DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

UNIVERSITY OF ARKANSAS | College of Engineering
Biological & Agricultural Engineering

BIOLOGICAL AND AGRICULTURAL ENGINEERING
LIFE LINE

Fall 2021

OUR MISSION IS TO DEVELOP

SUSTAINABLE WATER, FOOD, ENERGY,

AND RELATED SYSTEMS THROUGH

INNOVATION IN TEACHING, RESEARCH,

EXTENSION, AND ECONOMIC

DEVELOPMENT VIA TECHNOLOGY TRANSFER.

From the Department Head

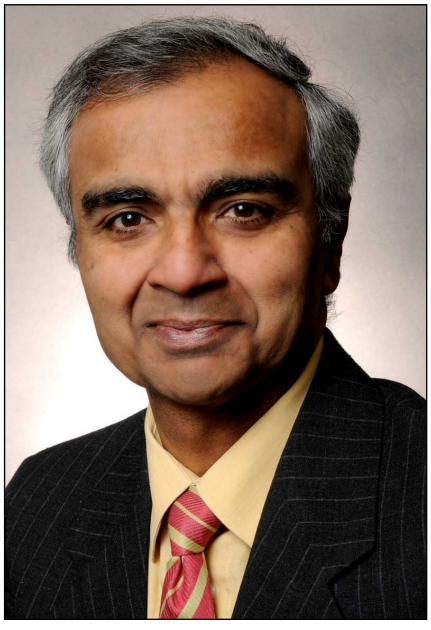
This semester has gone by fast with eager students excited about returning to class in-person and following the masking regulations. Our faculty are keeping busy with teaching, mentoring, research and extension responsibilities. We were successful in hiring a new Teaching Assistant professor just-in-time before Fall classes began. Dr. Ahmed Mahmoud joined us in August and immediately got busy teaching three courses while setting down in NW Arkansas. He joined us from Texas. Dr. Dongyi Wang, food systems engineering faculty joined us in late May while Dr. Kwofie is completing his first year at UA with us. It is exciting to have three new faculty in the department to join our team to serve students and stakeholders. The Accreditation Board for Engineering and Technology provided their official report confirming regular 6-year accreditation without any concerns or weakness. This is a testament to the diligence of Dr. Costello and our faculty for their dedicated efforts in providing an excellent engineering educational experience to our graduates to be successful in the engineering profession.

Our enrollment stands at 120 undergraduates with sophomore, junior or senior standings, and 19 graduate students. We have 10 senior design teams this fall directed by Dr. Osborn and they will be mentored by different faculty during the remaining academic year towards completion in the spring term. The College of Engineering's commencement on December 18 will see ten B.S., seven M.S. and three Ph.D. graduates. In spite of the pandemic restrictions, we began the semester with a student welcome mixer outdoors in September. The virtual meeting of the Arkansas Section of the American Society of Agricultural and Biological Engineers (ASABE) in October recognized the Outstanding Senior in Biological Engineering at the U of A and as the Outstanding Engineer. Dr. Chris Henry was recognized as the "*Outstanding Engineer*" at this event. The Arkansas Academy of Biological and Agricultural Engineering (AABAE) decided to postpone the Induction Banquet from October to April 2022. Some of the recent departmental recognitions are:

- Dr. Ben Runkle was recognized at the UA Football homecoming game on October 16 for his selection as the UA Alumni Association's "*Rising Teaching Faculty Award*" winner. He was also honored with the "*Distinguished faculty teaching and research award*" from the UA Honors College on Nov 9.
- Ms. Alexis Barber, one of our undergrads was selected as a 2021 ***Udall Scholar***.
- Dr. Marty Matlock is serving as *Senior Advisor for Food Systems Resiliency* with Marketing and Regulatory Programs with the USDA.

Dr. Ebenezer Kwofie was named *Distinguished Alumnus* at McGill

It is wonderful to be a part of highly qualified and dedicated team in our department at the University of Arkansas. Please send us your news and updates, visit our website www.bio-agengineering. uark.edu and feel free to seek additional information. On behalf of the department, let me wish you a ***very happy holiday season and the very best in the New Year.***



Sincerely,
Lalit Verma, Ph.D., P.E.
Professor and Head

Solar proving a good investment for poultry farms

Use of solar energy, net metering and grants from the U.S. Department of Agriculture have shown significant benefits for a Cleveland County poultry grower, said Yi Liang, associate professor-biological and agricultural engineering.

“Poultry farming is an energy-intensive business, with gas and electricity as major expenses,” said Liang, who works as part of the Center of Excellence for Poultry Science.

Liang looked at results from a solar installation by Stephen Boyd, who operates a six-broiler farm in Cleveland County. The farm has been growing throughout its 10 years in operation, with varying sized houses built in different years.

“One thing in common between houses is that electricity consumption increased dramatically over the years,” Liang said. “This increased electric demand is due to cooling requirements for modern broilers raised to heavy weights due to market demand.”

Liang said Arkansas provides an advantage for those who produce their own energy through its “net metering” policy in which excess electricity generated by a consumer can be credited and applied during periods of peak electricity usage.

The decision to go solar wasn’t made impulsively, Boyd said. His interest was piqued when he picked up some information from a vendor at an Arkansas Farm Bureau convention. The following year, there were more vendors, more information and more interest. Then in 2020, he decided it was time to get some bids. Delta Solar of Little Rock won the contract.

“I wanted to be energy independent and be a good steward of natural resources,” Boyd said. “It was pretty expensive, but I was able to apply for a REAP grant and use the tax benefits that go with the system. It just made sense to me.”

REAP is the U.S. Department of Agriculture’s Rural Energy for America Program, which provides guaranteed loan financing and grant funding to agricultural producers and rural small businesses.

The Boyd Family Farm had 460 solar panels installed on less than one acre of land and went online “right around Thanksgiving and I think the first full month was December,” Boyd said. “It didn’t produce a tremendous amount of energy in that month, due to the day length.”

However, “since that first month, I have not paid for more than the minimum for any bill,” he said. “My biggest bill for five meters combined has $104 and change.”

The system is expected to save $25,000 a year on electricity bills.

“That’s more than 90 percent of the farm’s annual electricity expenditure,” Liang said.

And while installing solar isn’t cheap, being able to use a USDA REAP grant and tax incentives will help Boyd to recoup his costs within two to four years.

“Under the Arkansas net-metering rules, any power that is put back onto the electric grid is credited against your other meters on a "1-to-1" basis,” said Doug Hutchings, CEO of Delta Solar. “This means that the energy you produce is valued at exactly what you would be paying for it. Note that farms, as commercial entities, will be paying less for power than residential users so it is critical to accurately model the true electric rate that a farmer is paying to accurately model the long-term savings.”

With the solar energy system’s 25-year warranty, “Boyd will earn free electricity for at least 20 years,” Liang said.

“The investment in solar is making financial sense now and adds tremendous values to his own farm business, no matter whether he sells the farm several years from now, or passes it along to the next generations,” Liang said. “A solar energy system has become more competitive due to the continuous drop of system prices and improvement on energy conversion efficiency, with additional benefits to reduce greenhouse gases.”

Although his initial investment wasn’t inexpensive, Boyd believes the system adds value to the farm and any future buyer of the farm will have the energy savings to look forward to.

In addition to solar, Boyd made other changes on his farm, changing to LED lights and tube heating throughout the poultry houses to increase efficiency of gas and electricity.

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New NASA-funded project to quantify the climate impact of rice cultivation

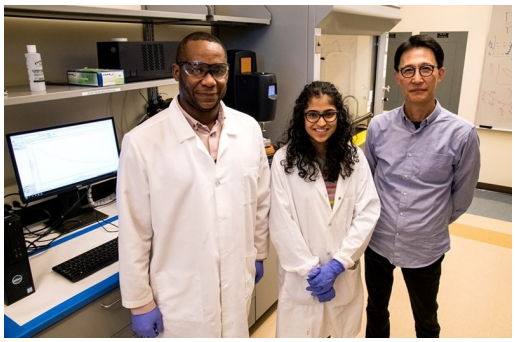
Biological Engineering professor, Benjamin Runkle, was recently awarded a grant from NASA's Carbon Monitoring Program to support their understanding of the greenhouse gas implications of rice cultivation. The grant, titled "A national quantification of methane emissions from rice cultivation in the U.S.: integrating multi-source satellite data and process-based modeling", was for $1,069,563 over the period 2021-2024. This funding supports hiring a postdoctoral scientist, graduate students, and undergraduates to work on the project. The team project includes colleagues at the University of Illinois, Urbana-Champaign, where Professor Kaiyu Guan will lead the detection of field inundation dynamics and advanced application of satellite imagery for understanding agricultural carbon and water dynamics.

This research is important because rice is a significant food crop – half of U.S. production is here in Arkansas! Unfortunately, rice production globally is also responsible for 8% of anthropogenic methane emissions, due to its cultivation in anaerobic soil environments. Methane is a greenhouse gas 30 times more potent than carbon dioxide in terms of how it warms the earth's atmosphere. There is still considerable uncertainty to the methane emissions associated with rice cultivation in the United States, and a more consistent product is necessary to observe, plan, and reduce this greenhouse gas source. This project takes on the challenge of monitoring methane production in the U.S.'s rice producing regions by integrating satellite data with a process-based model to produce a consistent national estimate of methane emissions associated with rice cultivation. The product will be validated against field flux observations taken by the eddy covariance method in the Lower Mississippi River Basin and California, two of the largest rice-producing regions in the U.S. Runkle has taken these observations since 2015 in Arkansas alongside colleagues from the USDA's Agricultural Research Service.

The project aims to overcome three main factors inhibiting success in current rice-related methane inventories: (1) lack of gold-standard, temporally-continuous benchmark data for methane emissions, including measurements in the U.S.'s biggest rice production area, (2) lack of inundation dynamics in the methane modeling and quantification, and (3) lack of observational constraints from plant growth in methane quantification. The team aims to overcome these challenges by assembling a database of methane emissions over rice-cultivated fields to benchmark a new modeled product. An appropriate, tested, process-based model for rice's methane emissions prediction will be used to generate daily flux estimates at the 500 m scale, for all the rice growing regions in the US. This product will be driven by a new daily, gap-free, cloud-free satellite-based map of both inundation and plant growth.

The project will be arranged in three work packages delivering (1) new satellite products of leaf area index, photosynthesis, and inundation at the daily scale, (2) methane emissions estimates using satellite observations and ground-truth benchmark eddy covariance flux observations to constrain process-based modeling, and (3) validation, verification, and uncertainty quantification. This last package includes uncertainty estimates from both satellite-derived variables and calibrated model parameters analyzed in a Monte Carlo sampling framework, a spatiotemporal trend analysis of rice's methane dynamics, and a comparison to current benchmark products and their implications for inversion modeling.

Cellulosic Nanomaterial May Help Solve Problem of Herbicide Drift



Joseph Batta-Mpouma and Gurshagan Kandhola found a tiny solution to a big problem.

Batta-Mpouma says up to 70 million pounds of herbicides are lost to the environment each year in the United States, according to Environmental Protection Agency estimates.

"Global crop production suffers immensely from the off-target drift of herbicides," Batta-Mpouma said. "Herbicides that miss their target, or that volatize and drift after application, damage sensitive crops. It can lead to over-spraying and environmental pollution."

To keep those herbicides on target and on the ground, Batta-Mpouma and Kandhola developed a unique formulation of biodegradable nanomaterials derived from cellulosic waste, like sawdust. The formulation is designed to be added as an adjuvant to herbicide spray mixtures to reduce drift.

The Arkansas Agricultural Experiment Station research was initially supported by the Center for Advanced Surface Engineering under the National Science Foundation's Established Program to Stimulate Competitive Research (EPSCoR) grant. The grant was awarded through the Arkansas EPSCoR program, ASSET III, administered through the Arkansas Economic Development Commission.

Later the project earned a $50,000 U of A Chancellor's Fund grant to continue advancing the technology.

Batta-Mpouma is a doctoral candidate in the materials science and engineering program at the U of A. He is a senior research assistant to Jin-Woo Kim, professor of biological and agricultural engineering for the Agricultural Experiment Station, the research arm of the University of Arkansas System Division of Agriculture, and the U of A's College of Engineering.

Kandhola has completed her doctoral degree in biological engineering and is a post-doctoral fellow in Kim's research group. She is partnering with Batta-Mpouma in a commercial venture to bring the nanocellulosic technology for herbicide drift control to market..

U of A Student Named 2021 Udall Scholar

Majoring in biological engineering with a sustainability minor, Barber has actively engaged in the Biological Engineering Student Club, the Volunteer Action Center and an ecological restoration project. Off-campus, she has interned with several engineering firms, including most recently as an environmental engineering intern at Perennial Energy in Pennsylvania.

"I am extremely grateful and honored to be a part of the Udall Scholar Family," Barber said. "It is a great privilege to represent the University of Arkansas, and I am looking forward to connecting with Udall Scholars from across the country to learn and share ideas."

Barber's professional aspirations are to build a career around utilizing the emissions from landfills in the United States as a means to make clean energy from the methane being released.

Upon graduation, Barber plans on entering the renewable energy industry and hopes to start her own business designing methane-reducing technologies for landfills that are trying to reduce their emission rates.

Barber said, "I want to start my own business to ensure the profits I generate can be used to fund environmental restoration efforts."

"Alexis is incredibly smart, getting things done because she is organized, proactive and engaged," said Scott Osborn, associate professor of biological and agricultural engineering and Barber's mentor. "Throughout her future career, she will be a leader addressing problems with both the environment and environmental justice. Alexis' potential is so great because she has the rare combination of intellect, work ethic, devotion to this cause and a deep respect and empathy for her fellow humans as both individuals and communities."

This year's class of Udall Scholars was selected from 416 candidates nominated by 187 colleges and universities. Thirty-seven Scholars intend to pursue careers related to the environment; 18 Native American/Alaska Native Scholars intend to pursue careers related to tribal public policy or Native health care.

The annual Udall Scholar Orientation will be held this August. Scholars will meet and connect with program alumni; learn more about the Udall legacy of public ser-

Dr. Benjmain Runkle wins the Honors College 2021 Distinguished Faculty Teaching and Research Award

Benjamin Runkle, associate professor, biological and agricultural engineering, College of Engineering. Benjamin Runkle leads a research group that aims to enhance our understanding of globally relevant landscapes through connections between the carbon and water cycles. His research on rice irrigation practices has helped quantify a water-saving technique that significantly reduces the greenhouse gas production of these food-providing landscapes.

Runkle's honors students have examined questions related to irrigation water use, rice plant growth dynamics, and modeling agricultural systems. One of these theses was published in peer-reviewed literature. In 2018, Runkle helped initiate a team research grant focused on the campus's green roof on Hillside Auditorium that also supported several individual honors research theses. He has also advised honors theses in sustainable urban and rural topic areas and he co-leads a study abroad course to Ghent, Belgium, that attracts many honors students. He is planning to offer an Honors College Forum, Nature-based Climate Solutions, in 2022.

Runkle has been recognized as an outstanding teacher by the University of Arkansas Alumni Association, the American Society of Engineering Education, the College of Engineering, and the Department of Biological and Agricultural Engineering. In research, he has received recognition from the Rice Technical Working Group, the College of Engineering, and the National Science Foundation, which awarded him a CAREER grant on climate-smart irrigation strategies for rice agriculture. In service, Runkle has co-advised the LGBTQ+ affinity group, oSTEM at the University of Arkansas, since its inception in 2018.

He received the CAREER award from the National Science Foundation in 2018 and has been acknowledged with departmental and college teaching and research awards.

U.S. Department of Agriculture Announces Key Staff

Dr. Marty Matlock will serve as Senior Advisor for Food Systems Resiliency with Marketing and Regulatory Programs. He was founding Executive Director of the University of Arkansas Resiliency Center and Professor in the Biological and Agricultural Engineering Department. Dr. Matlock is the recipient of the 2018 CAST-Borlaug Agriculture Communications Award and served on the USEPA Science Advisory Committee for Agriculture as well as the USDA Advisory Committee on Biotechnology and 21st Century Agriculture. He received his Ph.D. in Biosystems Engineering, Master of Science in Botany, and Bachelor of Science in Agronomy from Oklahoma State University. Dr. Matlock is a member of the Cherokee Nation and served as Chairman of the Cherokee Nation Environmental Protection Commission for the past 16 years.

“USDA continues to add talented individuals to our growing team, and this outstanding slate of leaders is no ex-

Dr. Runkle wins the The Wally Cordes Teaching and Faculty Support Center and the U of A Teaching Academy Rising Teacher Award

The Distinguished Faculty Achievement Award recognizes exceptional faculty members for teaching, research and service.

Benjamin Runkle, associate professor of Biological and Agri Engineering in the College of Engineering, is the recipient of the 2020 rising teacher award. Runkle joined the U of A’s Department of Biological and Agricultural Engineering in 2014. He teaches courses in sustainable watershed engineering and modeling environmental biophysics — both senior-level courses in biological engineering. Runkle has:

- Been honored with mentoring awards in 2018, 2019 and 2020 from the Provost’s Office and the Office of Nationally Competitive Awards.
- Mentored 2019 Razorback Classic Laura Gray and 2020 Razorback Classic Eleanor Henson.
- Earned the 2019 Early Achievement in Engineering Education Award from the Biological and Agricultural Engineering Division of ASEE.

Engineering, Food Science Faculty Member Named Distinguished Alumnus at McGill University

Ebenezer Miezah Kwofie, assistant professor of food systems sustainability and resilience, was honored with a 2021 Macdonald Distinguished Young Alumni Award by McGill University, where he earned his Ph.D. in 2016. Kwofie holds a joint appointment in Biological and Agricultural Engineering, Chemical Engineering and Food Science departments at U of A.

Named for McGill University founder Sir William Macdonald, the award recognizes outstanding contributions alumni have made in their professions in the same spirit of generosity and commitment to excellence as Macdonald.

Kwofie was recognized in a virtual ceremony Oct. 2.

He holds a Ph.D. in bioresource engineering from McGill. Prior to joining the University of Arkansas, he was a research associate at the food and bioprocess research lab in the Bioresource Engineering Department at McGill, where he served as manager for International Food Systems Development projects in developing countries such as Zambia, Malawi, Ethiopia, Bolivia and Honduras. These projects were focused on enhancing food systems sustainability and strengthening capacity of stakeholders including farmers, farmer cooperatives, small-scale food enterprises, nongovernmental organizations and local governments.

Kwofie's research explores the connectivity and dynamics of environmental, economic and product-process efficiency to address food system sustainability and resilience

Food Engineer Aims for Circularity of World Food Systems

Ebenezer Miezah Kwofie sees food production and consumption as linear, with waste products leaking out all along the line. He'd like to turn that line into a loop to create a more sustainable food system worldwide.

Kwofie has joined the University of Arkansas College of Engineering with appointments in the departments of biological and agricultural engineering and chemical engineering. He will also have a research appointment in the department of food science in the Dale Bumpers College of Agricultural, Food and Life Sciences.

The departments of biological and agricultural engineering and food science are also part of the University of Arkansas System Division of Agriculture.

"Dr. Kowfie's focus on sustainable food systems will add valuable capacity to the team on sustainable foods and nutrition to address global food challenges," said Lalit Verma, biological and agricultural engineering department head. "Dr. Jeyam Subbiah and I are working to build a core of excellence in food engineering in the Division of Agriculture and the University of Arkansas."

"Our departments' collaboration on integrated food sustainability requires analysis of profitability, food safety, social impacts and other elements," Subbiah, head of the food science department for the Division of Agriculture and Bumpers College, said. "Our scientists and engineers have to determine how to quantify those metrics, and Dr. Kwofie brings an exciting stock of skills and experience to the task."

Xinge Xi graduated in August with a PhD in engineering. She has joined faculty at China Agricultural University

Dr. Abdus Sobhan started in October as a postdoctoral research associate with Dr. Yanbin Li. He will be working on a project on nanomaterials and biosensors for food packaging.

Dr. Fei Jia joined Dr. Yanbin Li's research group as a research scientist. He will be working on projects on food safety monitoring and risk analysis systems for food supply chain.

Ellie Kuhn wins 1st place at the Triple Societies Conference for Honors Thesis presentation

Congratulation to the Class of 2021!

Undergraduates:

Jason Angel

Karina Arellano

Juan Arguijo

Sydney Bowman

Tatiana Castillo Hernandez

Kelsea Crabb

Jacob Fisher

Tarah Inema

Ryan Sklar

His-Cheng Su

Graduates:

Morgan Dulin

Jacob Hickman

Lydia Huck

Marguerita Leavitt

Colby Reavis

Slater Smith

Summer Wilke

Yiting Xiao

Scholarship Donation Opportunities

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Joel T. Walker Memorial Scholarship Fund $ _____

Carl L. Griffis Memorial Scholarship Fund $ _____

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Enjoy the Holidays and Happy New Year!