Seminar Best Presenter	First Place: Supriya Savalkar Second Place: Valentina Sierra Jimenez Third Place: Bhupinderjeet Singh	Dr. Kirti Rajagopalan Dr. Manuel Garcia-Perez Dr. Kirti Rajagopalan
BSE 3MT Thesis Competition	Ph.D. First Place: Ranjan Sapkota Ph.D. Second Place: Milton Ortiz Valencia Ph.D. Third Place: Supriya Savalkar MS First Place: SM Hasan Shahriar Rahat	Dr. Manoj Karkee Dr. Sindhuja Sankaran Dr. Kirti Rajagopalan Dr. Shulin Chen

BSE Outstanding Graduate Student Awards

Student	Award	Advisor
Martin Churuvija	Walter and Vinnie Hinz Scholarship & Alfred and Genevieve Gallucci Scholarship	Dr. Manoj Karkee
Atif Bilal Asad	Walter and Vinnie Hinz Scholarship & Alfred and Genevieve Gallucci Scholarship	Dr. Manoj Karkee
Dattatray Bhalekar	Arnie & Marta Kegel Endowed Fellowship	Dr. Lav Khot
Ranjan Sapkota	Arnie & Marta Kegel Endowed Fellowship	Dr. Manoj Karkee
Budi Harahap	Arnie & Marta Kegel Endowed Fellowship	Dr. Birgitte Ahring
Supriya Savalkar	Arnie & Marta Kegel Endowed Fellowship	Dr. Kirti Rajagopalan
Shafik Kiraga	Arnie & Marta Kegel Endowed Fellowship	Dr. Troy Peters



Supriya Savalkar, winner of BSYSE 598 Fall 2024 Graduate Seminar Best Presenter

Graduate Student Clubs



ASABE CLUB MEMBERS

Our engineering clubs provide opportunities for students and faculty to explore their interests while making friends. Clubs encourage students to learn more about leadership, communication, and how to present their research and projects. Club members are actively engaged in professional societies, paper competitions, and have the chance to earn travel grants and acquire prestigious industrial internships.

- Agricultural Automation and Engineering Club
- American Society of Agricultural and Biological Engineers (ASABE)—WSU Chapter
- Biomass Engineering Club
- Food Engineering Club

Agricultural Automation Engineering Club

The Agricultural Automation Engineering & Club (AAEC) aims to foster a global exchange of knowledge and expertise, provide students with industrial exposure, and incorporate engineering solutions to growers' problems. The club focuses on coordinating the AgTalk series, industrial trips, hands-on workshops, and panel discussions with grower stakeholders.



Advisor:

Dr. Lav Khot

Officers:

President: Martin Churuvija

Vice-President: Kingsley Umani

Secretary: Sarah Witherrite

Treasurer: Toky Andriamihajaso

Over the past academic year, AAEC has continued to advance its mission of connecting students, faculty, and research centers in the field of agricultural automation, fostering academic and professional development through hands-on learning, industry engagement, collaborative projects, and creative initiatives.

We began the year by supporting student participation in a field day at WSU's Smart Apple Orchard in Mattawa, Washington. This experience offered students an up-close look at the latest commercialization-ready automation and precision agriculture technologies, while also providing opportunities to network with vendors and industry professionals. To highlight the work of the students in our club, AAEC designed and displayed a banner



showcasing their research, underscoring the department's presence within the broader agricultural community.

Our activities extended into the fall with a tour of Allan Brothers Fruit's highly automated packinghouse in Naches, Washington.

Led by co-owner Dave Allan, the visit took students through every stage of apple processing, from washing and sorting to packing and cold storage, and allowed for engaging discussions with engineers and workers about the packinghouse's technologies.

During CAHNRS' Fall Festival, our club showcased the important role of technology in agricultural research by hosting an interactive booth. Visitors explored drones and robots used by students in their projects and joined in a trivia game with prizes. This even helped spark conversations with the wider WSU community and their families.

Creativity also played a central role in our programming. In partnership with BSE and fellow student clubs, we led the development of the BSE Visionary Roadmap Art Competition. This initiative invited students to represent our department's identity and aspirations through artistic expression, resulting



in eight works ranging from paintings to videos and sculptures. The artworks will be displayed in L.J. Smith Hall, serving as a lasting representation of the creativity of BSE students.

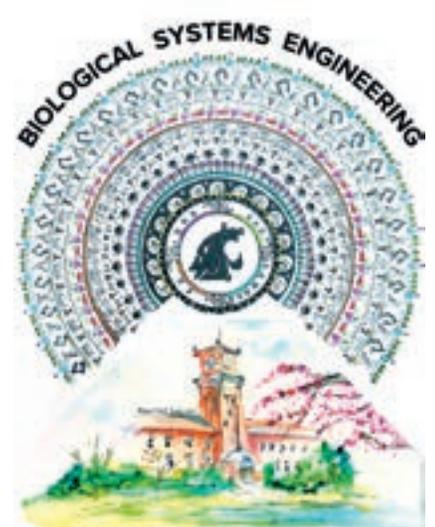
The art competition not only fostered engagement within the department but also strengthened collaboration across the clubs.

We also continued our tradition of academic enrichment by hosting seminars featuring distinguished international researchers. Dr. Alen Alempijevic from the University of Technology Sydney discussed the role of computer vision and artificial intelligence in transforming livestock production systems. Dr. Sunil Gorantiwar from Mahatma Phule Agricultural University, India, highlighted strategies and technology to improve water management and strengthen the resilience of smallholder farming systems, emphasizing the importance of bridging research and practice for farmer empowerment. Dr. Luca Grappadelli from the University of Bologna introduced the concept of agrivoltaic orchards, where fruit production and solar energy generation can coexist. Together, these presentations

offered unique global perspectives on the future of agricultural innovation.

Finally, AAEC invested directly in student success by sponsoring online courses and tools to support research and professional development. We provided access to Robot Operating System (ROS) training, equipping students with essential robotics skills, and Overleaf subscriptions, easing the process of collaborative writing and publishing. These resources gave members the tools to grow academically while preparing for future careers in agricultural engineering.

From field trips and industry visits to research talks and student support initiatives, AAEC has worked diligently to create opportunities for both its members and the students in the Department of Biological Systems Engineering. This year, our efforts were recognized with two prestigious awards honoring the EAAEC Registered Student Organization (RSO): the Chancellor’s RSO Leadership Award and the GPSA’s (RSO) of the Year Excellence Award, highlighting the significant impact of our work and inspiring future students to continue building on this legacy.



American Society of Agricultural and Biological Engineers (ASABE)



STUDENTS PARTICIPATED ONLINE AND IN-PERSON FOR ASABE-SEB GENERAL ELECTION ON MARCH 19, 2024

The American Society of Agricultural and Biological Engineers—Student Engineering Branch (WSU ASABE-SEB) of Washington State University is a Registered Student Organization (RSO), established in September 2012. The primary purpose of the ASABE-SEB at WSU is to promote and support the mission of the American Society of Agricultural and Biological Engineers (ASABE). This society aims to gather, organize, and disseminate ideas and information for advancing agricultural, biological, food, environmental, and ecological engineering.

It also works to bring diversified, interdisciplinary departmental graduate students to a common platform to strengthen communication among students and faculty within the department and to share research with colleagues to help foster professional development. In 2024, WSU's ASABE-SEB was led by the elected officers Mohammad Mezbah UI Hoque (president), Milton Valencia Ortiz (vice president), Oluwatunmise Israel Dada (secretary), and Veronica Jane Crow (treasurer), while Dr. Sindhuja Sankaran served as faculty advisor.



GRADUATE STUDENT TOKY ANDRIAMIHAJASOA GOING FOR A PERFECT STRIKE AT ZEPOZ (LEFT) WHILE STUDENTS (RIGHT) TOOK THE OPPORTUNITY TO SHARE EXPERIENCES WITH EACH OTHER AND ENGAGE SOCIALLY.

Networking and Social Engagement at Zeppoz in Pullman: ASABE-SEB kicked off the Fall 2024 semester with a Friday afternoon bowling event at Zeppoz in Pullman to foster camaraderie and strengthen connections among students from all focus areas within BSE. The gathering provided a relaxed and enjoyable atmosphere where students could unwind with food, fun, and friendly competition. Beyond the games, the event encouraged meaningful conversations,

allowing participants to share their experiences at WSU and engage with peers from different academic backgrounds. This informal setting helped break down barriers, promoted inclusivity, and created lasting bonds among students within the department. By blending recreation with relationship building, the bowling night contributed to improving departmental interrelationships and enhancing the overall sense of community.

Academic Seminars: WSU ASABE-SEB organized two academic seminars for members during the fall semester of 2024. In October of 2024, WSU ASABE-SEB organized a seminar (titled Career in Academia) that provided members across campuses with a chance to learn about pursuing careers in academia from a successful young faculty member in our field, but outside of our institution. The seminar was presented by Dr. Guarav Jha, an assistant professor in precision agriculture in the Department of Agronomy at Kansas State University. The second seminar was hosted in November of 2024 and was titled Functional Phenomics for Improved Climate Resilience in Tropical Agriculture. This seminar was presented by Dr. Michael Gomez Selvaraj, the leader of the Phenomics Platform at the Alliance Biodiversity & CIAT, CGIAR, the world's largest global agricultural innovation network. Both seminars were hosted as hybrid events with high attendance across the board, and in-person attendees enjoyed lunch together after

the seminar. The seminars also provided a valuable platform for networking, enabling students to connect with experts and peers in their field. By hosting this event, ASABE-SEB reinforced its commitment to supporting student professional growth and preparing future engineers and researchers for impactful careers.

ONLINE PARTICIPANTS ON ASABE-SEB AT WSU
LIGHTNING TALK 2025

Collaboration with Other Clubs: The ASABE-SEB collaborated with other clubs within the department to organize the BSE Departmental 100-Year Visionary Art Competition, celebrating a century of innovation and achievement. The joint effort brought together creativity and engineering perspectives, encouraging students to artistically envision the department's future. This collaboration promoted unity across organizations and interdisciplinary engagement while honoring the department's rich legacy and forward-looking vision.

Biomass Engineering Club (BEC)

The Biomass Engineering Club (BEC) at WSU is dedicated to advancing the science and technologies that transform biomass, such as crop waste, into valuable products, fuels, and compounds. BEC strives to create a strong bond among biomass engineering

students, faculty, and other interested individuals to foster a sense of community. The club encourages leadership, enhances presentation and communication skills, and introduces students to various facets of their field to stimulate greater interest in the profession.

1. CAHNRS Fall Festival

We joined the CAHNRS Fall Festival for the third consecutive year and featured an interactive word-guessing game centered on the biomass field. The activity captured the interest of students and visitors while highlighting key research processes, such as pyrolysis, fractionation, and the purification of valuable compounds. Participants who solved the challenges correctly received prizes.



Biomass Engineering Club

2. Visit to Qualterra

Our group visited Qualterra, a company dedicated to biochar production, to observe the biomass conversion process firsthand. The visit provided valuable insight into how agricultural and forestry residues are transformed through gasification into biochar, a carbon-rich material with multiple environmental applications. By seeing the process in operation, we were able to connect our research on biomass utilization with its real-world implementation, deepening our understanding of sustainable technologies and their potential to contribute to soil health, carbon sequestration, and the development of a circular bioeconomy.



Graduate Students visiting Qualterra

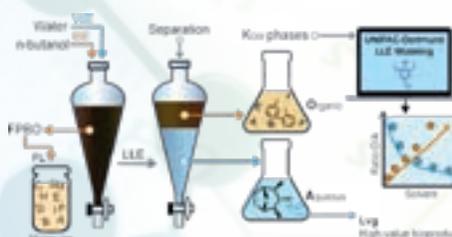
3. Visiting Scholar Presentation



Dr. Myriam Rojas presented the conference “Liquid–Liquid Equilibrium Prediction in Fast Pyrolysis Bio-Oil Systems: A Framework

for Incorporating Bio-Oil Complexity.” She holds a PhD in engineering - energy systems from the Universidad Nacional de Colombia and is currently a postdoctoral researcher at the Institute of Catalysis Research and Technology (IKFT) at the Karlsruhe Institute of Technology (KIT) in Germany. Her research focuses on synthetic lignin oligomers for analytical applications and modeling Liquid–Liquid Equilibrium in complex bio-oil systems. She brought extensive expertise in biobased chemical extraction and purification, thermochemical processes, analytical techniques, and project management, contributing to advancements in sustainable biomass utilization and bioenergy research.

Liquid-Liquid equilibrium prediction in fast pyrolysis bio-oil systems: A framework for incorporating bio-oil complexity



Dr. Myriam Rojas holds a Ph.D. in Engineering - Energy Systems from Universidad Nacional de Colombia and is currently a postdoctoral researcher at the Institute of Catalysis Research and Technology (IKFT), Karlsruhe Institute of Technology (KIT). Her research focuses on synthetic lignin oligomers for analytical applications and Liquid-Liquid Equilibrium modeling. She is skilled in biobased chemical extraction and purification, thermochemical processes, analytical techniques, and project management.

Join us for an outstanding presentation about her recent work at KIT.



The BEC will provide free pizza
RSVP by September 19th at
v.sierrajimenez@wsu.edu

FRIDAY

September 20, 2024

2:00 PM

L.J. Smith 259



Myriam Rojas
Speaker

Join us online by Zoom
Meeting ID: 912 4156 4278
Passcode: 776931

Food Engineering Club

1. CoFE 2024

Food Engineering Club members participated in the 16th Conference of Food Engineering (CoFE 2024), organized by the Society of Food Engineering (SoFE), held on August 25–28, 2024, in Seattle, Washington.



BSE Graduate Students and CoFE '24 participants

2. CAHNRS Fall Festival 2024

FEC members participated in the Fall Festival organized by CAHNRS.



BSE Food Engineering Club (FEC) members (from the left) Nick Hung, Rishabh Goyal, Pankaj Koirala, and Woody Wu and their advisor (middle), Dr. Kang Huang, at the 2024 CAHNRS Fall Festival.



Department of Biological Systems Engineering

Welcoming New BSE Students

In 2024, we welcomed 17 new graduate students from around the world.

Name	Last School Attended	Degree / BSE Research Area	Advisor
Alejandra Marggie Angarita Velasquez	Universidad Nacional de Colombia (UNAL)	MS / LAWREE	Dr. Anand Jayakaran
Angana Chaudhuri	Pennsylvania State University	PhD / Bioenergy	Dr. Birgitte Ahring
Susmita Dahal	Tribhuvan University, Pulchowk, Nepal	PhD / LAWREE	Dr. Anand Jayakaran
Seval Dogruyol Sevinc	Ondokuz Mayıs University, Turkey	PhD / Bioenergy	Dr. Bin Yang
Paulina Echeverria Paredes	University of Manchester, UK	PhD / Bioenergy	Dr. Manuel Garcia-Perez
Maryam Edrisi	Washington State University	PhD / Bioenergy	Dr. Manuel Garcia-Perez
Rishabh Goyal	National Institute of Technology, Rourkela, India	PhD / Food Eng.	Dr. Kang Huang
Pankaj Koirala	Mahidol University, Salaya, Thailand	PhD / Food Eng.	Drs. Shyam Sablani & Vivian Wu
Brandon Lewis	Eastern Washington State University	PhD / Bioenergy	Dr. Manuel Garcia-Perez
Lochana T. Marasingha	University of Ruhuna, Sri Lanka	PhD / Automation	Dr. Sindhuja Sankaran
Thomas Burke Parham	University of Massachusetts - Amherst	MS / LAWREE	Drs. Joan Wu & Kirti Rajagopalan
Micaela del Rocio Peralta Galarza	Universidad San Francisco de Quito, Ecuador	PhD / Bioenergy	Dr. Manuel Garcia-Perez
Raul Perez-Mena	Pedro Henriquez Ureña University, Santo Domingo, Dominican Republic	PhD / Bioenergy	Dr. Manuel Garcia-Perez
Sara Sarkhosh	Razi University, Kermanshah, Iran	MS / Bioenergy	Dr. Shulin Chen
Cynthia Sigira	Jomo Kenyatta University of Agriculture and Technology, Kenya	MS / Bioenergy	Dr. Kang Huang
Nipun Thennakoon	University of Kelaniya, Sri Lanka	MS / Automation	Dr. Lav Khot
Jianying Wang	Fuzhou University, China	PhD / Food Eng.	Dr. Kang Huang

2024 Graduates

Our heartfelt congratulations to the 7 doctoral students and 3 master's students who graduated in 2024. Our graduates will follow their chosen paths, discovering new ways to shape the future in national laboratories, institutions of higher learning, and throughout the agricultural industry.

Name	Degree	Area	Thesis/Dissertation Title	Advisor
Elda Yitbarek Bezuayene	MS	Automation	SCALING ENERGY BALANCE EVAPOTRANSPIRATION MODELS, METRIC, SEBAL, AND SSEB, TO HIGH RESOLUTION sUAS IMAGERY	Dr. Lav Khot
Zixuan He	PhD	Automation	Efforts towards Efficient Robotic Strawberry Harvesting	Dr. Manoj Karkee
Gajanan Kothawade	PhD	Automation	Identifying biomarkers of Little Cherry/X-disease in Prunus avium using volatile sensing technologies	Dr. Lav Khot
Achyut Paudel	PhD	Automation	MACHINE VISION BASED DECISION SUPPORT SYSTEM FOR PRECISION NITROGEN APPLICATION IN APPLE ORCHARD	Dr. Manoj Karkee
Milton Valencia Ortiz	PhD	Automation	Advanced sensing systems for Aphanomyces root rot (ARR) disease monitoring	Dr. Sinduja Sankaran
Austin Gluth	PhD	Bioenergy	ADVANCING PROTEOMICS APPROACHES TO STUDY STRESS RESPONSE AND METABOLISM IN OLEAGINOUS BASIDIOMYCETE YEASTS	Drs. Bin Yang & Weijun Qian
Budi Harahap	PhD	Bioenergy	Microbial Chain Elongation for Production of Medium Chain Carboxylic Acid from Wet Organic Waste	Dr. Birgitte Ahring
Sarah Witherrite	MS	Bioenergy	EXPLORING ANAEROBIC DIGESTION OF DAIRY MANURE AND ITS POTENTIAL SOIL APPLICATIONS	Dr. Shulin Chen
Rongge Zou	PhD	Bioenergy	DEVELOPMENT OF BIOMASS-DERIVED CARBON CATALYSTS FOR BIO-OIL AND SYNGAS UPGRADING	Dr. Hanwu Lei
Prabesh Khanal	MS	LAWREE	ASSESSING PHYSICO-CHEMICAL AND MICROBIAL PROPERTIES OF SOILS IN PERI-URBAN AGRICULTURAL AREAS: SOUTH PUGET SOUND, WA	Dr. Joan Wu



Dr. Bin Yang and his advisee Dr. Austin Gluth; Dr. Milton Valencia Ortiz and his advisor, Dr. Sinduja Sankaran



Dr. Sinduja Sankaran hooding her advisee, Dr. Milton Valencia Ortiz



Budi Harahap with his advisor Dr. Birgitte Ahring



Dr. Bin Yang hooding his advisee, Dr. Austin Gluth

2024 Peer-Reviewed Publications

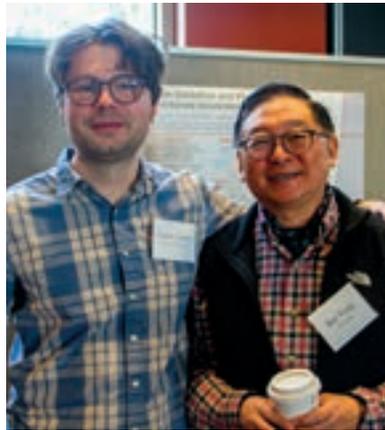
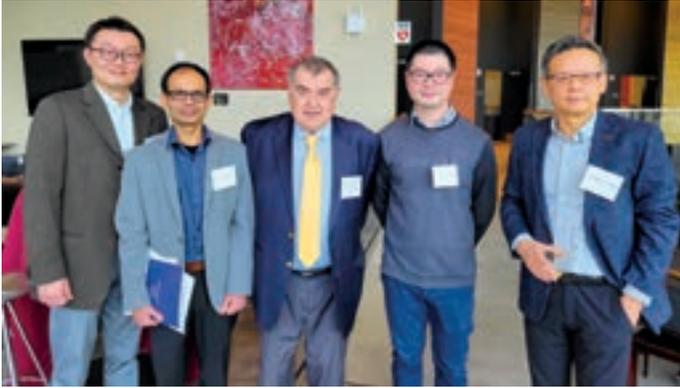
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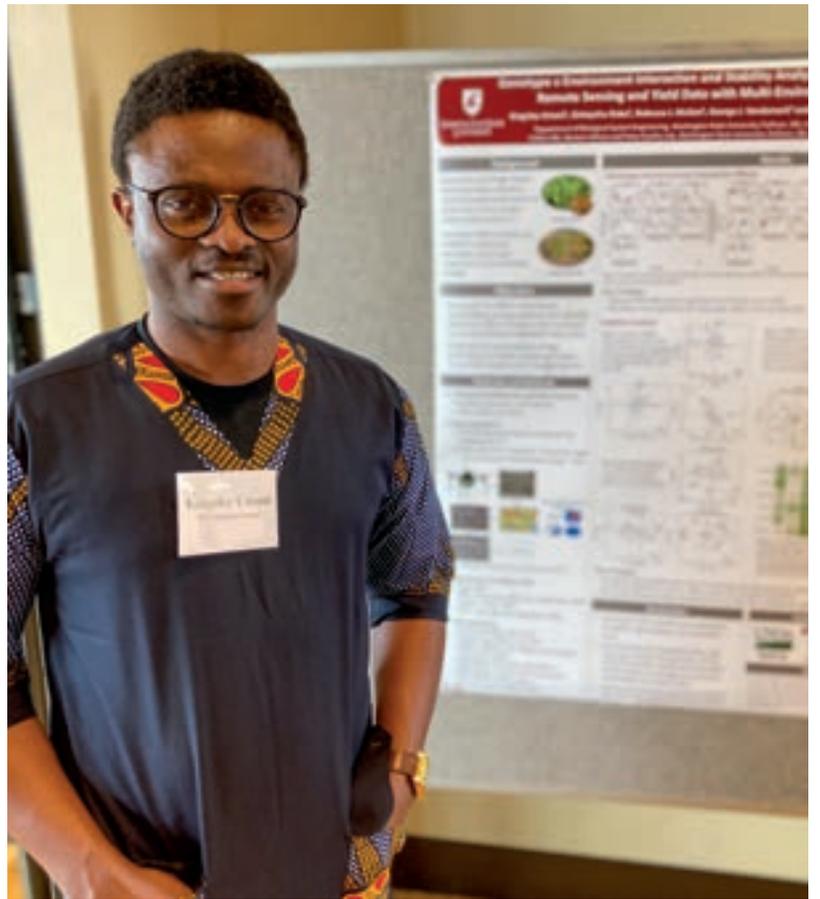
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