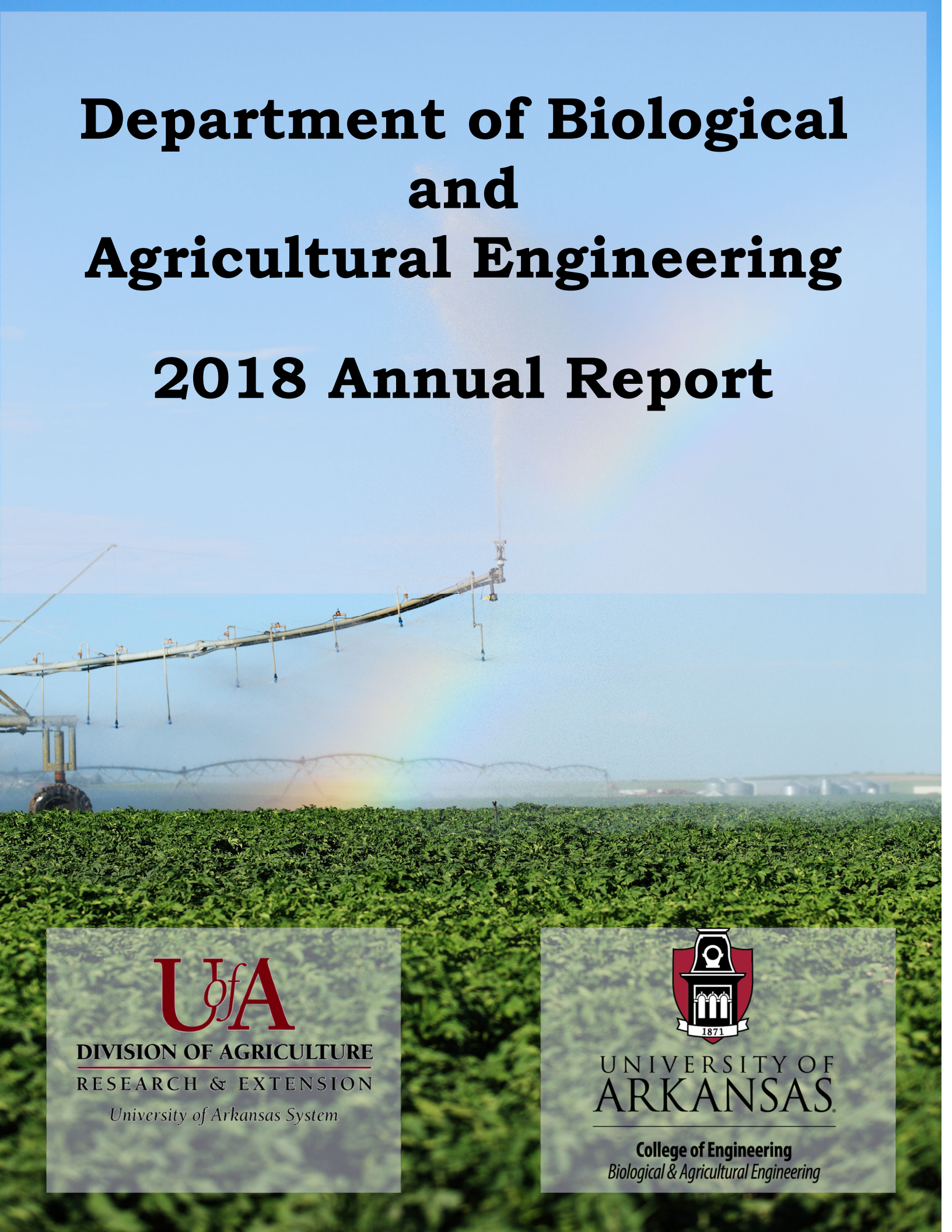
Department of Biological and Agricultural Engineering

2018 Annual Report



UofA
DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

1871
UNIVERSITY OF ARKANSAS
College of Engineering
Biological & Agricultural Engineering

2018 Annual Report
Department of Biological and Agricultural Engineering

Lalit R. Verma
Department Head

University of Arkansas
Division of Agriculture
Mark Cochran
Vice President for Agriculture

Arkansas Agricultural Experiment Station
Jean-Francois Meullenet
Associate Vice President for Agriculture Research

Cooperative Extension Service
Rick Cartwright
Associate Vice President for Agriculture Extension

College of Engineering
John English
Dean

University of Arkansas
Joseph E. Steinmetz
Chancellor

Jim Coleman
Provost and Vice Chancellor for Academic Affairs

Department of Biological & Agricultural Engineering

203 White Engineering Hall
University of Arkansas
Fayetteville, AR 72701

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Table of Contents

Foreword 1

Significant Accomplishments 2

Departmental Resources

Faculty 4
Professional and Administrative Staff 6
Boards and Committees 7
Academy Members and Inductees 8
Financial Information 9
History, UA and BAEG Department 11
History, City of Fayetteville 12

Teaching Program

Undergraduate Program 14
Graduate Programs 16
Courses 20

Faculty Research and Extension Projects 26

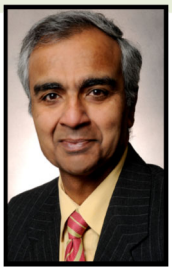
Grants 47

Publications

Books & Book Chapters 50
Refereed Articles 50
Other Peer-Reviewed Publications 54
Non-Refereed Publications and Articles 54
Professional Presentations 57
Oral or Poster Presentations 58
Other Creative Endeavors 63
Patents 63

FOREWORD

FROM THE DEPARTMENT HEAD



Lalit R. Verma,
Professor and Department Head

It is a pleasure to share the news and highlights of 2018. The mission of our department is "*to develop and disseminate engineering knowledge to address problems dealing with sustainable food, water and energy systems*." This mission supports the mission of our land-grant university and aligns well in addressing the grand challenges facing our society. Our Biological Engineering curriculum prepares engineers to solve problems in sustainable water, food and energy systems. A common thread noticed in the career goals of our students is their desire to "make a difference" and the program gives them the opportunity to do so by working to design engineering solutions for water, food and energy systems. The program continues to have a steady growth and attracts incoming engineering freshmen wishing to pursue careers closely aligned with sustainable systems. Our department has the opportunity to contribute to the programs of both the UA System's Division of Agriculture's research and extension programs, and the UA College of Engineering. We are housed in the engineering college and our departmental support budget is provided by the Arkansas Agricultural Experiment Station and the Cooperative Extension Service, while our academic programs are funded by the College of Engineering. Some of our faculty are located off-campus in the state office of the UA System Division of Agriculture's Cooperative Extension Service in Little Rock and at the Rice Research and Education Center in Stuttgart. Our team is engaged in providing engineering expertise for critically relevant issues to our state and nation, dealing with challenges in sustainable water, food and energy systems in support of the Arkansas agriculture enterprise.

Seven outstanding alumni were inducted in the Arkansas Academy of Biological and Agricultural Engineering (AABAE) in 2018 on April 20th. They are Mr. John Chris Brock, Dr. Dylan Carpenter, M.D., Mr. Zach Dalmut, Mr. Kyle Kruger, Ms. Toni McCrory, Ms. Katherine Merriman-Hoehne and Ms. Shelly Thomas. AABAE provides valuable support annually through scholarships, student membership in ASABE, travel for student competitions and student club activities. Mr. Gregory Baltz (BSAGE 1980) of Running Lake Farms in Pocahantas, AR was honored as a "*Distinguished Alumnus*" and Mr. Drake McGrudder (BSBE 2006) of Kraft Heinz Co. in Ft. Smith, AR was recognized as an "*Early Career Alumnus*" of the College of Engineering.

A successful industry tour for 43 undergraduates was coordinated by Dr. Tom Costello in the fall semester. Our enrollment is strong and required two sections of the sophomore level "Design Studio" course this semester. We had 117 undergraduate Biological Engineering students with sophomore, junior or senior standings, and 19 graduate students. Several faculty participated in the 2018 Annual International Meeting of the American Society of Agricultural and Biological Engineers (ASABE) in Detroit in July. Twenty four students in seven teams showcased their senior design projects on May 3rd. Ms. Ali Ezell, one of our 23 graduating seniors was selected as the "*Most Outstanding Graduating Senior*" in Biological Engineering and was recognized at the College of Engineering student recognition reception and graduation ceremony on May 12th. Three of our graduating seniors, Ali Ezell, Casey Gibson and Kendrick Hardaway were honored as "Seniors of Significance" with their mentor Dr. Scott Osborn by the Arkansas Alumni Association. Dr. Osborn, student club advisor organized and accompanied 16 students to the ASABE Southeast Student Rally in Lexington, KY during April 5 to 8.

Distinguished Professor Yanbin Li was inducted as a 2018 ***Fellow*** of the Institute of Biological Engineering in Norfolk, VA on April 7, 2018. He received a $2.3 million grant from the Walmart Foundation to conduct research for improving food safety in poultry supply chain in China. The project focuses on innovative biosensing technology to rapidly detect pathogenic bacteria and antibiotic residues in poultry supply chain and advanced dynamic risk-assessment models integrated with supply chain management to help the industry and regulators make better decisions for ensuring food safety in poultry. He was also awarded a College of Engineering "*Excellence in External Research Award*."

Dr. Ben Runkle is the recipient of the prestigious NSF CAREER Award. This *Faculty Early Career Development* award from the National Science Foundation is to expand his research on sustainable rice production. The NSF award will enable Dr. Runkle to quantify the climate impact of water-saving irrigation strategies. He was also recognized with the "*Rising Teaching Award*" in the College of Engineering.

In March it was announced in Washington, D.C. that Dr. Marty Matlock is the winner of the prestigious "*2018 Borlaug CAST Communication Award*." Drs. Tom Costello, Jin-Woo Kim and Brian Haggard were recognized for excellence in teaching, research and service to students in our department, respectively. Mr. Julian Abram was awarded the Division of Agriculture Non-Classified Support Personnel Award in January for his superior service. I had the opportunity to make a keynote address at the inaugural conference of the Pan-African Society for Agricultural Engineering in Nairobi, Kenya.

The Arkansas Section of ASABE held its 55th meeting on October 5th in Fayetteville in the Don Tyson Center for Agricultural Sciences. Ms. Laura Gray was named the "Outstanding Senior" and Dr. Sammy Sadaka was recognized as the "Outstanding Engineer" at this event. We have made good progress in raising funds to endow the ***Carl Griffis Memorial Scholarship*** but have not yet reached our goal. Support of our alumni and friends in endowing this scholarship is needed so we may honor the dedicated service of Professor Griffis to our students and our stakeholders.

Preparations are underway for an external departmental review of our research, extension and graduate education programs in 2019. I hope this annual report provides an overview of the programs, contributions and accomplishments of our faculty, students and staff in 2018.

Thank you,
Lalit R. Verma, Ph.D., P.E.
Professor and Department Head
www.bio-ag-engineering.uark.edu.

- Dr. Benjamin Runkle received the College of Engineering Rising Teaching Award.
- Dr. Chris Henry received the Conservation Systems Irrigator Researcher of the Year. 2018. National Conservation Systems. Presented at the annual Cotton and Rice Conference and Delta States Irrigation Conference, Memphis, TN.
- Dr. Chris Henry received the John W. White Outstanding Team Award. Discovery Farm Team 2018. Presented at the annual faculty conference, Fayetteville, AR.
- Dr. Chris Henry received the Distinguished Rice Research and Education Team Award 2018. Rice Technical Working Group. Presented at the bi-annual RTWG Conference, Long Beach, CA.
- Dr. Thomas Costello received the College Outstanding Teaching award for Biological and Agricultural Engineering.
- Dr. Brian Haggard received the College Outstanding Service to students award for Biological and Agricultural Engineering.
- Dr. Jin-Woo Kim received the College Outstanding Research award for Biological and Agricultural Engineering.
- Dr. Yi Liang received the 2018 ASABE Educational Aids Blue Ribbon award.
- Dr. Sammy Sadaka received the 2018 ASABE Outstanding Engineer award at the ASABE State Section meeting
- The University Of Arkansas Chapter Of Out in Science, Technology, Engineering & Mathematics, Incorporated, oSTEM, received the 2018 Rookie Chapter of the year award. Dr. Benjamin Runkle, coadvisor and nine students traveled to Houston, Texas, to accept the award.
- Dr. Yanbin Li, was inducted as a 2018 Fellow of Institute of Biological Engineering.
- Dr. Yanbin Li received the Distinguished Career Award, Association of Overseas Chinese Agricultural, Biological and Food Engineers.
- Dr. Yanbin Li received the 2018 Excellence in External Research Award, College of Engineering, University of Arkansas.
- Dr. Marty Matlock received the 2018 Borlaug Council for Agricultural Science and Technology (CAST) Communication Award for "Matlock's achievements as an internationally-recognized expert in agricultural sustainability metrics and assessment.
- Dr. Marty Matlock received the 2018 American Architecture Award by the Chicago Athenaeum: Museum of Architecture and Design and The European Centre for Architecture Art Design and Urban Studies, for Whitmore Community Food Hub Complex: Building Community around Food.
- Julian Abram was award the Division of Agriculture Non-Classified Support Personnel Award - Business, Financial, IT, Communications, Human Capital.

ALUMNI ACCOMPLISHMENTS

- Mr. John Chris Brock, Dr. Dylan Carpenter, Mr. Zach Dalmut, Mr. Kyle Kruger, Ms. Toni McCrory, Ms. Katherine Merriman-Hoehne, and Ms. Shelly Thomas were inducted into the Arkansas Academy of Biological and Agricultural Engineering.
- Mr. Greg Baltz, (BSAGE 1980) Owner/Operator, Running Lake Farms, was recognized as a "Distinguished Alumnus" and Mr. Kyle Kruger P.E., BSBE 2005, MSEnE 2009, Oklahoma Plant Team Leader, Garver, was recognized as an "Early Career Alumnus" of the College of Engineering.

Significant Accomplishments in 2018

Students

- *1st place in the 2018 Ph.D. Student Poster Presentation Competition sponsored by the Arkansas Chapter of Gamma Sigma Delta (GSD),* received by Wenqian Wang, Ph.D. Student in Poultry Science, March 16, 2018, Fayetteville, AR. Her presentation title is "An LSPR sensor coupled with magnetic nanobeads-based immunoseparation for rapid and sensitive detection of *E. coli* O157:H7."

- *2nd place in AOCABFE 2018 Graduate Research Papers Competition,* received by Yafang Shen, Ph.D. Student in Biosystems Engineering, July 29-August 1, 2018, Detroit, MI. Her paper title is "A nanomaterials-based biosensor for rapid detection of enrofloxacin in chicken products".

- *2nd Place Poster Award in AAFP 2018 Graduate Students Poster Competition (Category 4),* received by Wenqian Wang, Ph.D. student in Poultry Science, September 17-20, 2018, Fayetteville, AR. Her poster title is "A LSPR sensor coupled with magnetic nanobeads-based immunoseparation for rapid and sensitive detection of *E. coli* O157:H7. Presented at AAFP 2018 Annual Meeting".

- *3rd Place Poster Award in AAFP 2018 Graduate Students Poster Competition (Category 4),* received by Xinge Xi, Ph.D. student in Biological Engineering, September 17-20, 2018, Fayetteville, AR. Her poster is: "A label-free impedance immunosensor based on multi-walled carbon nanotube electrode for rapid and sensitive detection of *E. coli* O157:H. Presented at AAFP 2018 Annual Meeting."

- *The Society for Risk Analysis 2018 Travel Award*, received by Xingning Xiao, Ph.D. Student in Biosystems Engineering, SRA Annual Meeting, December 2-6, 2018, New Orleans, LA.

- *1st place in The University of Arkansas Three Minute Thesis Contest (for College of Engineering),* received by America Sotero, M.S. student in Biological Engineering, November 13, 2018, Fayetteville, AR.

- Kaushik Luthra. Second place award in graduate student poster competition at 55th annual ASABE's Arkansas Section Meeting "Quantification of the thermal load on broilers during transportation from farm to the processing plant", Oct. 5, 2018. Fayetteville, AR.

- Kendrick Hardaway named 2018 Razorback Classic by Alumni Association.

- Sarah Gould received the DAAD German Academic Exchange, Research in Science and Engineering (RISE) Fellowship.

- Casey Gibson received an honorable mention for an NSF Fellowship.

- Casey Gibson was selected as a Fulbright English Teaching Assistant for the country of Mexico.

- Ali Ezell was named Outstanding Senior in Biological Engineering

- Will Richardson, Ali Ezell, Casey Gibson, and Kendrick Hardaway were all named Seniors of Significance by the UA Alumni Association.

- Senior design team, Allison Sites, Samuel Lahodny, McKenna Belcher, and Kami Parmenter placed 2nd in the Gunlogson Environmental Student Design Competition, ASABE Annual Meeting, Detroit, MI, July 2018.

Thomas A. Costello, Ph.D., P.E.
Associate Professor
B.S. Ag.E. (1980) University of Missouri
M.S. Ag.E. (1982) University of Missouri
Ph.D. (1986) Louisiana State University
Research Areas: Ecological engineering, agricultural engineering, bio-energy, alternate energy, energy conservation, development and evaluation of economical BMP's for improved water quality, air quality and sustainability of agricultural production.

Brian E. Haggard, Ph.D.
Professor
Director, Arkansas Water Resources Center
B.S. Life Sciences (1994) University of Missouri
M.S. Environmental Soil & Water Science (1997) University of Arkansas Ph.D. Biosystems Eng. (2000) Oklahoma State University
Research Areas: Ecological engineering, environmental soil and water sciences, water quality chemistry, algal nutrient limitation, pollutant transport in aquatic systems, water quality monitoring and modeling.

Christopher Henry, Ph.D., P.E.
Associate Professor, Extension
B.S. (1996) Kansas State University
M.S. (1998) Kansas State University
Ph.D. (2009) University of Nebraska
Research Areas: Development and implementation of statewide integrated research and extension programs in irrigation water management and water quality; improve irrigation efficiency practices, novel irrigation system design, and improved energy efficiency and alternative energy sources for irrigation; develop alternative irrigation systems for rice; water policy research; solar power; pumping plant telematics; improve irrigation systems using embedded systems and mobile apps; develop curricula and training materials for educational programs in irrigation water management for cropping systems, performance and energetics, irrigation systems, and water quality impacts; investigate and develop solutions for reduction of pollutant loads with respect to gulf hypoxia; work with other UA personnel to develop and demonstrate irrigation and farming practices that address environmental, production, and economic considerations; develop and maintain positive working relationships with other government agencies and industries.

Jin-Woo Kim, Ph.D.
Professor
B.S. Ch.E. (1986) Seoul National University, Korea
B.S. Microbiology (1991) University of Iowa
M.S. Biology (1994) University of Wisconsin
Ph.D. Ag.E. (1998) Texas A&M University

Research Areas: Biotechnology engineering, biomedical engineering, bionanotechnology, and bio-abio interfacing technology.

Kieu Ngoc Le, Ph.D.
Instructor
B.S. Education and Foreign language (English), Cantho University (2006) , Vietnam
B.S. Hydraulic Engineering, Cantho University (2007) , Vietnam
M.S. Plant Soil and Environmental Science (2011) North Carolina Agricultural and Technical State University
Ph.D. (2017) North Carolina Agricultural and Technical State University
Research Areas: Field- and watershed-scale modeling to evaluate the impacts of land use, on-farm management decisions on soil organic carbon sequestration, soil properties, crop productivity and water quality. Life cycle assessment on the impact of conservation agriculture versus different tillage systems

Yanbin Li, Ph.D., P.E.
Distinguished Professor, Tyson Endowed Chair in Biosensing Engineering
B.S. Ag.E. (1978) Shenyang Agricultural University, China
M.S. Ag.E. (1985) University of Nebraska, Lincoln
Ph.D. Ag.E. (1989) Pennsylvania State University
Research Areas: Biosensor and bioinstrumentation, microbial predictive engineering, quantitative risk assessment, and food safety engineering.

Yi Liang, Ph.D.
Associate Professor, Extension
B.S. Ag. E. (1990) China Agricultural University, China
M.S. Ag. E. (1995) China Agricultural University, China
Ph.D. (2000). University of Alberta, Canada
Research Areas: Air quality and energy efficiency with confined animal feeding operations, quantification of emission and transportation of air pollutants, development and evaluation of emission prevention and control technologies.

Otto J. Loewer, Ph.D., P.E.
Professor
ASABE Fellow
B.S. Ag.E. (1968) Louisiana State University
M.S. Ag.E. (1970) Louisiana State University
M.S. Ag. Econ (1980) Michigan State University
Ph.D. Ag.E. (1973) Purdue University
Research Areas: Computer simulation of biological systems; linkages among technology, economics and societal values.

Marty D. Matlock, Ph.D., P.E., B.C.E.E.
Professor
Area Director, Center for Agricultural and Rural Sustainability
B.S. Soil Chemistry (1984) Oklahoma State University
M.S. Plant Physiology (1989) Oklahoma State University
Ph.D. Biosystems Engineering (1996) Oklahoma State University
Research Areas: Ecological engineering, ecological watershed modeling, biological assessment and monitoring, ecosystem design and management.

Scott Osborn, Ph.D., P.E.
Associate Professor
B.S. Ag.E. (1984) University of Kentucky
M.S. Ag.E. (1987) University of Kentucky
Ph.D. Bio & Ag.E. (1994) North Carolina State University
Research Areas: Grain and Food Processing, dissolved oxygen and ozone technologies for water and wastewater treatment.

Sammy Sadaka, Ph.D., P.E., P.Eng.
Associate Professor, Extension
B.S. (1982) Alexandria University, Egypt
M.S. (1988) Alexandria University, Egypt
Ph.D. (1995) Dalhousie University, Nova Scotia, Canada and Alexandria University, Egypt
Research Areas: Bioenergy and energy conservation, grain drying and storage; gasification, pyrolysis, biodrying, energy con-servation.

Benjamin Runkle, Ph.D.
Assistant Professor
B.S.E.. Princeton University
M.S., University of California, Berkeley
Ph.D., University of California, Berkeley
Research Areas: Wetland ecohydrology and agro ecosystems, surface water nutrient fluxes and source partitioning. Land-atmosphere exchange of carbon dioxide, methane, and water vapor.

Karl VanDevender, Ph.D., P.E.
Professor, Extension Engineer
B.S. Ag.E. (1985) Mississippi State University
M.S. Ag.E. (1987) Mississippi State University
Ph.D. Engineering (1992) University of Arkansas
Research Areas: Development and implementation of statewide extension programs in livestock and poultry waste management, liquid and dry; develop curricula and training materials for educational programs in collection, storage, and land application of waste to prevent contamination of surface and groundwater; work with other UA personnel to develop and demonstrate manure storage, treatment, and utilization practices that address environmental, production, and economic considerations; develop and maintain positive working relationships with other government agencies and industries.

Lalit R. Verma, Ph.D., P.E.
Professor
Department Head
B.Tech Ag.E. (1972) Agricultural University, India
M.S. Ag.E. (1973) Montana State University
Ph.D. Engineering (1976) University of Nebraska
Administration of the Department of Biological and Agricultural Engineering.

Jun Zhu, Ph.D.
Professor
B.S. Civil Eng. (1982) Zhejiang University, China
M.S. Civil Eng. (1985) Zhejiang University, China
Ph.D. in Ag. E. (1995) University of Illinois
Research Areas: Air and water quality related to animal agriculture and value added products production from agricultural renewable resources (bio-energy and chemicals).

Julian abram
Program Technician

Randy Andress
Program Associate

Eric Cummings
Program Associate

Sydney Jones
Administrative Specialist III; Extension

Beatriz Moreno Garcia
Post Doctoral Fellow

Janelle Mott
Fiscal Manager

Linda Pate
Department Administrative Manager

William Benjamin Putnam V
Research Associate

Lee Schrader
Program Assistant

Arvind Sinha
Post Doctoral Associate

Kosana Suvočarev
Post Doctoral Associate

Anthony Taylor
Administrative Specialist III

Ronghui Wang
Post Doctoral Associate

BAEG Advisory Board
2018 Members

Mark Christie
Manufacturing Services
Tyson Foods

Alan Fortenberry
Chief Executive Officer
Beaver Water District

Tyler Gipson
Hydraulic Engineer
Southwestern Power Administration

Kevin J. Igli
SVP and Chief EHS Officer
Tyson Foods

Kyle Kruger
Garver Engineering

Jeff Madden
Director of Engineering
Riceland Foods, Inc.

Toni Peacock McCrory
Director
Water Compliance
Wal-Mart

Robert Morgan
Manager of Environmental Quality
Beaver Water District

Chris Pixley
VP of Operations
Pacific Vet Group-USA

Randy Young
Executive Director
Arkansas Natural Resources Commission

Academic Advisory Committee
2018 Members

Bill HagenBurger
Beaver Water District

Jeff Madden
Riceland

Don Mosley
Entegrity

Katherine Yarberry
Wal-Mart

Thomas Costello
BAEG Faculty

Scott Osborn
BAEG Faculty

Lydia Huck
Undergraduate student

Katharine Campbell
Undergraduate Student

Departmental Resources

Academy Members and Inductees

Active Academy Members

David Anderson
B.S. ('70)

Stanley B. Andrews
B.S. ('90), M.S. ('93)
COE Young Alumni 2007

Howard B. Austin
B.S. ('56)

Ray Avery
B.S. ('03) M.S. ('07)

Greg Baltz
B.S. ('80)

Pat Bass
B.S. ('76)

David Beasley
B.S. ('71), M.S. ('73), Ph.D. ('77)

John L. Bocksnick
B.S. ('76), M.S. ('78)

John Chris Brock
B.S. ('85) M.S. ('00)

Shawn Brewer
B.S. ('94), M.S. ('98)

Dennis K. Carman
B.S. ('73)

Dylan Carpenter
B.S. ('05) M.S. ('07)

Indrajeet Chaubey
M.S. ('94)

Robert Chatman
B.S. ('71)

Randy Childress
B. S. ('85)

John J. Classen
B.S. ('87), M.S. ('90), Ph.D. ('95)

William L. Cooksey
B.S. ('79)

David "Gail" Cowart
B.S. ('60)

Zach Dalmut
B.S. ('06)

Steven D. Danforth
B.S. ('80)

Glenn Davis
B.S. ('67)

Anthony Doss
B.S. ('94)

Joe D. Faddis
B.S. ('67)

Alan D. Fortenberry
B.S. ('72), M.S. ('77)
COE Distinguished Alumni 2007

Fred G. Fowlkes
B.S. ('68), M.S. ('77)

Michael W. Freer
B.S. ('85), M.S. ('88)

Dennis R. Gardisser
B.S. ('79), M.S. ('81), Ph.D. ('92)

Floyd R. Gunsaulis
B.S. (88), M.S. (90)
COE Young Alumni 2006

Kevin Henry
B.S. ('99)
COE Young Alumni 2008

Darrell Holmes
B.S. ('81)

John P. Hoskyn
B.S. ('60), M.S. ('64)

Michael D. Jones
B.S. ('67), M.S. ('68)

Jeff Keeter
B.S. ('84)

Dayna King-Cook
B.S. ('85), M.S. ('88)

Kyle Kruger
B.S. ('86)

John L. Langston
B.S. ('71), M.S. ('73)

Otto J. Loewer
B.S. ('68), M.S. ('70), Ph.D. ('73)

Jeffery D. Madden
B.S. ('88)

Ralph A. Mashburn
B.S. ('58)

Stanley A. Mathis
B.S. ('84)

Kate MerrimanAmber Meisner
B.S. ('02)

Drake McGruder
B.S. ('06)

Katie Migliaccio, Ph.D.
Ph.D. ('05)

Bruce Netherton
B.S. ('60)

Robert W. Newell
B.S. ('54)

Richard Penn
B.S. ('82), M.S. ('92)

Carl Peters
B.S. ('58), M.S. ('61)

Chris Pixley
B.S. ('02) Ph.D. ('13)

Jonathan W. Pote
B.S. ('75), M.S. ('75), PhD ('79)

Bill R. Ridgway
B.S. ('88)

David Wesley Ritter
B.S. ('79), M.S. ('81)

Richard M. Rorex
B.S. ('78), M.S. ('81)
COE Distinguished Alumni 2011

Michael D. Shook
B.S. ('82)

William Hix Smith, JR
B.S. ('67)

Eugene H. Snawder
B.S. ('69)

Billy Staton
B.S. ('91), M.S. ('95)

Phil Tacker
B.S. ('79), M.S. ('82)

Marcus Tilly
B.S. ('00)

Karl VanDevender
B.S. ('87), M.S. ('87), PhD ('92)

Earl Vories
B.S. ('81), M.S. ('83), Ph.D. ('87)

Paul N. Walker
B.S. ('70), M.S. ('71), Ph.D. ('74)

William K. Warnock
B.S. ('72), M.S. ('75), Ph.D. ('77)

Bruce E. Westerman
B.S. ('90)
COE Young Alumni 2005
COE Distinguished Alumni 2012

John Westerman
B.S. ('94)

Dawn Wheeler-Redfearn
B.S. ('99), M.B.A. ('00)
COE Distinguished Alumni 2008

Robert W. White
B.S. ('72), M.S. ('76)

Honorary Academy Members

Billy Bryan
B.S. ('50) M.S. ('54) Posthumously

Albert H. Miller
Posthumously

Harold S. Stanton
B.S. ('50) M.S. ('53)

H. Franklin Waters
B.S. ('55) Posthumously

Carl L. Griffis
B.S. ('63), M.S. ('65),

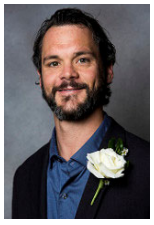
Stanley E. Reed
B.S. ('73) Posthumously

Freddie C. Stringer
B.S. ('70)

Albert E. "Gene" Sullivan
B.S. ('59)

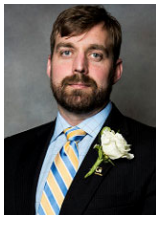
2018 Academy Inductees

John Chris Brock
B.S. ('85) M.S. ('00)

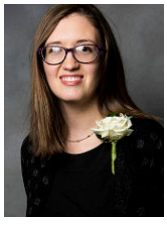


Dylan Carpenter
B.S. ('05) M.S. ('07)

Zach Dalmut
B.S. ('06)

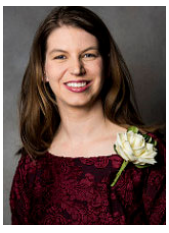


Kyle Kruger
B.S. ('86)



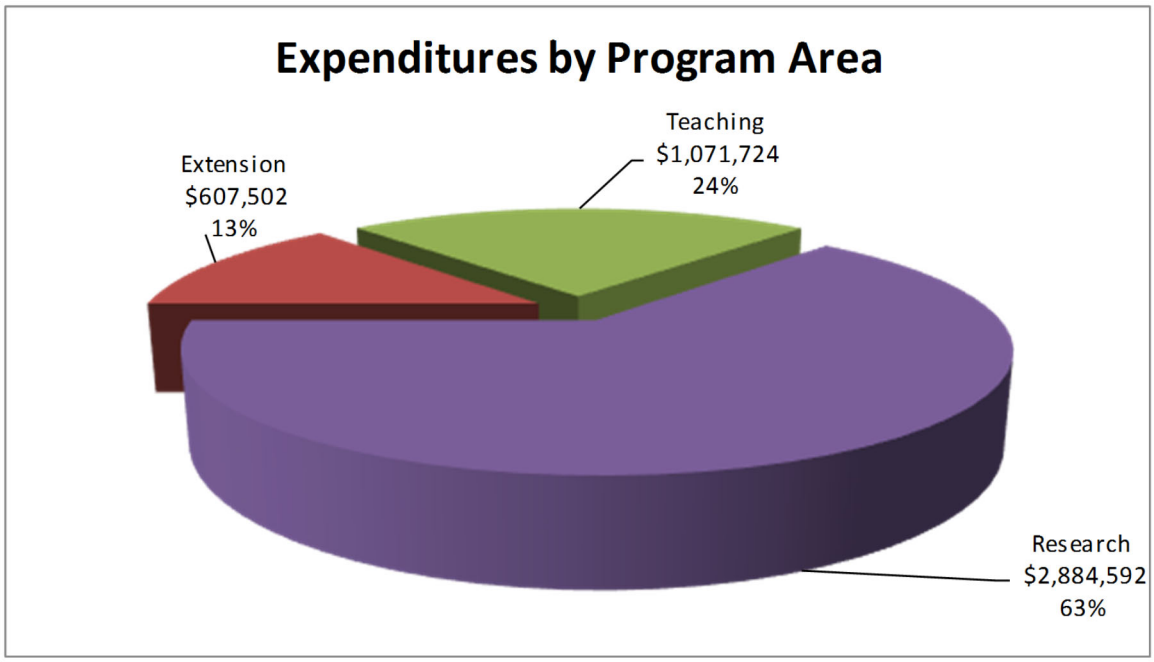
Kate Merriman-Hoehne B.S. ('02)

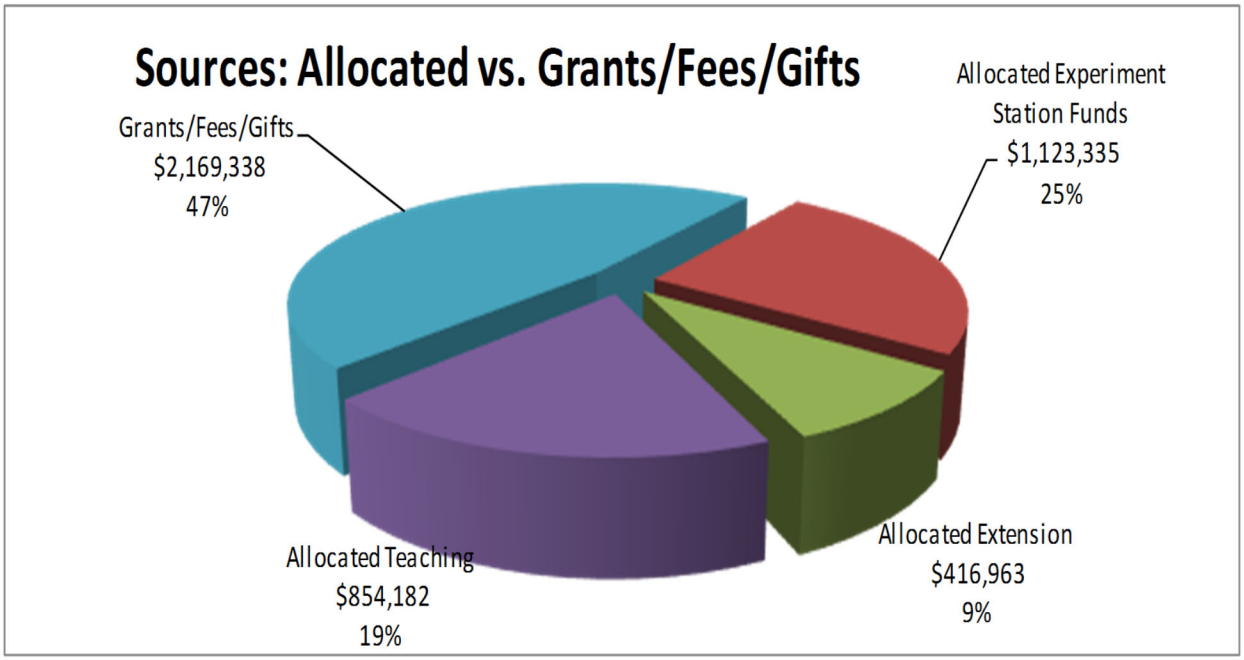
Shelly West
B.S. ('05)

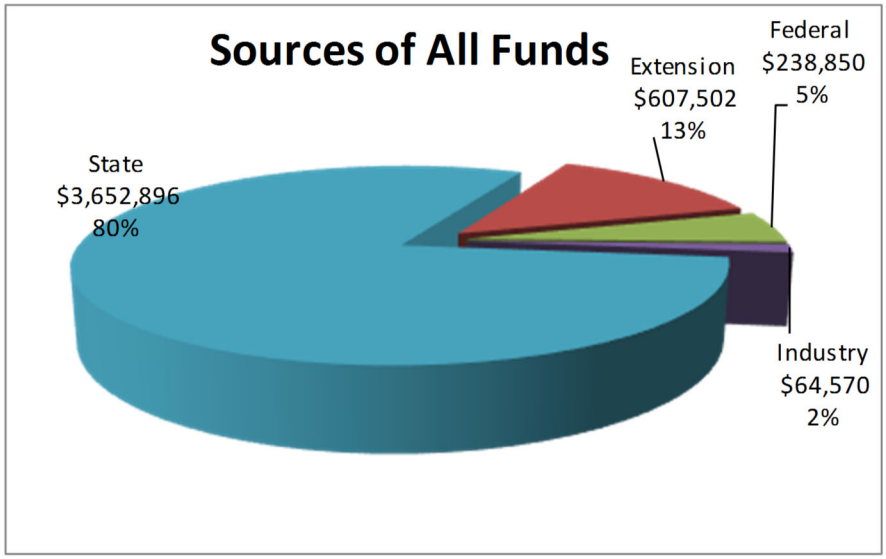


Toni McCrory
B.S. ('07)

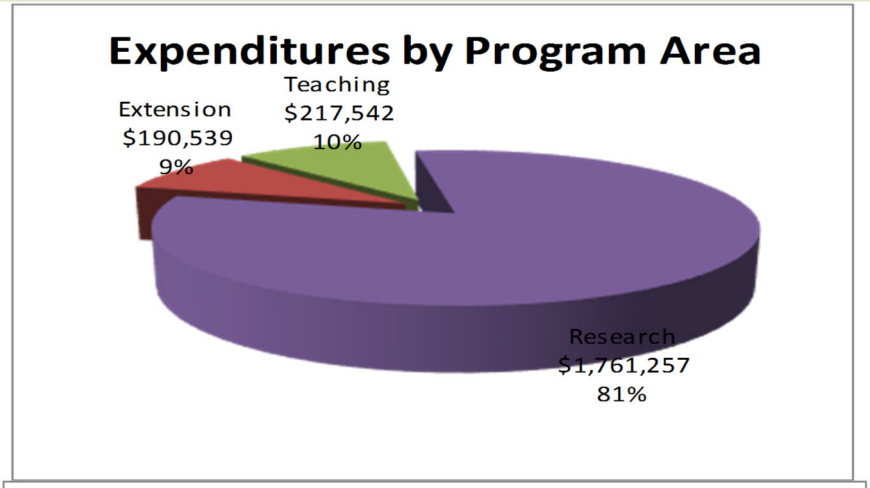
TOTAL EXPENDITURES, JULY 1, 2017 TO JUNE 30, 2018
$4,563,818

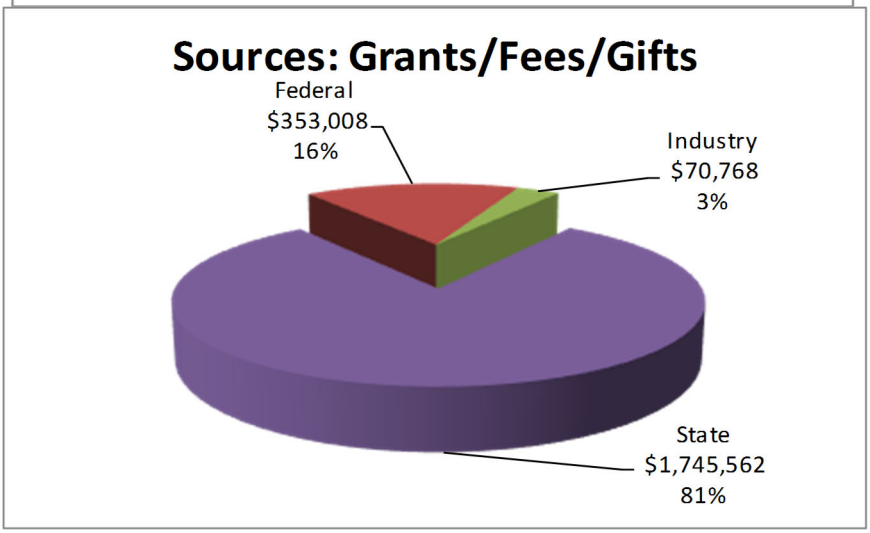






GRANTS/FEES/GIFTS
$2,169,338





University of Arkansas

The University of Arkansas was founded in 1871 under the Morrill Land-Grant Colleges Act of 1862. Originally named Arkansas Industrial University, classes began in February of 1872.

Old Main was completed in 1875, and was the primary instructional and administrative building. The first class to graduate etched their names in the sidewalk in front of Old Main, starting Senior Walk and a tradition that is still going today.

The University of Arkansas became the first major Southern public university to admit African-American student without litigation when Silas Hunt of Texarkana, an African-American veteran of World War II, was admitted to the university's School of Law in 1948. Vitamin E was co-discovered by UA Agricultural Chemistry Professor Barnett Sure (1920-51). Sure, along with fellow professor Marinus C. Kik (1927-67), made major advances in nutrition science during their tenures at the university. Along with this discovery, Sure extended knowledge of how vitamin E, amino acids, and B-vitamins function on reproduction and lactation. Kik developed the process for parboiling rice to increase retention of vitamins and shorten cooking time. Kik also documented benefits of adding fish and chicken to rice and grain diets to provide adequate protein for a growing world population.

The university has many great traditions like Senior Walk. The *UA Alma Mater* was written in 1909 by Brodie Payne and was recognized in 1931 as one of the twenty-five best college songs by the University College Song Association in New York, and at the end of the song, students and alumni always point toward Old Main. The *Arkansas Fight Song* was written in the late 1920's and is still sung at every football game. The university received the Razorback mascot in 1909 during a speech by the current football coach, Hugo Bezdek, when he referred to the team as "a wild band of Razorback hogs," and in 1910, the student body voted to change the mascot from the Cardinals to the Razorbacks. The "calling of the Hogs" began in the 1920's, when several local farmers attending a football game decided to try to help a lagging team and yelled "Woo, Pig Sooie!" The school colors are cardinal red

The Carnegie Foundation recognized the University of Arkansas as one of 108 elite research universities in the nation for 2011, one of only seven schools in the Southeastern Conference to receive this distinction.

Northwest Arkansas and the University of Arkansas were featured in the July 2013 issue of *U.S. Airways Magazine*. The 11-page section on NWA detailed the many positive impacts provided by the $1 billion Campaign for the 21st Century, one of the largest fundraising efforts by a U.S. public university, while focusing on the university's future goals.

Department of Biological & Agricultural Engineering

In 1921, the University of Arkansas activated the Department of Agricultural Engineering to teach service courses and conduct applied research. The department was housed in Gray Hall, located where Mullins Library now stands. The department moved to the old campus infirmary, nicknamed "the old agriculture building" and now called the Agriculture Annex, in 1966, and finally to its current location in Engineering Hall in 1990 after a renovation of the building originally built in the early 1900's.

The first Bachelor of Science in Agricultural Engineering was conferred in 1950, with the first Master of Science in Agricultural Engineering following in 1952. The first Ph.D. degree was conferred in 1984.

To reflect the change in the engineering field of study, the department's name was changed to Biological and Agricultural Engineering in 1988. In 1990, the B.S. and M.S. degrees were renamed to reflect the change in the curriculum and the new name of the department, and in 2002, were renamed again to Biological Engineering.

In 2003, the department received approval from the Arkansas Department of Higher Education to begin the M.S. in Biomedical Engineering program. This showed the department's continued goal of keeping up with the changes in the biological engineering research fields. The first M.S. in Biomedical Engineering was conferred in 2006.

DEPARTMENT OF BIOLOGICAL & AGRICULTURAL ENGINEERING

In 2012, the Biomedical Engineering program was separated and the revised curriculum in Biological Engineering of *"Healthy Planet Healthy People"* was designed to address the challenges in sustainable food, water and energy systems.

The Biological and Agricultural Engineering Department is housed on the second floor of the John A. White Jr. Engineering Hall. The main department office and all the faculty offices are located on the second floor. The department has use of two classrooms, two conference rooms, one computer lab, one student lab, and a study lounge.

The department also has offices and labs at the Biological and Agricultural Lab, located on North Garland Avenue, and at the Institute for Nanoscience and Engineering , located at 731 W. Dickson St.

CITY OF FAYETTEVILLE AND NORTHWEST ARKANSAS

Fayetteville is the third-largest city in Arkansas and county seat of Washington County. The city is centrally located within the county and has been home of the University of Arkansas since the institution's founding in 1871. Fayetteville is on the outskirts of the Boston Mountains, deep within the Ozarks. Known as Washington until 1829, the city was named after Fayetteville, Tennessee, from which many of the settlers had come. It was incorporated on November 3, 1836 and was rechartered in 1867. The four-county Northwest Arkansas Metropolitan Statistical Area is ranked 105th in terms of population in the United States with 463,204 in 2010 according to the United States Census Bureau. The city had a population of 73,580 at the 2010 Census.[5] At 1,400 feet of elevation, it is also one of the highest major US cites between the western Great Plains and the Appalachian Mountains.

Fayetteville is home to the University of Arkansas, the state's largest university. When classes are in session, thousands of students on campus dramatically change the city's demographics. Thousands of Arkansas Razorbacks alumni and fans travel to Fayetteville to attend football, basketball, and baseball games. The University's men's track and field program has won 41 national championships to date. Fayetteville was named the third best place to live in the United States in the 2016 U.S. News Best Places To Live Rankings, and one of the best places to retire in the South. Forbes also ranked Fayetteville as the 24th-best city for business and careers in 2016. Lonely Planet named Fayetteville among its top 20 places to visit in the South in 2016. Based in nearby Bentonville, the Walmart corporation has dominated Fayetteville's economy. The city hosts the Wal-Mart Shareholders Meetings each year at the Bud Walton Arena.

According to the 2018 census, Fayetteville has a population of 86,751 and is the third most populous city in Arkansas. It boasts a proud history, with several notable residents including authors Ellen Gilchrist (*In the Land of Dreamy Dreams*, 1981) and Donald Harrington (*The Cherry Pit*, 1965), Arkansas U.S. Senators J. William Fulbright and David Pryor, poet Miller Williams and his Grammy Award-winning songwriter daughter Lucinda, and noted architect E. Fay Jones.

The city of Fayetteville has many highlights, including the town square, where a farmer's market is held from April through November. Dickson Street is a main thoroughfare leading to the University of Arkansas and is lined with shops and restaurants. The Walton Arts Center is a professional performing arts center and hosts many national and international fine art events throughout the year.

Many industry giants consider Northwest Arkansas home. Bentonville based Wal-Mart, is the world's largest public corporation by revenue, according to the 2008 Fortune Global 500. Founded by Sam M. Walton in 1962, it is the largest private employer in the world and the fourth largest utility or commercial employer. Lowell is the home for J.B. Hunt Transport Services, Inc., one of the largest truckload transportation companies in the United States, with annual revenues of over $2 billion. Tyson Foods, Inc. is based out of Springdale and is the world's largest processor and marketer of chicken, beef, and pork.

Scholarship Recipients for 2018

Names listed in Italic are spring 2018 scholar ship Recipients the others listed are fall 2018 scholarship recipients.

Arkansas Academy of Biological & Agricultural Engineering Scholarship
Thomas Helvick
Bailey Keller
Laura Gray
Megan O'Hare

Biological & Agricultural Engineering Departmental Scholarship
Kendrick Hardaway
Natalie VonTress

Billy B. and Mildred V. Bryan Scholarship
McKenna Belcher
Kaden Belcher
Katharine Campbell
Lillie Haddock
Bailey Keller
Daisy Mota

Division of Agriculture Scholarship
Ryan Clark
Trent Woessner
Isabel Arrocha Cordovez
Issac Bertels
Kanaan Hardaway
Cady Puckett

J.A. Riggs Tractor Company Scholarship
Lillian Glaeser
Nicholas Cross
Sarah Gould
Lydia Huck
Marilyn Pharr

Xzin McNeal Scholarship
McKenna Blecher
Laura Gray
Trent Woessner
Brooke Benham
Megan Woodsworth
Gavin Heller
Wesley Jones
Michael Leppold
Mary Lawson
Taylor Butler
Juan Arguijo
Jennifer Bravo
Evan Byrd
Nicole Duncan
Wesley Jones
Mary Lawson
Angel Meneses Castillo
Thania Ramos
(David) His-Cheng Su
Chandler Trotter
Trent Woessner
Clare Yurchak
Jacob Askey
McKenzie Gillit

Joel Steel & Hardy Croxton Beaver Water District
Trent Woessner

John W & Trannye Odom White Scholarship
Natalie Von Tress
Jacob Askey

Mike & Yvonne Jones Scholarship
Lillian Glasser
Natalie VonTress
Kendrick Hardaway
McKenzie Gillit
Clare Yurchak

Graduates for 2018

Bachelor of Science in Biological Engineering

Spring 2018
Mckenna L. Belcher
Brooke Anne Benham
Seth Edward Boles
Colton E. Bryant
Linden Kay Cheek
Ryan James Clark
Ali K. Ezell
Casey Ann Gibson
Kendrick Clay Hardaway
Thomas Helvick
Rose Elizabeth Hendley
Merrisa Kendrick Jennings
Samuel Stone Lahodny
Madeline Jane Ludwig
Madison Taylor Rain McMillen
Kami A. Parmenter
Alexander Wayne Parr
Mason Christopher Puckett
Will Pape Richardson
Rachel Christine Schlais
Allison A. Sites
Jacob Alan Stanosheck
Megan Faith Woodworth

Fall 2018
Zachary Morgan Johnson
Pablo Andres Pena Cabezas

Biological Engineering Student Club

2018-2019 Officers

David Su—*President*
Kat Campbell—*Vice President*
Mason Jewell—*Treasurer*
Kira Simonson—*Secretary*
Priscila Morales —*Social Outreach Coordinator*
Wesley Wahls– *Outdoor Event Coordinator*
Advisor: Dr. Scott Osborn

The department's mission is: *Healthy Planet, Healthy People*. Biological engineers improve people's lives today and help assure a sustainable quality of life for tomorrow. They create solutions to problems by coupling living systems (human, plant, animal, environmental, food, and microbial) with the tools of engineering and biotechnology. Biological engineers improve human health; ensure a safe, nutritious food supply; and secure a healthy and safe environment. The department focuses on engineering design that promotes sustainable production, processing and management of food water and energy. A Bachelor of Science degree in biological engineering is a job-ready degree with opportunities in many industries, government agencies, and consulting firms. It is also excellent preparation for medical, veterinary, dental or other health science professional school as well as M.S. and Ph.D. studies in engineering in other areas.

Biological Engineering is an ABET accredited program leading to the B.S. degree. The M.S. and Ph.D. degrees are also offered. The curriculum is under the joint supervision of the dean of the College of Engineering and the dean of the Dale Bumpers College of Agricultural, Food and Life Sciences. The B.S. in Biological Engineering is conferred by the College of Engineering and is granted after the successful completion of 128 hours of approved course work.

The educational objective of the Biological Engineering Program at the University of Arkansas is to prepare students to successfully practice engineering involving the design and management of sustainable food, water, and energy systems.

Diverse applications of biological engineering can be pursued through elective coursework such as:

- Integrating ecological principles into the design of sustainable systems to treat, remediate, and prevent pollution to the environment. Applications include stream restoration, watershed management, water and wastewater treatment design, ecological service management, urban greenway design and enclosed ecosystem design.
- Food processing, food safety and security, biosensing and bioinstrumentation, biotechnology at the micro and nanoscale, developing new products from biomaterials, and biotransformation to synthesize industrial and pharmaceutical products.
- Sustainable design and management of finite resources with a broad perspective, local and global and cradle to grave life cycle analysis of resource utilization, and environmental impacts with a view toward long-term prosperity.

The B.S. in Biological Engineering degree can lead to careers in consulting, ecological engineering and design, environmental engineering, sustainable agriculture and food production, low impact development, water quality and watershed management, human health, biotechnology, natural resource engineering, nanotechnology, and biofuels development to name but a few.

BIOLOGICAL ENGINEERING B.S.B.E., EIGHT-SEMESTER DEGREE PROGRAM 2017-2018 COURSE CATALOG

The Bachelor of Science in Biological Engineering program is eligible for students who want to participate in an eight semester degree program. The plan below lists a semester-by-semester sequence of courses to finish the degree in eight semesters. University core courses for engineering are listed at the bottom of this page. Students may submit a maximum of four (4) hours of "D" in BENG courses for their degree. Some courses are not offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course pre-requisites.

Freshman Year	
First Semester 1 GNEG 1111 Introduction to Engineering I 3 ENGL 1013 Composition I 3 CHEM 1103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture 4 MATH 2554 Calculus I (ACTS Equivalency = MATH 2405) 4 PHYS 2054 University Physics I (ACTS Equivalency = PHYS 2034)	**Second Semester** 1 GNEG 1121 Introduction to Engineering II 3 ENGL 1033 Technical Composition or 1023 Technical Composition II 4 First-Year Engineering Science Electives * 4 MATH 2564 Calculus II (ACTS Equivalency = MATH 2505) 3 U.S. History Requirement **(15 Semester hours)**
Sophomore Year	
First Semester 2 BENG 2632 Biological Engr Design Studio 4 MATH 2574 Calculus III (ACTS Equivalency = MATH 2603) 4 Sophomore Science Electives ** 4 BIOL 1543/1541L Principles of Biology and Lab 3 MEEG 2003 Statics	**Second Semester** 3 BENG 2643 Biological Engineering Design Methods 4 MATH 2584 Differential Equations 4 BIOL 2013/2011L General Microbiology w/Lab 3 MEEG 2403 Thermodynamics (OR CHEG 2313) 3 Humanities/Social Science Electives **(17 Semester hours)**
Junior Year	
First Semester 3 BENG 3653 Global Bio-Energy Engineering 3 BENG 3663 Biological Engineering Methods II 3 BENG 3733 Transport Phenomena in Biological Systems 4 CHEM 3603/3601L Organic Chemistry I w/Lab or CHEM 2613/2611L Organic Physiological Chemistry w/Lab 3 CVEG 3213, Hydraulics (OR MEEG 3503 OR CHEG 2133) **(16 Semester hours)**	**Second Semester** 3 BENG 3723 Unit Operations in Biological Engr 3 BENG 3113 Measurements and Controls for Biological Systems 3 BIOL 3863 General Ecology 3 CVEG 3223 Hydrology 3 Technical Elective **(15 Semester hours)**
Senior Year	
First Semester 2 BENG 4812 Senior Biological Engineering Design I 1 BENG 4831 Biological Engineering Professionalism 3 BENG 4743, Food and Bio-Product Systems Engineering 3 BENG 4933 Sustainable Watershed Engineering 3 Humanities/Social Science Electives 3 Humanities/Social Science Electives **(15 Semester hours)**	**Second Semester** 3 BENG 4823 Senior Biological Engineering Design II 3 BENG 4663 Sustainable Biosystems Design 3 Engineering Electives 3 Fine Arts Electives (from University/State core list) 3 Humanities/Social Science Electives 3 Technical Electives **(18 Semester hours)**

* The First-Year Engineering Science Elective must be chosen from either CHEM 1123/1121L or PHYS 2074.
** The Sophomore Science Elective must be: PHYS 2074 if CHEM 1123/1121L was chosen as the First-Year Engineering Elective; or CHEM

MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY IN BIOLOGICAL ENGINEERING

FOREWORD

The Department of Biological and Agricultural Engineering desires that each graduate student receives a broad and comprehensive educational experience. This experience includes social as well as intellectual development to lead students to an increased level of maturity. Certainly, coursework is primary, but social activities—the exploration of the unknown and the exchange of ideas with fellow students and faculty—are also part of the total educational experience.

An additional part of this development process occurs through service to others. Students are encouraged to become involved in all departmental functions including teaching, research, extension, and social activities so that they may obtain the best possible education.

The core of graduate education lies in obtaining technical expertise in an area of specialization. Specifically, the objectives of the Master's and Ph.D. engineering graduate program are for students to:

- Develop the ability to comprehend and apply engineering principles in order to solve problems in research, development and design.
- Obtain sufficient understanding of the mathematical, physical and biological sciences for comprehension of literature in these and related fields.
- Acquire the skills required to use appropriate equipment, including instruments and computers, in solving problems in their areas of interest.
- Achieve the technical competence necessary to teach college-level courses and conduct an adult education program (such as in Cooperative Extension).

In the attainment of the above objectives, graduate students will combine biological or biomedical engineering courses with other engineering fields, the physical sciences, mathematics, statistics and the biological sciences in developing their program of study. The advanced degrees are primarily research degrees awarded for significant creative research or design accomplishment, and not for the completion of a specified number of courses. Therefore, a student's program concentration is on a significant thesis or dissertation problem completed under the supervision of members of the graduate faculty. This complements a program of strong course support to properly address the thesis or dissertation problem.

ADMISSION REQUIREMENTS

In general, admission to the Department of Biological and Agricultural Engineering graduate program is a three-step process. First, the prospective student must be admitted to graduate standing by the University of Arkansas Graduate School. Second, the student must be accepted into the department's program, which depends on transcripts, recommendations, a statement of purpose, and the following GPA and test scores.

A. Students with an ABET-Accredited or equivalent Engineering Degree

- Students to a M.S. program from a B.S. degree in engineering or to a Ph.D. program from a B.S. degree in engineering and a M.S. degree:
    1. A score of 301 (1100 for the tests taken prior to August 1, 2011) or above (verbal and quantitative) on the Graduate Record Examination (GRE).
    2. A TOEFL score of at least 550 (paper-based) or 213 (computer-based) or 80 (Internet-based). This requirement is waived for applicants whose native language is English or who earn a Bachelor's or Master's degree from a U.S. institution.
    3. GPA of 3.00 or higher on the last 60 hours of a B.S. degree or B.S. and/or M.S. degrees.
    4. B.S. degree in engineering from an ABET (Accreditation Board for Engineering and Technology) accredited or equivalent.
- Students to Ph.D. program directly from a B.S. degree in engineering:
    1. A score of 307 (1200 for the tests taken prior to August 1, 2011) or above (verbal and quantitative) on the GRE.
    2. A TOEFL score of at least 550 (paper-based) or 213 (computer-based) or 80 (internet-based). This requirement is waived for applicants whose native language is English or who earn a Bachelor's or Master's degree from a U.S. institution.
    3. A cumulative GPA of 3.5 or above for undergraduate work.
    4. B.S. degree in engineering from an ABET accredited program or equivalent.

- Students to a M.S. program from a non-engineering B.S. degree:

    1. A score of 301 (1100 for the tests taken prior to August 1, 2011) or above (verbal and quantitative) on the GRE.
    2. A TOEFL score of at least 550 (paper-based) or 2013 (computer-based) or 80 (internet-based). This requirement is waived for applicants whose native language is English or who earn a Bachelor's or Master's degree from a U.S. institution.
    3. GPA of 3.00 or higher on the last 60 hours of a B.S. degree.
    4. Completion of 18 hours of engineering course work (listed below under Degree Requirements). Also see additional information below under the Admission Requirements for Master of Science in Biological Engineering.

- Students to a Ph.D. program from non-engineering B.S. plus M.S. degrees:

    1. A score of 301 (1100 for the tests taken prior to August 1 , 2011 or above (verbal and quantitative) on the GRE.
    2. A TOEFL score of at least 550 (paper-based) or 213 (computer-based) or 80 (internet-based). This requirement is waived for applicants whose native language is English or who earn a Bachelor's or Master's degree from a U.S. institution.
    3. GPA of 3.00 or higher on the last 60 hours of B.S. and/or M.S. degrees.
    4. Completion of 18 hours of engineering course work (listed below under Degree Requirements). Also see additional information below under the Admission Requirements for Doctor of Philosophy in Biological Engineering.

- Students to a Ph.D. program directly from a non -engineering B.S. degree:

    1. A score of 307 (1200 for the tests taken prior to August 1, 2011) or above (verbal and quantitative) with 155 (700 for the tests taken prior to August 1, 2011) and 4.5 or above in writing on the GRE
    2. A TOEFL score of at least 580 (paper-based) or 237 (computer-based) or 92 (Internet-based). This requirement is waived for applicants whose native language is English or who earn a Bachelor's or Master's degree from a U.S. institution.
    3. A cumulative GPA of 3.5 or above for undergraduate work.
    4. Completion of 18 hours of engineering course work (listed below under Degree Requirements). Also see additional information below under the Admission Requirements for Doctor of Philosophy in Biological Engineering.

Finally, a member of the faculty who is eligible (graduate status of group II or higher) must agree to serve as major advisor to the prospective student.

Details concerning admission for both international and domestic students are provided in the University's Graduate School Handbook.

Graduate Students

The following students were part of the Graduate program during 2018. Several students cannot be listed due to limitations of the Family Educational Rights and Privacy Act (FERPA). Faculty advisors provided support and planning to the students throughout their career in the Department of Biological and Agricultural Engineering.

Master of Science in Biological Engineering

Student	Advisor
Josef Dalaeli	Dr. G. Scott Osborn
Christian Heymsfield	Dr. Yi Liang
Jacob Hickman	Dr. Marty Matlock
Vaishali Kandapal	Dr. Chris Henry
Deanna Mantooth	Dr. Marty Matlock
Angelica Makuch	Dr. Marty Matlock
Dominic A. Romero	Dr. Jin-Woo Kim
Andrew Shaw	Dr. Marty Matlock
Slater Smith	Dr. Brain Haggard
America Sotero	Dr. Yanbin Li
Brandon Taylor	Dr. Marty Matlock
Summer Wilkie	Dr. Marty Matlock

Master of Science in Microelectronics –Photonics

Student	Advisor
Mahshid Imiparast	Dr. Jin-Woo Kim

Doctor of Philosophy in Biological Engineering

Student	Advisor
Prathamesh Bandekar	Dr. Marty Matlock
Zachary Callaway	Dr. Yanbin Li
Eric Cummings	Dr. Marty Matlock
Gurshagan Kandhola	Jin-Woo Kim

Doctor of Philosophy in Biological Engineering

Student	Advisor
Abbie Lasater	Dr. Brian Haggard
Kaushik Luthra	Dr. Sammy Sadaka
James McCarty	Dr. Marty Matlock
Colby Reavis	Dr. Benjamin Runkle
Sepideh Tavakoli	Dr. Jin-Woo Kim
Xinge Xi	Dr. Yanbin Li

Doctor of Philosophy in Cell and Molecular Biology

Student	Advisor
Joseph N. Batta-Mpouma	Dr. Jin-Woo Kim
Cody Chivers	Dr. Jin-Woo Kim
Xiaofan Yu	Dr. Yanbin Li

Doctor of Philosophy in Poultry Science

Student	Advisor
Wenqian Wang	Dr. Yanbin Li

Graduate Degrees Earned

The following students completed all requirements for their degree program and were awarded a degree from the University of Arkansas.

SPRING 2018
Christian Heymsfield MSBE
Jay Mishra MSBE

SUMMER 2018
Vaishali Kandpal MSBE

GRADUATE STUDENT ADVISEES IN OTHER AREAS

The following students are participating in other programs across the university with a member of the department's faculty serving in an advising role. Several students cannot be listed due to limitations of the Family Educational Rights and Privacy Act (FERPA).

STUDENT	PROGRAM	ADVISOR
Jacob Alberti	Master Science Engineering	Dr. Otto J. Loewer
Joshua Blackstock	PhD Geosciences	Dr. Benjamin Runkle
Lulu Cao	Master Science Zhejiang University	Dr. Yanbin Li
Christopher Carr	Maters Science Engineering	Dr. Otto J. Loewer
Huang Dai	PhD Zhejiang University	Dr. Yanbin Li
John Deurpinghaus	Masters Industrial Engineering	Dr. Benjamin Runkle
Luke Dinkledine	Master Science Engineering	Dr. Otto J. Loewer
Dean Dronen	Master Science Engineering	Dr. Otto J. Loewer
Tyler Fochtman	Master Science Computer Science	Dr. Jin-Woo Kim
William Garrahan	Master Science Engineering	Dr. Otto J. Loewer
Yawen He	Master Science Zhejiang University	Dr. Yanbin Li
Jeffrey Henson	Master Science Biomedical Engineering	Dr. Jin-Woo Kim
Jacob Hickman	Master Science Environmental Engineering	Dr. Marty Matlock
Josh Humphreys	PhD Crop Soil & Environmental Sciences	Dr. Benjamin Runkle
Zhishang Li	PhD Zhejiang University	Dr. Yanbin Li
Aoming Liang	Masters of Science Zhejiang University	Dr. Yanbin Li
Bo Ma	PhD Microelectronics-Phontonics	Dr. Jin-Woo Kim
Shelly Maddox	PhD Mechanical Engineering	Dr. Jin-Woo Kim
Jacob Marsh	Master Science Engineering	Dr. Otto J. Loewer
Sangeeta Mukhopadhyay	PhD Food Science	Dr. Scott Osborn
Haiying Pang	Master Of Science Zhejiang University	Dr. Yanbin Li
Leigh Parette	PhD Poultry Science	Dr. Yanbin Li
Joseph Parker	Master Science Engineering	Dr. Otto J. Loewer
Alexander Plumb	Master Science Engineering	Dr. Otto J. Loewer
Zahohui Qiao	PhD Zhejiang University	Dr. Yanbin Li
Francia Ravelombola	PhD Crop, Soil and Environmental Sciences	Dr. Chris Henry
Jacob Reed	Master Science Engineering	Dr. Otto J. Loewer
Trent Rodgers	PhD Computer Science and Computer Engineering	Dr. Jin-Woo Kim
Savanna Royals	Master Science Engineering	Dr. Otto J. Loewer
Bradley Silfies	Master Science Engineering	Dr. Oto J. Loewer
Yafang Shen	PhD Zhejiang University	Dr. Yanbin Li
Xiangning Xiao	PhD Zhejiang University	Dr. Yanbin Li
Xiaofan Yu	PhD Cell and Molecular Biology	Dr. Yanbin Li
Qi Zhang	PhD Zhejiang University	Dr. Yanbin Li

The following courses are taught as part of the Biological & Agricultural Engineering curriculum for the Undergraduate, Master's, and Ph.D. programs.

BENG 2632 Biological Engineering Design Studio (Fa) Application of the engineering design process to projects involving living systems. Projects are team-based open-ended design with hands-on construction and testing of design prototypes. Emphasis is placed on understanding, quantifying and controlling complex interacting living systems involving humans, animals, plants and microbes with the goal of creating economically and ecologically sustainable systems. 4 hours of design studio per week. Pre- or Corequisite: PHYS 2054 and BIOL 1543/1541L, and (GNEG 1111 or GNEG 1103).

BENG 2643 Biological Engineering Methods (Sp) Introduction to the tools needed to perform biological engineering design, integrated through projects in the food, energy and/or water area. The tools covered include structured programming language for modeling, statistical analysis, geographic information systems, engineering graphics, and engineering economics. Two hours of lecture and three hours of lab per week. Corequisite: Lab component. Prerequisite: BENG 2632.

BENG 3113 Measurement and Control for Biological Systems (Sp) Principles of sensors, instruments, measurements, controls, and data acquisition systems, with emphasis on applications for biological systems; including basic circuit analysis, sensor calibration and hardware selection. Basic process monitoring and control methods, including hardware and software. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: EPHYS 2054.

BENG 3113H Honors Measurement and Control for Biological Systems (Sp) Principles of sensors, instruments, measurements, controls, and data acquisition systems, with emphasis on applications for biological systems; including basic circuit analysis, sensor calibration and hardware selection. Basic process monitoring and control methods, including hardware and software. Lecture 2 hours, laboratory 3 hours per week. Corequiste: Lab component: Prerequistie: PHYS 2074 and honors candidacy.

BENG 3653 Global Bio-Energy Engineering (Fa) Global energy sources with a focus on renewable energy, solar and biomass derived fuels. Biomass energy production from crops and organic residues or waste products. Conversion of biomass to usable fuels. Utilization of renewable energy in society. Includes detailed systems analyses to examine inputs, efficiencies, usable outputs and by-products. Systems design to select and integrate components which meet client needs while maximizing sustainable global impacts. Three hours of lecture per week. Pre- or Corequisite: BENG 2643 and (MEEG 2403 or CHEG 2313).

BENG 3663. Biological Engineering Methods II (Fa). 3 Hours.
Modeling biological processes to predict system behavior as part of the design process. Development and use of spreadsheets and script programming code to represent biological phenomena and processes. Introduction to experimental design as applied to biological processes, including data collection and analysis, and elementary statistics. Use of engineering economics to aid comparisons of alternatives. Analysis of engineering designs and management practices to best meet the needs of society and the client in areas of sustainable water, food and energy systems.
Lecture 3 hours per week. Prerequisite: PHYS 2054 and MATH 2564.

BENG 3723 Unit Operations in Biological Engineering (Sp) Design of basic unit operations typical of biological engineering practice; unit operations include pump-pipe, fan-duct, moist air (psychrometric) processes (cool/heater/humidifier/dryer), air mixing, aeration, and refrigeration; unit operations design will account for unique constraints imposed by biological systems. Lecture 2 hours and lab 3 hours per week. Corequisite: Lab component. Prerequisite: (MEEG 2403 or CHEG 2313) and (CVEG 3213 or CHEG 2133 or MEEG 3503).

BENG 3733 Transport Phenomena in Biological Systems (Fa) Basic principles governing transport of energy and mass. Estimating transfer of energy (heat) through solid bodies and liquid/gas boundary layers through conduction, convection, and radiation. Modeling the rates at which biological reactions occur (kinetics). Estimating the transfer of diffusing mass (gas or liquid) through solid bodies and liquid/gas boundary layers, including processes such as drying and oxygen diffusion. Three hours lecture per week. Pre- or Corequisite: (CVEG 3213 or MEEG 3503 or CHEG 2133.) Prerequisite: (MEEG 2403 or CHEG 2313) and MATH 2584.

BENG 4123 Biosensors & Bioinstrumentation (Odd years, Sp) Principles of biologically based sensing elements and interfacing techniques. Design and analysis methods of biosensing and transducing components in bioinstrumentation. Applications of biosensors and bioinstrumentation in bioprocessing, bioenvironmental, biomechanical and biomedical engineering. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: BIOL 2013 or BIOL 2533 and BENG 3113.

BENG 450V Special Problems (Sp, Su, Fa) Selected problems in biological engineering are pursued in detail. Prerequisite: senior standing. May be repeated for up to 4 hours of degree credit.

BENG 451VH Honors Thesis (Sp, Su, Fa) Prerequisite: Honors candidacy.

BENG 452V Special Topics in Biological Engineering (Irregular) Special topics in biological engineering not covered in other courses. May be repeated for up to 8 hours of degree credit.

BENG 4663 Sustainable Biosystems Designs (Fa) Process and methodologies associated with measuring, assessing, and designing sustainable systems in water, energy and food. Quantitatively rigorous methodology for life cycle analysis (LCA) for inventory, assessment and impact analyses. Use of other systems analyses and process control theory to evaluate and design sustainable systems. Application of the methods to a project to gain experience in defining, quantifying and utilizing sustainable metrics. Three hours of lecture per week. Prerequisite: BENG 3653.

BENG 4703 Biotechnology Engineering (Fa) Introduction to biotechnology topics ranging from principles of microbial growth, mas balances, bioprocess engineering as well as emerging principles in the design of biologically based microbial and enzymatic production systems. Application areas such as biofuels, and fine and bulk chemical production. Lecture 2 hours, laboratory 3 hours per week. Prerequisite: BENG 2632. Corequisite: Lab component.

BENG 4743 Food and Bio-Product Systems Engineering (Fa) Sustainable bio-product engineering through biosystem design, analysis, modeling, control, and optimization. Life cycle phases for bio-products (food, fiber, feed, and fuel). System analysis of inputs and outputs of energy, water and mass for the purpose of producing and processing biomass for human uses. Advanced bioprocess design topics to utilize enzymes, cells, tissues and organisms to create bio-products and methods for deactivating biological agents to preserve the quality and safety of food and other bio-products. Three hours lecture per week. Prerequisite: BENG 3723 and BENG 3733.

BENG 4753L Nanotechnology Laboratory (Fa) Provides students with hands-on experience in several major areas of nanotechnology, including nanoscale imaging, synthesis of nanomaterials, nanostructure assembly and manipulation, device and system integration, and performance evaluation. Students can earn credit for only one of the following courses: MEEG 4323L, BENG 4753L, BMEG 4103L, CHEM 4153L, PHYS 4793L. Corequisite: Drill component, junior standing and instructor consent. Prerequisite: MATH 2564, PHYS 2074, CHEM 1123, or CHEM 1133.

This course is cross-listed with MEEG 4323L, CHEM 4153L, PHYS 4793L.

BENG 4753M Honors Nanotechnology Laboratory (Fa) Provides students with hands-on experience in several major areas of nanotechnology, including nanoscale imaging, synthesis of nanomaterials, nanostructure assembly and manipulation, device and system integration, and performance evaluation. Students can earn credit for only one of the following courses: MEEG 4323L, BENG 4753L, BMEG 4103L, CHEM 4153L, PHYS 4793L. Corequisite: Drill component, junior standing and instructor consent. Prerequisite: MATH 2564, PHYS 2074, CHEM 1123, or CHEM 1133.

This course is cross-listed with MEEG 4323L, CHEM 4153L, PHYS 4793L.

BENG 4812 Senior Biological Engineering Design I (Fa) Initiation of comprehensive two-semester team-design projects to design processes, devices and systems to meet needs of clients in sustainable water, food and energy. Practice in following the design process, including the definition of design objectives and constraints, establishing functions and performance criteria, generating alternatives and evaluating alternatives through analysis, modeling and prototype testing; exploring relevant design considerations including performance, efficiency, costs, environmental impacts, sustainability and stewardship, safety and ethics. Developing analytic capability; and practicing design optimization to find best alternative for the

client. Lecture 1 hour, laboratory 3 hours per week. Prerequisite: Instructor consent. Corequisite: Lab component.

BENG 4823 Senior Biological Engineering Design II (Sp) Completion of comprehensive two-semester team-design projects to design processes, devices and systems to meet needs of clients in sustainable water, food and energy. Focus on building of prototypes or models, system optimization, evaluation and improvement. Final design details packaged to meet the needs of the client. Interaction with appropriate persons from other disciplines.Written and oral reporting. Communications with peers, supervisor, clients and the public. Lecture 1 hour per week, two 2-hour lab periods per week. Prerequisite: BENG 4812. Corequisite: Lab component.

BENG 4831. Biological Engineering Professionalism (Fa). Preparation to be job-ready, employable and successful in transition to a professional career and further study in Biological Engineering. Introduction to job and graduate study searches. Professional and ethical responsibilities; professional registration. Conflict, change and project management. Effective communications and interactions with supervisors, peers, clients, and stakeholders. Two hour discussion section per week. Prerequisite: Senior standing.

BENG 4933 Sustainable Watershed Engineering (Sp) Provides students with expertise in using advanced tools in watershed monitoring, assessment, and design. Builds on core competencies in hydrology and hydraulics to allow student to evaluate water used by sector in water management regions; evaluate and quantify water demands by sector with emphasis on irrigation; develop risk-based simulations of hydrologic processes, including precipitation, evapo-transportation, infiltration, runoff, and stream flow; quantify and simulate constituent loading to watersheds using GIS-based models, and understand the applications of these methods in water resource management policy. Three hours lecture per week. Prerequisite: CVEG 3223

BENG 500V Advanced Topics in Biological Engineering (Irregular) (1-6) Special problems in fundamental and applied research. Prerequisite: Graduate standing. May be repeated for up to 6 hours of degree credit.

BENG 5103 Advanced Instrumentation in Biological Engineering (Even years, Sp) Applications of advanced instrumentation in biological systems. Emphasis on updated sensing and transducing technologies,dataacquisition and analytical instruments. Lecture 2 hours, lab 3 hours per week. Corequisite: Lab component. Prerequisite: BENG 3113.

BENG 5253 Bio-Mems (Irregular) Topics include the fundamental principles of microfluidics, Navier-Stokes Equation, bio/abio interfacing technology, bio/abio hybrid integration of microfabrication technology, and various biomedical and biological problems that can be addressed with microfabrication technology and the engineering challenges associated with it. Lecture 3 hour per week. Prerequisite: MEEG 3503 or CVEG 3213 or CHEG 2133. (Same as MEEG 5253)

BENG 5303 Fundamentals of Biomass Conversion (Fa) Web-based overview of the technology involved in the conversion of biomass to energy, including associated sustainability issues. Overview of biomass structure and chemical composition; biochemical and thermochemical conversion platforms; issues, such as energy crop production related to water consumption and soil conservation. Further topics include: biomass chemistry, logistics and resources; biological processes; and thermochemical processes. Two web-based lectures/meetings per week. Prerequisite: Graduate standing or instructor consent.

BENG 5313 Fundamentals of Bioprocessing (Sp) This course covers the fundamentals of mass and energy balances, fluid dynamics, heat and mass transfer, as applied to Bioprocessing. The microbial growth, kinetics and fermenter operation as applicable to Bioprocessing will be covered in this course. Industrial Bioprocessing case studies that involve the integration of the course contents will be discussed. This course is offered on-line in collaboration with the AG*IDEA consortium of land grant universities. The principal instructor will be a non -UA faculty member at a participating university. Prerequisite: MATH 2554, CHEM 3813, and PHYS 2054.

BENG 5323 Bioseparations (Even years, Sp) Study of separations important in food and biochemical engineering such as leaching, extraction, expression, absorption, ion exchange, filtration, centrifugation, membrane separation, and chromatographic separations. This course is offered on-line in collaboration with the AG*IDEA consortium of land grant universities. The principal instructor will be a non-UA faculty member at a participating university. Prerequisite: Instructor Consent.

BENG 5333 Biochemical Engineering (Odd years, Sp) The analysis and design of biochemical processing systems with emphasis on fermentation kinetics, continuous fermentations, aeration, agitation, scale up, sterilization, and control. This course is offered on-line in collaboration with the AG*IDEA consortium of land grant universities. The principal instructor will be a non-UA faculty member at a participating university. Prerequisite: Instructor Consent Required.

BENG 5343 Advanced Biomass Thermochemical Conversion (Odd years, Fa) Advanced study, evaluation, and application of thermochemical conversion pathways in biofuel production. Specific topics include biomass gasification, pyrolysis, liquefaction, and heterogeneous catalysts. This course is offered on-line in collaboration with the AG*IDEA consortium of land grant universities. The principal instructor will be a non-UA faculty member at a participating university. Prerequisite: Instructor Consent.

BENG 5351 Sustainability Seminar (Su) Topics in environmental sustainability, green engineering, life cycle analysis, sustainable development and sustainability science. This course is offered on-line in collaboration with the AG*IDEA consortium of land grant universities. The principal instructor will be a non -UA faculty member at a participating university. Prerequisite: CHEM 1123.

BENG 5613 Simulation Modeling of Biological Systems (Irregular) Application of computer modeling and simulation of discrete-event and continuous-time systems to solve biological and agricultural engineering problems. Philosophy and ethics of representing complex processes in simplified form. Deterministic and stochastic modeling of complex systems, algorithm development, application limits, and simulation interpretation. Emphasis on calibration, validation and testing of biological systems models for the purposes of system optimization, resource allocation, real-time control and/or conceptual understanding. Prerequisite: AGST 4023 or STAT 4003 or INEG 2313.

BENG 5623 Life Cycle Assessment (Sp) This course will examine the process and methodologies associated with life cycle analysis (LCA). The course will explore the quantitatively rigorous methodology for life cycle inventory (LCI), LCA and life cycle impact assessment (LCIA). This course is offered on-line. The principal instructor will be a UA faculty member.

BENG 5633 Linkages Among Technology, Economics and Societal Values (Sp, Fa) Addresses how macro-level change is influenced by the linkages among technology, economics and societal values. Three major course initiatives: 1) Developing a conceptual model for understanding how macro-level change has occurred over history; 2) Examining recorded history in order to develop a contextual appreciation for Society's current situation; and 3) Using statistical data to identify six overriding world trends that are likely to greatly impact society's goal of achieving sustainable prosperity and well-being in the foreseeable future. Prerequisite: Graduate standing or instructor permission. (Same as OMGT 5633)

BENG 5703 Design and Analysis of Experiments for Engineering Research (Irregular) Principles of planning and design of experiments for engineering research. Propagation of experimental error. Improving precision of experiments. Analysis of experimental data for optimal design and control of engineering systems using computer techniques. Students must have an introductory background in statistics. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component.

BENG 5723 Food Safety Engineering (Even years, Fa) Principles of engineering methods applied to food and safety and sanitation. Principles of engineering methods applied to food safety and security. Discussion of thermal, chemical and electrical pasteurization or sterilization in food processing. Demonstration of monitoring and detecting techniques for food safety, including image analysis, biosensors and modeling. Lecture 3 hours per week. Prerequisite: BENG 4103 and FDSC 4123 (or equivalent).

BENG 5733 Advanced Biotechnology Engineering (Odd years, Fa) Applications of the principles of bioprocess/biochemical engineering to microbiological and biomedical problems. Topics include applied enzymology, metabolic engineering, molecular genetics and control, and bioinformatics and nanobiotechnology in addition to classical applied enzyme and cell-growth kinetics and advanced bioreactor design. Prerequisite: BENG 3733 or BENG 4703 or BENG 5743 or equivalent.

BENG 5743 Biotechnology Engineering (Fa) Introduction to biotechnology topics ranging from principles of microbial growth, mass balances, bioprocess engineering as well as emerging principles in the design of bio-

logically based microbial and enzymatic production systems. Application areas such as biofuels, and fine and bulk chemical production. Lecture 2 hours, laboratory 3 hours per week. Students may not earn credit for both BENG 5743 and BENG 4703. Prerequisite: Graduate standing. Corequisite: Lab component.

BENG 5801 Graduate Seminar (Sp) Reports presented by graduate students on topics dealing with current research in biological engineering. Prerequisite: Graduate standing.

BENG 5923 Nonpoint Source Pollution Control and Modeling (Irregular) Control of hydrologic, meteorologic, and land use factors on nonpoint source (NPS) pollution in urban and agricultural watersheds. Discussion of water quality models to develop NPS pollution control plans and total maximum daily loads (TMDLs), with consideration of model calibration, validation, and uncertainty analysis. Prerequisite: BENG 4903 or CVEG 3223.

BENG 5933 Environmental and Ecological Risk Assessment (Sp) Process and methodologies associated with human-environmental and ecological risk assessments. Environmental risk assessments based on human receptors as endpoints, addressing predominantly abiotic processes. Ecological risk assessments based on non-human receptors as endpoints. Approach using hazard definition, effects assessment, risk estimation, and risk management. Application of methods to student projects to gain experience in defining and quantifying uncertainty associated with human perturbation, management and restoration of environmental and ecological processes.

BENG 5953 Ecological Engineering Design (Fa) Design of low impact development techniques to enhance ecological services, reduce peak runoff, and capture sediments, nutrients and other pollutants resulting from urban development. Techniques may include: bio-swales, retention basins, filter strips. Design of sustainable ecological processes for the treatment and utilization of wastes/residues. Techniques may include: direct land application to soils/crops, composting systems, lagoons and constructed wetlands. Design goals include optimization of ecological services to maintain designated uses of land, water and air; including enhancement of habitat for wildlife and recreation, and the discovery of economically viable methods for co-existence of urban and agricultural land uses. Lecture 3 hours per week. Students may not earn credit for both BENG 5953 and BENG 4923. Prerequisite: BENG 4903 or equivalent.

BENG 600V Master's Thesis (Sp, Su, Fa) (1-6) Graduate standing required for enrollment.

BENG 700V Doctoral Dissertation (Sp, Su, Fa) (1-18) Candidacy is required for enrollment.

Student Field Industry Tour FALL 2018

Salina Pumped Storage Facility, Salina, OK

Bergey Windpower, Norman,

Bergey Windpower, Norman, OK

The Gathering Place (park) in Tulsa, Ok

Bergey Windpower, Norman, OK

Faculty Research & Extension Projects

We are engaged in research and extension programs which contribute to improving the quality of life, security, economic development, and environmental stewardship for Arkansas and the world. Our engineering expertise is uniquely qualified to solve problems in food, water and energy systems. Biological and agricultural engineers utilize the engineering tools of systems analysis and design to solve complex problems in biological systems, ranging from microbes to the global environment. Our goal is to design sustainable systems that meet our present needs while enhancing the ability of future generations to meet their needs.

Our faculty provide leadership and expertise in several centers and organizations across the university, including:

- Water Resources Center
- Office of Sustainability
- Center for Agricultural and Rural Sustainability
- Watershed Research and Education Center
- Society of Women Engineers (SWE)
- Advancement of Women in Academic Science and Engineering Careers (ADVANCE)
- Bioenergy Consortium
- Institute for Nanoscience and Engineering
- Poultry Center of Excellence
- Community Design Center
- Center for Advanced Spatial Technologies
- Interdisciplinary graduate programs in Cell and Molecular Biology, Microelectronics and Photonics, Public Policy and Environmental Dynamics

The Biological and Agricultural Engineering research program is engaged in designing a sustainable future through innovation in interdisciplinary research in water, food and energy systems.

- Water systems include: watershed ecosystem services, stream bank, lake, and reservoir restoration and management, ecological engineering design, water resources, water quality and non-point source pollution management, watershed modeling and monitoring, irrigation technologies, water management at watershed and ecosystems scales, metrics for sustainable water management, and low-impact development.
- Food Systems include: food safety, bio-sensing technology, food and bio-processing, bio-products utilization, microbial risk assessment, antimicrobial technologies, nano-biotechnology, bio/abio interfacing, phytochemical extraction, and bio-driven nanostructures.
- Energy systems include: biomass production and post-harvest engineering, energy use at farm level, bio-refineries, thermo-chemical conversion of biomass and by-products, extraction of co-products, pretreatment of feed stock, farm-scale thermochemical reactors, bio-conversion and bio-processing, bio-products, equipment, poultry/animal housing energy efficiency, and energy effectiveness analysis.

Research areas of the Biological and Agricultural Engineering Department

- **Agricultural and Food Engineering**: Faculty in this area are developing more efficient and sustainable ways to produce food for a growing population. They are investigating ways to improve practices in several agricultural industries, including on-farm grain drying for transportation costs reduction, on-farm utilization of agricultural residues for biofuel and bioenergy production, space-heating poultry houses using renewable fuels, aerial emissions and mitigation from poultry housing, indoor air quality and environmental control, risk assessment of microbial hazards in poultry and food processing, predictive models of pathogenic bacteria in food products, value-added products production from agricultural renewable resources for bio-energy and chemicals, production of algae as a biofuel feedstock, livestock and poultry manure management, and applications of site-specific and geospatial technologies in food production systems.

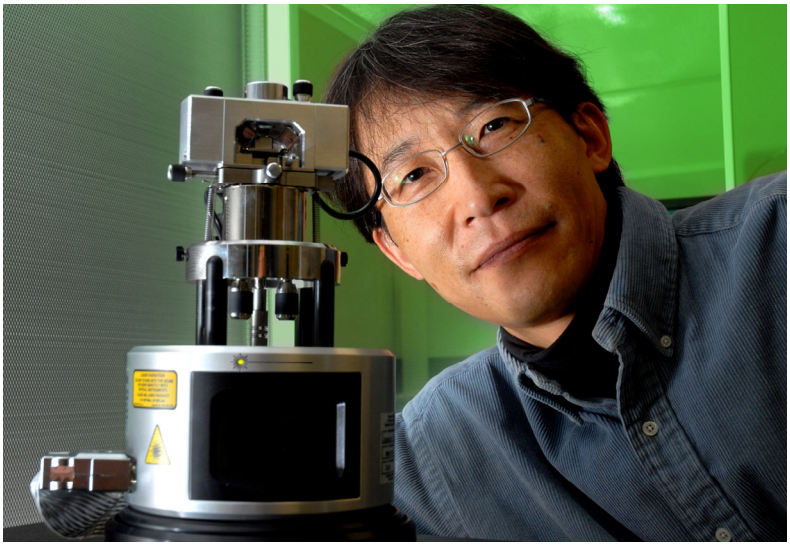
- **Biotechnology Engineering**: Faculty in this area design systems utilizing engineering tools with life sciences. Examples of biotechnology engineering include biosensors and bioinstrumentation for foodborne pathogens, avian influenza in poultry and food safety. Bio-nanotechnology for DNA-computing, nano-building block toolboxes (nano-toolboxes) for multifunctional nanocomposites with "customizable" shapes and functions, nano-therapeutics and diagnostics (nanotheranostics) with nanoparticles and nanocomposites, multimodal, multiplex, multicolor bio-detection platform for agriculture, food safety and biosecurity, bio-driven nanostructure self-assembly, nanoscale bio/abio interfacing technology, and nucleic acid technology for molecular computation, genomics and proteomics.

- **Ecological Engineering and Water Resources**: Faculty in this area combine the science of ecology with the practice of engineering to solve complex ecosystem problems. These solutions include designing systems to restore lakes, disinfect water, remove nutrients and contaminants, repair eutrophic reservoirs, and monitor water quality. Studies are conducted on agricultural and urban Best Management Practices and efficiencies, water quality management and trends, stream restoration, eco-hydrology, ecological risk assessment, designing water risk protocols for governments and industries under climate change scenarios, non-point source pollution engineering, water quality impacts of row crop irrigated agriculture in Arkansas, irrigation scheduling, water resource development, irrigation system technology development and alternative irrigation systems, crop water use, chemigation, irrigation scheduling, pumping plant performance and irrigation energy use.

- **Sustainability and Green Engineering**: Sustainability concerns inform all the areas of biological and agricultural engineering. Researchers in this department are using lifecycle assessment of agricultural, urban and supply chain systems, designing sustainable global food supply systems, devising corporate strategies for risk reduction and management, and reducing environmental impacts. Impacts of climate change are being studied by evaluating evapotranspiration, surface water nutrient fluxes and source partitioning, land-atmosphere exchange of carbon-dioxide, methane and water vapor, and wetlands eco-hydrology in agricultural practices. Researchers are also collaborating with national and international organizations to develop industry standards and contribute to the global conversation about sustainability.

Biological and Agricultural Engineering extension programs offer information and skill-development to assist Arkansans in maintaining and improving their access to sustainable food, water and energy systems. Our programs provide a biological and systems perspective to the state-wide extension team. Expertise exists in nutrient management, design and practices for animal manure management; farm safety, grain drying, storage and handling, web and mobile-device information delivery, modeling of watersheds, climate-change variables, and biomass resources; irrigation, water use efficiency, air-emission quantification for control and mitigation of air-pollution, poultry-house indoor air-quality; poultry farm energy efficiency, thermal energy-conversion, and residential energy conservation and efficiency.

Dr. Benjamin Runkle at Chris Isbell's rice field, three miles south of Bayou Meto conducting research on reducing Rice's Carbon Footprint. The tower, 12-feet tall and supported by tripod sticks, measures everything – the basic, such as air temperature, rainfall, wind speed and relative humidity, and the advanced, including soil nutrients and acidity, water vapor concentration, water evaporation rate, soil moisture and temperature, and, perhaps most importantly, carbon emissions in form of methane and carbon dioxide.



Jin-Woo Kim, a biological engineering researcher at the University of Arkansas, is part of a cutting-edge nanotechnology research group that has discovered a way to capture tumor cells in the bloodstream. The work could dramatically improve early cancer diagnosis and prevent deadly metastasis.

Dr. Yanbin Li, a biological engineering researcher project has two main focuses: biosensing technology to more rapidly and easily detect pathogenic bacteria and antibiotic residues in the poultry supply chain and dynamic risk-assessment models integrated with supply chain management to help the industry and regulators make better decisions for ensuring food safety.

Simulating Cooling Systems for Heat Relief of Broilers prior to Processing

Thomas Costello, Associate Professor

ISSUE:

The configuration of cooling systems in commercial holding sheds, where broiler chickens are held prior to slaughter, varies between processing plants, with the cooling efficacies largely unknown. Live broilers loaded in steel mesh transport modules, with high stocking density, wait for an average of two hours under open holding sheds before processing. Considerable heat stress can be experienced in hot weather, leading to animal suffering and mortality, with reduced meat yield and quality from the surviving birds that are harvested. There is a pressing need for effective and economically feasible heat stress mitigation measures during the summer in the south central United States.

ACTION:

A computational fluid dynamics (CFD) model was developed to simulate airflow through cage modules on a poultry trailer in a typical holding shed configuration. Experimental data were collected within modules on a poultry trailer, parked in an existing commercial holding shed during warm summer conditions. Results from the CFD model had reasonable agreement with measured field data, with simulated air velocities mostly within one standard deviation of measured values. Alternative design configurations were simulated in order to explore the potential to improve the air velocity profiles for better cooling performance. Simulation of airflow through modules in the original configuration showed that less than 20% of air mass from the fans actually travelled through the bird-occupied space. Regions not aligned with the faces of the fans, such as the uppermost and bottommost tiers, and horizontal locations offset from the fans, received the least airflow through the modules. Design alternatives, modeled in the simulation, were predicted to experience increased airflow rates through the bird-occupied space, ranging in increases of 4% to 100%. The increased air velocity using the alternative designs illustrates the potential improvement in convective cooling of broilers held within transport modules.

IMPACT:

The computational fluid dynamics model enabled quick testing of multiple design alternatives, making it a powerful, cost effective and efficient tool to assist in making future design decisions for holding sheds, modules and transport systems. The expected project outcomes are to develop and test new configurations based on model results, and to demonstrate improved systems to commercial poultry integrators, leading to adoption of the updated equipment designs, and ultimately to improved animal well-being, decreased mortality and increased production efficiency.

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Risk Indicators for Identifying Critical Sources Areas in Arkansas Watersheds

Brian Haggard, Professor

ISSUE:

Where should we implement best management practices to improve water quality? This is the question that often asked for many reasons, including the State's investment in water-quality monitoring, best management practices, and other voluntary actions. The Arkansas Water Resources Center continues to monitor water quality in streams in Northwest Arkansas to answer this question.

ACTION:

The Arkansas Water Resources Center, funded by the 319 Nonpoint Source Program of the Arkansas Natural Resources Commission, collects water samples from streams in the Upper Illinois River Watershed, Upper White River Basin and the Poteau River Watershed, as well as other watersheds across the state. These water samples were analyzed for chloride, nitrogen, phosphorus, sediment and sulfate at its water quality lab, which is certified by the Arkansas Department of Environmental Quality. The data was organized, and then water quality trends with watershed land use was evaluated using cool statistical techniques.

IMPACT:

The Arkansas Water Resources Center suggests that source water protection programs could potentially focus best management practices inn areas that meet these four criteria:

- Watersheds that have less than 50% forested area within the drainage area.
- Watersheds that have less than 50% forested area within the riparian buffer zone.
- Watersheds that have more than 0.9 poultry houses km^{-2}.
- Watersheds with a stream density that exceeds 50 m ha^{-1}.

Watershed that met this criteria tended have greater nutrient concentrations, suggesting this might be where we want to invest resources to improve water quality. The data collected by the Center is critical to our understanding of how we influence water quality with what we do in our watersheds.

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Arkansas Irrigation Yield Contest: A Novel Extension Approach to Promoting Irrigation Conservation

Chris Henry, Associate Professor

ISSUE:

Regional water management programs have identified a number of technologies and management practices that have the potential to reduce the overdraft on the Mississippi Valley Alluvial and Sparta Aquifers, thereby ensuring that soybean producers can achieve sustainable groundwater yields while maintaining overall profitability. In Arkansas groundwater withdraws from the alluvial aquifers are only about 42 percent sustainable and 54.6 percent sustainable from the Sparta/Memphis aquifer. Without sustainable irrigation practices, yields could be 30-50% less in the future if water becomes limited in the region. Aquifer overdrafts in this region pose a real concern about the future of row crop production in the region. For example in Arkansas 3.8 Million acres are expected to have limited or no water resources by 2050 according to a recent study, which is about the annual soybean acres currently grown in Arkansas.

ACTION:

A program was initialed in to promote IWM through an irrigation yield contest. Participants acquire a portable flow meter, where the installation is verified and sealed to prevent tampering. Rain was predicted for each site using a computer-based tracking system. Yield was measured on 3 acres for a minimum sized 30 acre field. Participant made their own irrigation decisions. County Agents served as advisors for irrigation management and judges for the yield measurement. Some contestants used the tools they learned about in Irrigation Schools to improve their irrigation management. Contests were established for three commodities, corn, soybeans, and rice. Financial support was provided by commodity boards and industry. All corn and soybean fields were furrow irrigated.

IMPACT:

This program is providing key data on water use, yields, and water use efficiency. The participants are demonstrating extremely high yields, low water use and high water use efficacies. Most importantly the contest demonstrates the full effect and results that can be achieved when irrigators apply highly managed crop production and irrigation management practices. The program is demonstrating how a comprehensive approach to IWM can achieve sustainability.

In summary, the yields, water use efficiency and extremely low irrigation depths participants were able to achieve are nothing but short of amazing. Irrigation application rates were nearly half or more than half of the long term average water demand assumed and reported. This program demonstrates that through management and the use of off the shelf irrigation technology, large gains are possible to attaining a sustainable yield from the aquifer.

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Collaborators:

Dustin Pickelmann and Greg Simpson

County Agent Collaborators:

Phil Horton, Rick Wimberly, Grant Beckwith, Chuck Capps, Russel Parker, Stewart Runsick, Herb Ginn, Mike Andrews, Dave Freeze, Craig Allen, Keith Perkins, Brett Gordon, Stan Baker, Kevin Norton, Shawn Payne, Branon Thiesse, Steve Kelly, Allen Davis, Chris Grimes, Matthew Davis, Robert Goodson, Brent Griffen and Ray Benson. All other county agents not listed who have done irrigation programming.

FUNDING SOURCES:

Arkansas Soybean Promotion Board, Arkansas Corn and Grain Sorghum Promotion Board, Ricetec, P & R Surge Systems, Irrometer, Delta Plastics, Trellis, McCrometer, USDA NRCS, Damgates.

Adoption of Multiple Inlet Rice Irrigation using a Mobile App

Chris Henry, Associate Professor

ISSUE:

Regional water management programs have identified a number of technologies and management practices that have the potential to reduce the overdraft on the Mississippi Valley Alluvial and Sparta Aquifers, thereby ensuring that soybean producers can achieve sustainable groundwater yields while maintaining overall profitability. In Arkansas groundwater withdraws from the alluvial aquifers are only about 42 percent sustainable and 54.6 percent sustainable from the Sparta/Memphis aquifer. One of the Irrigation Water Management Practices that has demonstrated a water savings of 25% is Multiple Inlet Rice Irrigation (MIRI). However, one of the challenges has been that the implementation and planning of MIRI is challenging, because there are no tools available and to successfully implement MIRI. The area of levees must be known, information which is difficult for irrigators to obtain. Another water saving technology, Alternate Wetting and Drying(AWD) aka Intermittent Flooding of rice requires the proper implementation of MIRI on precision grade or contour levees to implement AWD.

ACTION:

A mobile app, "Rice Irrigation" has been under development since 2012 for Android operating systems and was made available in 2016. An iOS version for apple products was released in January of 2017 they are available on google play and the apple app store for phones and tablets. Most growers have or use Apple products as almost no usage was observed between 2016 and 2017. Awareness of the app has been mostly by word of mouth and twitter, and brief mention at industry meetings. In 2018 an education effort was started to train end users on the app, twenty-one people attended the five schools.

IMPACT:

The 114,004 acres of planned MIRI represents 15% of the 7.556 million rice acres grown in Arkansas. The impact of this implementation is an annual savings of 25 Billion gallons of water for an Extension program that has only conducted a handful of small trainings.

An appraisal from an NRCS irrigation Specialist "*I have had a chance to review Chris Henry's rice irrigation app for side inlet and multiple inlet rice irrigation and I have to say I am quite impressed with the ease of use and fluidity of the app itself. I know you wanted some outside input on it, and I think this app will take the place of planimeter in my irrigation toolbox. I especially like how easy it is to draw the levees, and go back and change things as necessary. Chris has done a fantastic job and I will definitely be using this app on my ipad this irrigation season*."

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FUNDING SOURCES:

USDA Forest Service and the app was previously funded by the Arkansas Rice Research and Promotion Board.

Irrigation Schools Improve Water Management

Chris Henry, Associate Professor

ISSUE:

Regional water management programs have identified a number of technologies and management practices that have the potential to reduce the overdraft on the Mississippi Valley Alluvial and Sparta Aquifers, thereby ensuring that soybean producers can achieve sustainable groundwater yields while maintaining overall profitability. In Arkansas groundwater withdraws from the alluvial aquifers are only about 42 percent sustainable and 54.6 percent sustainable from the Sparta/Memphis aquifer. Without sustainable irrigation practices, yields could be 30-50% less in the future if water becomes limited in the region. Aquifer overdrafts in this region pose a real concern about the future of row crop production in the region. For example in Arkansas 3.8 Million acres are expected to have limited or no water resources by 2050 according to a recent study, which is about the annual soybean acres currently grown in Arkansas.

ACTION:

Considerable adoption of Computerized Hole Selection has occurred in Arkansas from industry and Extension efforts. Those that attended our schools reported using CHS on 41% of their acres but only used surge irrigation on 3% and soil moisture sensors on 12% of their acres. However Irrigation Water Management (IWM) requires more than just CHS to improve the long term sustainability of irrigated agriculture in Arkansas. On-farm demonstration has proven that the combined implementation of CHS, surge irrigation and soil moisture sensors can reduce water and energy use by 27%. To accomplish this a series of full day schools were delivered to irrigators, a series of trainings for irrigators was held, one was a surge irrigation school and the other a soil moisture sensor school. 74 participants attended the surge school and 81 attended the soil moisture schools for a total of 472 contact hours. Schools are limited to 20 people per school and these are designed as intense learning environments, with an average of 2-5 contact hours. A program was initialed in 2018 to promote IWM through an irrigation yield contest. Participants acquire a portable flow meter, where the installation is verified and sealed to prevent tampering. Rain was predicted for each site. Yield was measured on 3 acres for a minimum sized 30 acre field. Contests were established for three commodities, corn, soybeans, and rice. Financial support was provided by commodity boards and industry

IMPACT:

County agent-led Computerized Hole Selection (CHS) programming and Irrigation Water Management (IWM) demonstrations have improved the adoption of Computerized Hole Selection by 83% and adoption is wide spread. Efforts since 2012 have successfully increased the adoption of CHS to 41% where previously it was very low (< 5%). Adoption of surge irrigation and soil moisture sensors is still very low, and these tools are the next step to improving water management practices in the region. The schools resulted in high degrees of learning, but participants only reported modest behavior change of 12% increase in surge acres and 5% acre increase in sensor adoption. However they reported that the tools could be applied to large portions of their production (35% for surge and 60% for sensors). No capital investment is required to implement CHS. Likely the capital investment for surge and sensors is hindering rapid adoption, but that they recognize the tools are applicable to their farms indicates that they will adopt these practices in the future as a result of the schools. These and other efforts have resulted in water savings of over 21 billion gallons annually in Arkansas. Wide-spread adoption of IWM practices will have a dramatic impact on the overdraft of Arkansas aquifers and improve the profitability and sustainability of row crop production

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FUNDING:

USDA Natural Resource Conservation Service, Arkansas Soybean Promotion Board, Arkansas Corn and Grain Sorghum Promotion Board, US Forest Service

Nanotoolbox Technology for Programmable Self-Assembly of Multifunctional Hierarchical Structures for Biomimetic Advanced Materials and Devices Jin-Woo Kim, Professor

ISSUE:
Engineering multiple nanoscale materials into single multifunctional structure with predefined biophysicochemical characteristics has much promise for advanced materials and devices. Geometric factors, such as shape, size, and material compositions, influence the biophysicochemical properties of materials. Hence, the assembly of various nanoparticles (NPs) of different sizes, shapes, and compositions into desired patterns and geometries could realize programmable platforms for a variety of applications, ranging from optoelectronics and nanophotonics to biosensing, biosecurity, and nanomedicine. As a result, there has been considerable interest in the assembly of multifunctional structures with defined shapes, sizes, and functions that incorporate diverse NPs. Particularly, self-assembly has emerged as a powerful and practical strategy for controlled synthesis of such hierarchical structures. However, the accurate, scalable, and high-rate assembly of various nanocomponents into multifunctional architecture with specifically designed shapes and sizes remains difficult to attain.

ACTION:
To meet the challenge, Dr. Kim's group focuses on **a** transformative research to develop a nano-building block toolbox ("nanotoolbox") for the programmable self-assembly of advanced biomimetic materials with arbitrary shapes and arbitrary functions. This is accomplished with our novel nano-building block ("nBlock") technology and its further generalization that enable controls over the number, placement, and orientation of bio-functional ligands, including DNA, RNA, and peptide, on various NPs, including metallic NPs, quantum dots, bio-based NPs (*e.g.*, cellulose nanocrystals), *etc*. Since the nBlock technology could incorporate NPs of different composition, generating toolboxes of various NPs with bio-ligands at defined locations and in defined 3D orientations on a NP, it promises not only complicated shapes, but also the ability to tune the function of the assembly. When DNA is used, such well-defined and controlled functionality and directionality of various NP building blocks promise precisely controlled self-organization of structures with greater complexity for "customized" size, shape, and functionality for specific applications.

IMPACT:
The ultimate significance of the nanotoolbox technology is that it addresses the urgent need in the field of nanotechnology for functional, reliable and scalable techniques for "programmable and customizable" integrations of highly functional bio-hybrid systems, on the basis of target applications, in desired patterns and geometries at all scales and in all dimensions, beyond the inherent limitations of existing technologies, further driving innovations in novel hybrid fused technologies. The nanotoolbox technology holds high promise to transform many fields of research, ranging from optoelectronics, nanophotonics, and nanomedicine to agriculture, food safety, and biosecurity, contributing to the enhancement of economic well-being and quality of life not only in the State of Arkansas but also in the world, and making significant contributions toward the land grant mission.

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FUNDING:
National Science Foundation (NSF; award#: CMMI-1235100, OIIA-1457888 and ECCS-1810014) and National Institute of Health (NIH; award#: 1R21HG010055)

Cellulose Nanomaterials from Woody Biomass in Arkansas and Their Applications

Jin-Woo Kim, Professor

ISSUES:

A report published by Department of Energy (DOE) indicates that US forestry operations result in the generation of 97 million dry tons of waste annually; and as per US Department of Agriculture (USDA), 4 million dry tons are produced in the State of Arkansas alone. This abundant and cheaply available (< $60/ton) raw material, if sustainably and economically converted into value-added products, could provide a significant boost to the state economy, which heavily relies on its forest industry. Cellulose nanomaterials, derived from lignocellulosic woody biomass, have shown significant promise for the development of advanced functional nanomaterials owing to their unique physicobiochemical properties. The wood-derived nanoscale materials have drawn significant attention from many research communities, ranging from bioresource engineering, to biological and biomedical engineering, to bionanotechnology, to materials science and engineering. However, there are great challenges in the extraction of cellulosic nanomaterials from woody biomass and efficient and sustainable technologies to synthesize nanocellulose with desired morphological and physicochemical properties remain difficult to attain.

ACTION:

This project aims to develop effective, efficient and sustainable technologies to produce cellulosic nanomaterials from woody biomass in Arkansas with desired morphological and physicochemical properties for their uses in the fabrication of various value-added products with commercial value. Sustainable and scalable technologies are being developed by maximizing yields with desirable purities by uniquely combining two or more existing processes (*i.e.*, thermochemical, biochemical, and mechanical processes) and optimizing its reaction conditions and parameters (*e.g.*, temperature, acid concentration, incubation time, *etc.*). The process is also being generalized to various forestry biomass in Arkansas by investigating the influence of genetic and environmental factors on the quantity as well as quality of nanocellulose with the goal of identifying best cellulosic resources in Arkansas. Furthermore, the synthesis processes are being designed and developed to be customizable based upon the intended uses. Specifically, we plan to target both high volume/low cost and high cost/low volume markets by developing processes with options to synthesize cellulose example, nanomaterials in different degrees of purities: for example, nanocellulose with relatively low purity (*i.e.*, low crystallinity) for the high volume/low cost markets, including packaging materials, filtration materials for environmental and agricultural applications, *etc.*; and nanocellulose with high purity for the high cost/low volume markets, such as smart fabrics for defense logistics and medical industries, tunable nanomaterials for drug delivery systems, sensing/imaging nanomaterials, *etc*.

IMPACT:

USDA estimates that the market size of nanocellulose-enabled products will reach 35 million metric tons per year by 2050. By producing high-quality cellulosic nanomaterials with defined physicochemical properties, we can accelerate the development of various innovative nanocellulose-based technologies, propelling Arkansas into a new era of forest bio-based product capabilities. Hence, this project would lead to a viable way to fabricate value-added products from cellulosic nanomaterials, thereby advancing their commercialization that has high potential to impact Arkansas' manufacturing, agriculture, forestry, and healthcare industries among many others.

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FUNDING:

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Portable Biosensors for In-field Screening of Pathogenic Bacteria in Poultry Supply Chain

Yanbin Li, Distinguished Professor, Tyson Endowed Chair Biosening Engineering

ISSUES:

Contaminated food, mainly by pathogenic microorganisms, is estimated to cause 76 million illnesses, 325,000 serious illnesses resulting in hospitalization, and 5,000 deaths in the US each year. USDA/ERS estimates the medical costs and productivity losses associated with *E. coli* O157, *Salmonella*, *Listeria monocytogenes* and *Campylobacter* alone amount to at least $6.9 billion annually. Current methods for detection of bacteria rely upon culture plating, ELISA and PCR. However, these methods are time consuming, expensive, or not specific, and require trained operators with laboratory facilities. There is an urgent need for rapid methods to detect foodborne pathogens in the field in poultry supply chain

ACTION:

The objective of this project is to develop portable, automated, nanomaterials-based biosensors for rapid detection of foodborne bacterial pathogens in poultry. The biosensor system consists of a magnetic nanobeads bioseparator for separation of target bacteria from a poultry sample and an impedance or fluorescent detector for detection of target bacteria. The portable biosensor system has been designed, fabricated and evaluated for screening of *Salmonella* Typhimurium in samples from poultry on farm, processed chicken carcasses in plants and poultry products in market. The biosensors are able to provide the required specificity (strain level), sensitivity (10-100 cfu/ml or cfu/g) and time (less than 1 h). The testing data can be directly transmitted to the network through a smart phone without delay.

IMPACT:

The poultry industry and federal regulatory agencies may apply this novel biosensing method to food safety inspection and quality control to ensure food safety and security. Our society could be benefited from this technology in terms of reducing foodborne diseases and consequently related medical costs. Application of the nanotechnology-based biosensors would also enable the poultry industry to be benefited economically in terms of prevention of product recalls with the microbial contamination of poultry products.

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FUNDING:

Walmart Foundation, ABI

Quantitative Risk Assessment of *Salmonella* and Antibiotic Residues in Poultry Supply Chain in China

Yanbin Li, Distinguished Professor, Tyson Endowed Chair Biosening Engineering

ISSUE:

Food safety is becoming an important factor in shaping China's demand in the poultry sector. *Salmonella* is one of many foodborne pathogens, which not only can cause serious economic losses to the poultry industry, but also pose a serious threat to human health. In China, approximately 70-80% of foodborne bacterial infections are caused by *Salmonella*. Antibiotics approved for veterinary clinical applications in China are mainly used for the treatment of a variety of mycoplasma infections in poultry. Antibiotics carryover in poultry products not only affect the health of consumers, but also lead to the emergence and spread of bacterial resistance, and ultimately affect human health resources.

ACTION:

The objective of this project is to identify food safety challenges, issues, and solutions for poultry supply chains in China. Foodborne pathogens and antibiotics residues in the poultry supply chain is investigated with in-field testing methods and intervention technologies. Quantitative risk assessment and supply chain management are integrated to provide a powerful way to improve food safety of poultry products. The foodborne pathogens and antibiotic samples in poultry and poultry products are collected to identify food safety problems. A "farm to table" risk assessment strategy can be applied to enhance the food safety of poultry products in supply chain management.

IMPACT:

The food producers, processors, distributors, and retailors and regulatory agencies in China as well as other countries may apply this novel approach to improve food safety of poultry supply chains. Our society could be benefited from this in terms of reducing foodborne pathogens and antibiotics in poultry products. Application of the quantitative risk assessment would enable our poultry products much safer and our global food supply systems more sustainable.

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FUNDING:

Walmart Foundation

Simulating Cooling Systems for Heat Relief of Broilers prior to Processing

Yi Liang, Associate Professor

ISSUES:

The configuration of cooling systems in commercial holding sheds, where broiler chickens are held prior to slaughter, varies between processing plants, with the cooling efficacies largely unknown. Live broilers loaded in steel mesh transport modules, with high stocking density, wait for an average of two hours under open holding sheds before processing. Considerable heat stress can be experienced in hot weather, leading to animal suffering and mortality, with reduced meat yield and quality from the surviving birds that are harvested. There is a pressing need for effective and economically feasible heat stress mitigation measures during the summer in the south central United States.

ACTION:

A computational fluid dynamics (CFD) model was developed to simulate airflow through cage modules on a poultry trailer in a typical holding shed configuration. Experimental data were collected within modules on a poultry trailer, parked in an existing commercial holding shed during warm summer conditions. Results from the CFD model had reasonable agreement with measured field data, with simulated air velocities mostly within one standard deviation of measured values. Alternative design configurations were simulated in order to explore the potential to improve the air velocity profiles for better cooling performance. Simulation of airflow through modules in the original configuration showed that less than 20% of air mass from the fans actually travelled through the bird-occupied space. Regions not aligned with the faces of the fans, such as the uppermost and bottommost tiers, and horizontal locations offset from the fans, received the least airflow through the modules. Design alternatives, modeled in the simulation, were predicted to experience increased airflow rates through the bird-occupied space, ranging in increases of 4% to 100%. The increased air velocity using the alternative designs illustrates the potential improvement in convective cooling of broilers held within transport modules.

IMPACT:

The computational fluid dynamics model enabled quick testing of multiple design alternatives, making it a powerful, cost effective and efficient tool to assist in making future design decisions for holding sheds, modules and transport systems. The expected project mortality and increased production efficiency.

outcomes are to develop and test new configurations ultimately to improved animal well-being, decreased adoption of the updated equipment designs, and based on model results, and to demonstrate improved systems to commercial poultry integrators, leading to

adoption of the updated equipment designs, and ultimately to improved animal well-being, decreased mortality and increased production efficiency.

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Improving the Competitiveness of Arkansas Small Business in Food Processing: Craft Brewing

Scott Osborn, Associate Professor

ISSUE:

The craft brewing industry is focused on high quality products (for which consumers have shown a willingness to pay premium prices) created using traditional, small-batch techniques rather than large-scale, highly engineered techniques of national breweries. The scale of craft breweries does not allow the purchase of typical large-scale food manufacturing equipment because of the high capital costs relative to throughput. However, craft breweries are businesses with owners and operators that want to maximize their profits within the goals of creating their craft beer. There is a need for applying engineering to craft beer production to bridge the gap between home brewing and large breweries to allow an economically sustainable scale of beer to be produced while maintaining high quality and time honored, traditional methods. Creating innovative technologies for more cost effectively producing craft beer can help a burgeoning Arkansas industry grow more quickly, which will produce more jobs and help improve the overall innovation and technology ecosystem in the food processing industry in the state.

ACTION:

The research being conducted with in the University of Arkansas Division of Agriculture has focused on improving the force carbonation process. This process dissolves carbon dioxide gas into beer immediately before packaging and can result in 50% of the gas being wasted. Carbonation is a critical step for producing the desired flavor, mouthfeel and aroma of beer. A new process was created to reduce carbon dioxide waste to nearly zero while allowing the brew master to have more precise control over carbonation to assure quality. One US patent has been issued for the process and another related to use of the process for the effective addition of other gases such as nitrogen (think Guinness) is pending. A prototype was constructed and is currently being tested in a local craft brewery to compare the new technology to what they are currently using. If these tests prove successful, the brewery that is testing the device has expressed interest in purchasing a beta unit for use in their process and larger scale testing. The brewery will also provide feedback on how to scale the unit for commercial use including how to fit it into the existing control scheme. Another advantage of the invention is that it may allow replacement of a costly meter currently used to measure carbonation in beer. Previous prototype was reworked twice by incorporating new ideas to improve carbonation rate and reduce energy input thereby reducing capital cost recovery period.

Prototype was moved to Core Brewing in Springdale, AR for tests using donated beer. Core donated space, utilities, beer, and operator expertise to the project (an estimated value of $3000). Four senior biological engineering students used this project for BENG 4823, a required capstone design class. The students redesigned and constructed a prototype and tested the unit at Core Brewing using donated beer. This project provided the students valuable experience in the food processing industry to make them much more competitive for entry level engineering jobs. Data is currently being collected for publication of the invention testing results in a beverage industry journal. Planning is underway for testing the prototype for nitrogenation of beer for a potential new product. ION:

IMPACT:

To this point, testing has shown that beer can be carbonated with no wasted carbon dioxide gas. The invention also has the ability to precisely control dissolved CO_2 and appears to be an improvement over the existing method. The prototype is at approximately 1/15 of full scale. By reducing wasted CO_2, the brewery will save substantial costs as well as reduce their carbon footprint by reducing the amount of a greenhouse gas released into the atmosphere. All of this will help the bottom line of brewers and allow them to advertise their "green" approach to creating beer that is highly desirable among craft beer consumers. Cost projections indicate that the payback period for the capital investment of the equipment will be 2 years or less.

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FUNDING:

Core Brewing Company, and UA System Division of Agriculture.

Reducing methane emissions from rice fields using the alternate wetting and drying irrigation strategy

Benjamin Runkle, Assistant Professor

ISSUE:

Rice cultivation contributes 11% of the global 308 Tg CH_4 anthropogenic emissions, and Arkansas generates about half of the U.S.'s total rice production. One potential solution to the CH_4 challenge is the Alternate Wetting and Drying (AWD) irrigation practice, which conserves water while reducing CH_4 emissions through the deliberate, periodic introduction of aerobic soil conditions. This method has been studied as a CH_4 reduction practice with chamber-based approaches mostly in experimental plot trials, but has not been examined using eddy covariance (EC). The EC method provides continuous, direct observations over a larger footprint than in previous studies. This work is necessary to connect the carbon and water cycles in these agricultural systems, as farmers are increasingly testing different water-saving irrigation strategies. These strategies include multiple inlet irrigation using lay-flat poly-pipe, furrow irrigation, and zero-grading fields, as well as the use of more productive hybrid varieties to maximize harvest yield for the same water inputs.

ACTION:

Runkle is researching the AWD method and related water saving strategies for rice production in Arkansas. His group's paper[1] is the first to report the impact of AWD on rice field CH_4 emissions with the eddy covariance method. Seasonal CH_4 emissions from a pair of adjacent, production-sized rice fields under delayed flood (DF) and AWD irrigation were compared from 2015 to 2017. Correcting for field-to-field differences in CH_4 production, the AWD practice reduced seasonal CH_4 emissions 64.5 ± 2.5%. No significant differences in harvest yield were determined between the two practices. The AWD practice is increasingly implemented and incentivized for water conservation in the U.S. Mid-South; however, this study shows it also has great potential for reducing CH_4 emissions. Runkle's group is doing additional work on 10 different fields through a project funded by Unilever to encourage sustainable water use by its contributing rice farmers. The group is also studying four different water management strategies in a unique partnership with researchers at at the USDA-ARS Delta Water Management Research Unit in Jonesboro, AR, with funding from the USDA NRCS office in Little Rock, AR. He also contributed to a synthesis of the greenhouse gas implications of different management practices in US rice production[2]. The synthesis work was recognized with the 2018 Rice Technical Working Group Distinguished Rice Research and/or Education Team Award for "Advancing irrigation management practices to achieve sustainable intensification outcomes", alongside Merle Anders, Michele Reba, Christopher Henry, Joseph Massey, Jarrod Hardke, Arlene Adviento-Borbe, Steve Linscombe, Dustin Harrell, and Bruce Linquist.

FUNDING:

This work was funded through the U.S. Geological Survey's 104(b) program under Cooperative Agreements G11AP20066 and G16AP00040 administered by the Arkansas Water Resources Center; the USDA-NRCS under Cooperative Agreement 68-7103-17-119, and the NSF under its flagship CAREER program award CBET:1752083. A project funded by Unilever investigates Water Sustainability in Arkansas rice fields

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On-Farm Safety

Sammy Sadaka, Associate Professor

ISSUE:

According to the USDA, in 2015, 21 million full and part-time jobs were related to the agricultural and food sectors in the US). Direct on-farm employment accounted for about 2.6 million of these jobs. A few field dangers cause many farm-related injuries and fatalities. Unfortunately, the number of agricultural work-related injuries increased from 47,332 in 2009 to 58,385 in 2014 according to the Centers for Disease Control and Prevention. Thus, every day about 160 agricultural workers suffer a lost-work-time injury. The primary cause of injury has remained largely unchanged, with persons, plants, animals, materials, tools, instruments, equipment, and other causes responsible for the majority of work-related injuries in agriculture.

ACTION:

I established one of the most effective On-Farm Safety programs in the Southern States of the USA. A website titled Farm and Home Safety Tips for Arkansans as well as several essential fact sheets were developed. The on-farm and home safety website include Farm Equipment Safety, Home and Small Equipment Safety, Farm Shop Safety, Grain Handling Safety, Outdoor Farming Safety and Livestock Handling Safety sub-websites. Additionally, the safety fact sheets include Chain Saw Safety, Grain Bin Entrapment and Engulfment – Causes, Prevention and Rescue, Awareness of Residential Fire Safety, Tornado Safety, Skid-Steer Safety, Instructions for Safe Storage and Management of On-Farm Fuels and Chemicals, On-Farm Hazards and Accident Prevention, Large Farm Equipment Accident Prevention, Tips for On-Farm Equipment, Metal and Livestock Protection From Theft and On-Farm Safety for Grain Wagons, Semi-Tractor Trailers and Trailers.

IMPACT:

The implementation and utilization of the information included in these websites and fact sheets would minimize on-farm deaths, and injuries relate to agricultural activities.

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FUNDING:
This extension activity was supported by the University of Arkansas System Division of Agriculture.

Assisting Arkansas Nutrient Management Planning Efforts via Development and Maintenance of a P Index Calculator and Nutrient Management Planning Tool

Karl VanDevender, Professor

ISSUE:

The production of animal derived food and products generates manure byproducts. The management of these byproducts has potentially significant impacts on food production, societal economic wellbeing, human and animal health, as well as environmental quality. Concerns regarding these potential impacts on farmers, neighbors, and consumers has resulted in numerous regulations and policies that livestock producers and those that manage manure byproducts must adhere too. Central to most of these is the development of farm specific Nutrient Management Plans based on farm conditions, phosphorus and nitrogen runoff risk, and crop agronomic requirements.

ACTION:

In keeping with the land grant mission of dispersal of research based information and service, a Microsoft Excel workbook based nutrient management planning tool (ARNMP) has been developed and refined over a number years. In the past the tool has been provided to nutrient management planners to facilitate and expedite their plan writing process. Over time, both the Arkansas Department of Environmental Quality, the Arkansas Natural Resources Commission, and the Natural Resources Conservation Services have come to expect plans be written using ARNMP. In the past ARNMP was distributed via email. This year the latest version was posted to www.uaex.edu/manure. This posting was advertised via email to key personnel within the agencies listed above with a request to forward to their appropriate internal and external personnel.

IMPACT:

The results of this long term and continuing efforts is a nutrient management tool that is focused at Arkansas landowner and nutrient planner needs. The tool is provided at no charge to potential users. This provides Arkansas's limited number of certified planners a tool targeted at the writing of nutrient management plans that meet certification requirements. In addition the tool coupled with Extension's planner certification train helps to ensure that written plans are structurally uniform which facilitates agency review. Both of which helps to reduce the development/approval time of a plan as well as increase the number of plans that can be written/revised. A benefit to Arkansas' landowners and their downstream neighbors

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Includes Various University of Arkansas Division of Agriculture Departments, The Arkansas Natural Resources Conservation Commission, The National Resource Conservation Service, The Arkansas Department of Environmental Quality, and Various organizations representing livestock producers.

FUNDING SOURCES:

Various general base state and federal funds.

Development of applicable anaerobic digestion technologies for poultry litter treatment

Jun Zhu, Professor

ISSUE:

Given the fact that Arkansas is ranked #2 in poultry production in the nation with about 4.1 million metric tons of litter generated annually, lack of cost-effective techniques to treat this waste stream environmentally and resourcefully has been an pending issue because conventional land application of poultry litter as fertilizer at the agronomic rate for nitrogen (N) has long been proved to always lead to excessive amounts of plant extractable phosphorus (P) in the soil due to the high concentration of P relative to N in the litter. Reviewing literature indicates that several techniques were investigated in the past in treating poultry litter including compost, direct combustion, palletization, and anaerobic digestion. The first three methods were developed predicated upon the dry nature of poultry litter; however, they have inherent problems. For instance, composting can lead to loss of N, carbon, and other nutrients during the process, high equipment cost and labor, odor emissions, and large land acreage for establishing the composting site. Direct combustion of poultry litter can release particulate matter, dioxins, arsenic, bio-aerosols, and other toxins into the atmosphere, the various components of which are associated with cardiovascular disease, cancer, respiratory illness, and other diseases for humans. Although palletization of poultry litter can produce a sellable fertilizer product, both pelleting and granulation are costly processing methods at roughly $50 per ton, which makes the litter pellets an expensive product but with low fertilizer density compared to commercial fertilizers. The last technology, anaerobic digestion, has been around for at least over a century, and wastes to which this technology has been applied run the gamut including industrial, agricultural, and municipal sources. However, the only requirement for using technology is that the substrate must be a liquid, while poultry litter is a solid. To overcome this issue, one option is to add water to the litter to make a liquid, leading to a large quantity of water wasted and increasing the difficulty and workload to handle the digested effluent, which is not a palatable option to the producers. The other option is to recycle the effluent from the digester to the front to dilute the incoming litter. Certainly, the second option requires treating the effluent to meet the minimum water standards, so the fresh water usage can be minimized in digestion operation. This is a challenge requiring us to conduct in-depth and translational research to develop novel systems and technologies and make these technologies available to poultry producers in a timely manner.

ACTION:

In order to understand the basics of anaerobic digestion of poultry, research experiments were first developed and designed to investigate co-digestion of poultry litter with another liquid waste stream, and also with another carbon source such as crop residues to improve the carbon to nitrogen ratio to determine the optimal operating conditions for the digestion process. Based on the data, models were developed to simulate the digestion process using data from batch experiments of anaerobic co-digestions of poultry litter and wheat straw at 2% total solids level, which consisted of 100, 75, and 50% VS of poultry litter. The maximum specific methane volumes were obtained to be 207, 134, 5.18 mL $(gVS)^{-1}$ for 50, 75, and 100% VS co-digestion, respectively. The developed model for bio-products was successfully applied to cumulative methane volumes produced from anaerobic co-digestion. The data from these experiments will pave the way for further studying a treatment system consisting a digester, a precipitator or an electrical reactor to produce struvite, and a water cleaning unit to remove nutrients and other substances for water recycling. This step-wise research plan will provide us knowledge about the feasibility and practicality of using liquid anaerobic digestion technology to treat poultry litter, a dry solid, and help develop new, cost effective, and applicable treatment systems for on-farm use.

IMPACT:

The long-term impact of this research rests with the successful development of an applicable anaerobic digestion system for poultry litter treatment. As said early, a cost-effective technology to treat poultry litter and recycle nutrients for the Arkansas poultry industry is not currently available, and thus highly needed to support the growth of the industry while still protecting the environment. The ongoing research that produces key information for technology development over time will eventually lead to a long-term technical solution to the poultry litter issue facing the producers in Arkansas. It is expected that as the research moves forward, an advanced, cost-effective system to handle and treat a large quantity of poultry production waste to not only recover the value of the waste but also reduce the environmental footprint of poultry production in Arkansas will come to fruition. In the due course, several manuscripts are published annually in high-impact refereed journals based on the continuous research outcomes on the topic, which contributes to the scientific literature. This has a global impact, with a large number of audiences, on the advancement of science and engineering in new technology development in the agricultural production realm.

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COLLABORATORS:

Amanda Ashworth, USDA/ARS, Sammy Sadaka and Thomas Costello, Biological and Agricultural Engineering, Wen Zhang, UA Civil Engineering, Mike Popp UA Agricultural Economics and Agribusiness, Sarah Wu, University of Idaho, and Zhiwu Wang, Virginia Tech. University

FUNDING:

UA System Division of Agriculture

Grain Drying and Storage

Sammy Sadaka, Associate Professor

ISSUE:

Arkansas's production of grain, *i.e*., rice, soybean, corn, wheat, and sweet sorghum reached 234.0, 178.5, 108.8, 6.5 and 0.5 million bushels, respectively, in 2017, according to the USDA National Agricultural Statistics Service. Accordingly, the total harvested grain reached 528.3 million bushels. When grain is collected from the field, it comprises water and dry matter. Although water is required for the development of the plant, extra water in the grain after development would lead to severe problems during the storage process. Therefore, producers dry their grain either naturally, in the field, or artificially to preserve their grain for a long time. Currently, most grain and some oilseed crops require drying nearly every year in several counties in Arkansas. Both rice and corn are typically harvested too wet for safe storage and require drying. Of the other major crops, sorghum, among the cereal grains, is most frequently dried artificially. Although the practice of grain drying and storage dates back to the time when humans started cultivating grains, grain producers in Arkansas are continuously looking for the best practice management of grain drying and storage. There is a tremendous amount of useful information, in text format and web-based format, available for producers. However, due to the particular environment of the Mid-South region, grain producers in Arkansas are looking for the specific information that applies to our region including the basics of grain drying, grain drying methods, and various types of grain dryers.

ACTION:

I established one of the most effective grain drying and storage programs in the Mid-South region of the USA that gained national and international acknowledgment. I developed grain drying and storage websites, peer-reviewed fact sheets, book chapters, an online course, interactive excel sheets, and smartphone apps. Ten book chapters that cover the basics of drying and storage of each commodity were developed. These book chapters are included in the Cooperative Extension Handbooks as well as published textbooks. A website titled "Arkansas Grain Drying and Storage" along with several sub-websites were developed and became available online. These websites outline the basics of on-farm grain drying and storage of individual commodities. Additionally, more than 15 peer-reviewed fact sheets were developed to explore the basics of grain drying and storage techniques. These fact sheets were shared with county agents and made available to the public via the extension website. Moreover, I created an interactive on-line grain drying and storage course which includes five modules to help county extension agents to understand the basics of the drying process based on their schedules. Furthermore, I developed 20 Smartphone apps and interactive web-based Excel sheets that help county agents and producers make an educated decision related to best management practice of grain drying and storage.

On the other side, I established a very successful applied research program in the area of grain management. My program attracted graduate students to the area of grain management. I collaborated with several colleagues and industrial partners and succeeded to develop and publish more than 20 peer-reviewed manuscripts that cover the most recent development in grain management areas. The research program impact was highly recognized as evident by the number of manuscript citations, industrial collaboration and the industrial opportunities for my graduate students.

IMPACT:

The application and utilization of the information included in these book chapters, peer-reviewed fact sheets, on-line drying course, websites, interactive excel sheets, smartphone apps, and peer-reviewed manuscripts would help producers maintain grain quality at their highest levels, improve grain drying efficiency, and reduce grain drying and storage cost.

CONTACT:

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COLLABORATING SCIENTISTS:

Griffiths Atungulu, Gbenga Olatunde, Scott Osborn, Thomas Costello and Terry Siebenmorgen.

FUNDING SOURCES:

These extension and research activities were supported by the University of Arkansas System - Division of Agriculture.

Bioenergy Production and Energy Conservation

Sammy Sadaka, Associate Professor

ISSUES:

Bioenergy production and energy conservation are the two factors that create a substantial task to the United States citizens during the latest decades. The 2011 Billion-Ton Update estimates potential annual supplies of agricultural residues, forest residue and animal manure to be about 205, 119, and 60 million dry ton, respectively. The collection, transportation, and conversion of this vast amount of agricultural wastes create a challenge to producers, industrial personnel, and scientists. Currently, there are several well-established conversion technologies to convert organic matter to value-added products. These technologies include biological, chemical and thermochemical conversion processes. Each of these conversion technologies requires specific characteristics of the organic matter. Occasionally, physical, chemical and thermochemical characteristics of some organic materials hinder the conversion process. County extension agents, producers, and citizens are continuously looking for modern advanced technologies to produce bioenergy and value-added products.

On the other hand, energy conservation is an important aspect that plays a significant role in our citizen's budget. Energy conservation would help Arkansas citizens to save money. It is estimated that the average annual residential electricity bill in Arkansas is $1,248, which ranks 28th in the U.S. Arkansas citizens are continuously looking for tips and techniques to conserve energy. For example, lighting accounts for about 20% of an electric bill in the average Arkansas home. Choosing the best lighting has multiple benefits, including helping our citizens to be as energy efficient as possible. Switching from traditional light bulbs or fluorescent bulbs to light emitting diodes (LED) could be a foremost change that Arkansas citizens can make to reduce their energy usage and energy costs at homes and offices

ACTION:

I initiated and developed a bioenergy lab located at the Rice Research and Extension Center, Stuttgart AR. I utilized this lab to serve the saying of learning science by doing science. Following are highlights of the actions that took place while performing bioenergy and energy conservations extension and research program:Authored/co-authored more than 15 peer-reviewed factsheets to cover the energy production and energy conservation areas. These fact sheets were distributed to county extension agents and were made available to Arkansas citizens. Served as PI/CO-PI in 10 successful competitive grant proposals that were approved for $5,559,560 ($570,357 for my share) from agencies such as California Energy Commission, USDA-NIFA, and DoE to support my extension programs and activities. Developed six peer-reviewed and two non-refereed extension websites as part of a multi-state extension effort to cover gasification and pyrolysis technologies. Developed and delivered 23 In-Service training to county agents, faculty members, and AR national guards.Developed 2 On-line courses contain ten modules that cover On-Farm Energy Conservation and Home Energy Conservation. These courses are available for county agents at any time.Developed and delivered eight invited presentations in the state or via webinar, 17 oral presentations. Additionally, I presented 21 posters in national and international meetings.

Developed and delivered 21 E-Tips to provide energy guidelines for Arkansas citizens as well as three educational Webinars.Established 4 new apparatuses: (1) A biodiesel mobile unit to educate clientele on how to convert waste oil to biodiesel, (2) A fluidized bed gasification/pyrolysis unit that was used during field days and in-service training, (3) An auger system that convert biomass to biochar, a soil amendment material, that could increase water holding capacity up to 10% and (4) A batch fluidized bed drying system. Conducted group training meetings to discuss energy conservation tips. Many of these training have incorporated hands-on experience via new lab facilities and demonstration/lab trailers developed under my leadership.

Involved in many program planning activities with various clientele (county agents and program councils/committees, state agencies/ organizations).Demonstrated the biofuel production technologies during field days.

Trained and supervised 13 employees (2 Full-time employees, 8 Research Associates, and 3 Program Technicians), most of them accepted full-time jobs in Arkansas and other States.Worked with High School Science Teachers to educate their students on Biofuel and Bioenergy. Two students decided to join an engineering college. Additionally, hosted Arkansas talented and gifted students for three consecutive years (2012, 2013, and 2014). They learn about monitoring and control systems.

Authored/co-authored 27 refereed manuscripts published in high impact factor journals. Total No. of scientific citations is 1013.Authored/co-authored ten conference papers and eight published abstracts.Advised two M.S. students (graduated), one Ph.D. student (graduated), who is currently working as an Assist. Prof. at NC State University.

Served as a graduate committee member of five students.

Developed and delivered 15 presentations in the state, 6 in national and 8 in international conferences.

IMPACT:

The application and utilization of the information included in the previously mentioned peer-reviewed fact sheets, peer-reviewed websites, online courses, and peer-reviewed manuscripts would help Arkansas citizens and industrial partners in several manners. These include selecting the best technology to convert biomass to the useful and value-added product, reducing the carbon footprint, increasing the longevity of the landfills and rewarding Arkansas citizens with some extra cash. Additionally, energy conservation would benefit Arkansas citizens in many ways. As an example, changing the lighting system to LED would help to reduce the electric bills. Upon the availability of funds, U of A - CES is implementing the LED technology and may be utilizing the information provided in my fact sheet titled "Efficient Lighting." Several Arkansas buildings already changed their lights to LED.

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COLLABORATING SCIENTISTS:

Greg Thoma, Thomas Costello, Karl VanDevender, Hal Liechty.

FUNDING SOURCES:

These extension and research activities were supported by the University of Arkansas System - Division of Agriculture as well as several other sources.

Congratulations to the Class of 2018!

Undergraduate:

Mckenna L. Belcher
Brooke Anne Benham
Seth Edward Boles
Colton E. Bryant
Linden Kay Cheek
Ryan James Clark
Ali K. Ezell
Casey Ann Gibson
Kendrick Clay Hardaway
Thomas Helvick
Rose Elizabeth Hendley
Merrisa Kendrick Jennings
Samuel Stone Lahodny
Madeline Jane Ludwig
Madison Taylor Rain McMillen
Kami A Parmenter
Alexander Wayne Parr
Mason Christopher Puckett
Will Pape Richardson
Rachel Christine Schlais
Allison A. Sites
Jacob Alan Stanosheck
Megan Faith Woodworth
Zachary Morgan Johnson
Pablo Andres Pena Cabezas
Andreas Gustav Kleveland

Research Grants

The following active grants during 2018 fund research in specific areas.

AWRC Program Administration
Dr. Brian Haggard
USGS 104B
2018
$30,985

AWRC Information Transfer
Dr. Brian Haggard
USGS 104B
2018
$8,757

Sediment Phosphorus Release
Dr. Brian Haggard
Beaver Water District
2018
$50,000

Water Quality Monitoring
Dr. Brian Haggard
Beaver Water District
2018
$24,000

Water Shed Investigative Support
Dr. Brain Haggard
Poteau Valley Improvement Authority
$40,000

USGS Internship Program
Dr. Brian Haggard
USGS
$20,408

Improving Yield and Yield Stability for Irrigated Soybeans
Dr. Chris Henry
Soybean Promotion Board
2018
$80,424

Improving Irrigation Scheduling and Efficiency in Corn and Grain Sorghum
Dr. Chris Henry
Arkansas Corn and Grain Sorghum Promotion Board
2018
$159,424

Promoting the use of Multiple Inlet in Arkansas Rice Production
Dr. Chris Henry
Arkansas Rice Promotion Board
2018
$75,000

Analysis of Irrigation Survey
Dr. Chris Henry
Mid-South Soybean Promotion Board
2018
$38,803

Improving Furrow Irrigated Rice
Dr. Chris Henry
Arkansas Rice Promotion Board
$75,500

Economics of Irrigation Technologies and Practices
Dr. Chris Henry
Arkansas Soybean Promotion Board
2018
$1000

Economics of Multiple Water– Saving Technologies across the Arkansas Delta Region
Dr. Chris Henry
Arkansas Rice Research Promotion Board
2018
$1000

Implementing Irrigation water Management as a Holistic Approach to Water Management for Arkansas Irrigators
Dr. Chris Henry
USDA NRCS
2018
$500,000

Center for Advanced Surface Engineering
Dr. Jin-Woo Kim
NSF-OIA
2018
$327,827

Engineering Nano-Building Block Toolboxes for Programmable Self Assembly of Nanostructures with Arbitrary Shapes and Functions
Dr. Jin-Woo Kim
NSF
2018
$50,000

Poultry Excellence in China-Improving Food Safety in Poultry Supply Chain
Dr. Yanbin Li
Walmart Foundation
2018
$208,300

Bio-nanogate based Aptasensor for Rapid Detection of Avian Influenza Viruses (renew)
Dr. Yanbin Li
ABI
2018
$24,000

Highly Integrated Optofluidic Biosensor for Portable Bacteria Detection
Dr. Yanbin Li
ABI
2018
$4,000

Optofluidic Biosensor for Portable Bacteria Detection
Dr. Yanbin Li
ERSIF
2018
$4,000

Managing Crop Residues to Reduce Particulate Matter Emissions
Dr. Yi Liang
AR Department of Environment Quality
2018
$64,000

In-vessel Mortality Composter Management Guidelines Refinement and Educational Material Development
Dr. Yi Liang
NRCS-AR CIG
2018
$67,730

CAREER: Developing Climate- Smart Irrigation Informing post-disaster Restoration through Modeling Interdependent Agric. & Transportation Networks
Dr. Benjamin Runkle
MarTREC
2018
$40,000

Reducing Arsenic and Methylmercury Intake from Rice
Dr. Benjamin Runkle
USDA-NIFA
2019
$500,000

INFEWS/T2: Enhanced Spatiotemporal Imaging of Resource Availability, Utilization, & Efficiency in Agric. Systems
Dr. Benjamin Runkle
2018
$2,500,000

Improving Root Zone Soil Water and Nutrient Availability, Farm Economics, and Regional Policy for Sustainable Crop Production in Gulf Coast States
Dr. Benjamin Runkle
USDA-NIFA
2019
$10,000,000

Development of On-line Instructional Program for Nutrient Management Training Required by ANRC Titles XX, XXI and XXII
Dr. Karl VanDevender
ANRC
2018
$184,198

UA Sustainable Nutrient Management
Dr. Karl VanDevender
CES Subcontract of UA AES grant from NRCS
2018
$18,333

In-Vessel Mortality Composter Management
Dr. Karl VanDevender
AR NRCS
2018
$33,865

Books, Book Chapters

Sivaraman, S., Sinha, A., Lim, K.-T., **Kim, J.-W.**, Rao, R. & Jensen, H. Nanotechnology-based stem cell tissue engineering. *In:* Characterization Tools for Nanotechnology-Based Tissue Engineering. K. Challa (ed). Springer (*in press*).

Sinha, A., Sakon, J., Roper, D.K., Li, W.J., Ghosh, A., Han, H., Zharov, V.P. & **Kim, J.-W.** Nanoscale particles and multifunctional hybrid soft nanomaterials in bio/nano medicine. *In:* Nanoscale Materials in Nano/Bio Medicine. J.-W. Kim, et al. (ed). World Scientific Publishing Company/Imperial College Press (*in press*).

Singaravelu, I., Kotagiri, N. & **Kim, J.-W.** Cell-derived biomimetic nanostructures for biomedical applications. *In:* Nanoscale Materials in Nano/Bio Medicine. J.-W. Kim, et al. (ed). World Scientific Publishing Company/Imperial College Press (*in press*).

Henson, J.C., Jensen, H., Balachandran, K., Rao, R., **Kim, J.-W.** & Jensen, M. Cues from the nano-environment: the role of nanomaterials in stem cell differentiation and stem cell tissue engineering. *In:* Nanoscale Materials in Nano/Bio Medicine. J.-W. Kim, et al. (ed). World Scientific Publishing Company/Imperial College Press (*in press*).

Hristov, A. N., J. M. F. Johnson, C. W. Rice, M. E. Brown, R. T. Conant, S. J. Del Grosso, N. P. Gurwick, C. A. Rotz, U. M. Sainju, R. H. Skinner, T. O. West, **B. R. K. Runkle**, H. Janzen, S. C. Reed, N. Cavallaro, and G. Shrestha, 2018: Chapter 5: Agriculture. In Second State of the Carbon Cycle Report (SOCCR2): A Sustained Assessment Report. [Cavallaro, N., G. Shrestha, R. Birdsey, M. A. Mayes, R. G. Najjar, S. C. Reed, P. Romero-Lankao, and Z. Zhu (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 229-263, doi: 10.7930/SOCCR2.2018.Ch5; https://carbon2018.globalchange.gov/downloads/SOCCR2_Ch5_Agriculture.pdf

Atungulu, G., G. Olatunde & **S. Sadaka**. 2018. Rice aeration: Fundamental and principles. Chapter 5. In: Advances in Science & Engineering of Rice. Edited by: Pan, Z. and Khir, R. DEStech Publication, Inc.

Atungulu, G. & **S. Sadaka**. 2018. Postharvest technology: rice drying. Chapter 15. In: Rice Chemistry and Technology. Edited by Bao, J. AASCC International and Elsevier Publisher.

Sadaka, S. & D. Jayas. Cereal Grains Drying. In: Storage of Cereal Grains and Their Products. Edited by Rosentrator, K. AASCC International and Elsevier Publisher. Submitted to the editor.

Sadaka, S. & K. Rosentrator. The significance of Grain Moisture and Its Measurement. In: Storage of Cereal Grains and Their Products. Edited by Rosentrator, K. AASCC International and Elsevier Publisher. Submitted to the editor.

Peer-Reviewed Journal Articles

Austin, B.J. S. Entrekin, M.A. Evans-White, J. Kelso, and **B.E. Haggard**. 2018. Can high volume hydraulic fracturing effects be detected in large watersheds? A case study of the South Fork Little Red River. Current 0pinion in Environmental Science and Health 3:40-46

Entrekin, S., M.A. Evans-White, others, and **B.E. Haggard**. 2018. Ecological responses to surface water alterations from high-volume hydraulic fracturing: Fayetteville Shale as a case study. Current Opinion in Environmental Science and Health3:27-32

Grantz, E., **B.E. Haggard**, and J.T. Scott. 2018. Censored data can inflate or obscuretrends in analyses used for water quality target development. Environmental Monitoring and Assessment 190:394

Austin, B.J., S. Patterson, and **B.E. Haggard**. Water Chemistry during base flow helps inform watershed management: A case study of the Lake Wister Watershed, Oklahoma, USA. Journal of Contemporary Water Research and Education. (submitted)

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Harmel, R., K. King, D. Busch, D. Smith, F. Brigand, and **B.E. Haggard**. 2018. Measuring edge-of-field water quality: Where we have been and the path forward. Journal of Soil and Water Conservation 73:86-96

PUBLICATIONS

McCarty, J.A., M.D. Matlock, J.T. Scott, and **B.E. Haggard**. 2018. Risk indicators for identifying critical source areas in five Arkansas watersheds. Transactions ASABE 61:1-8

Reavis, M.A., and **B.E. Haggard**. 2018. Mitigating soil phosphorus release using liquid water treatment residuals. Journal American Water Works Association 110:12

Scott, E., and **B.E. Haggard**. 2018. Evaluating Water Quality and Standard Violations at the West Fork of the White River. Environmental Monitoring. (Submitted)

Simpson, Z.P., and **B.E. Haggard**. 2018. Optimizing the flow-adjustment of constituent concentrations via LOESS for trend analysis. Environmental Monitoring and Assessment 190:103

G.D. Spencer, L.J. Krutz, L.L. Falconer, W.B. **Henry, C.G**. Henry, E.J. Larson, H.C. Pringle III, C.J. Bryant, R.L. Atwill. 2018. Irrigation Water Management Technologies for Furrow Irrigated Corn that Decrease Water Use and Improve Yield and On-Farm Profitability. Agronomy Journal. Accepted for publication.

Jinyoung Y. Barnaby, Anna M. McClung, Jai S. Rohila, **Chris G. Henry**, Lewis H. Ziska, Richard C. Sicher. 2018. Intraspecific variation in leaf metabolite profiles for rice cultivars subjected to different irrigation levels: Relationship to stress adaptation and yield performance. Submitted to the Frontiers of Plant Science.

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RanguMagar, A.B., Chhetri, B.P., Paremesharam-Thanknam, A., Watanabe, F., **Kim, J.-W**., Bris, A.S. & Ghosh, A. Visible light induced rapid nitrophenols mineralization using nitrogen doped TiO_2 supported on carbonaceous material derived from nanocellulose and dopamine. *ACS Omega* 3, 8111-8121 (2018). DOI: 10.1021/acsomega.8b01020 *[JIF: N/A]*

Seo, Y.-R., **Kim, J.-W.,** Hoon, S., Kim, J., Chung, J.H. & Lim, K.-T. Cellulose-based nanocrystals: sources and applications via agricultural byproducts. *J. Biosystems Eng.* 43, 59-71 (2018). – -This article was featured as a "Front Cover Image" of the journal issue *[JIF: N/A]*

Le, K. N., Jeong, J., Reyes, M. R., Jha, M. K., Gassman, P. W., Doro, L., Hok, L., and Boulakia, S. (2018). Evaluation of the performance of the EPIC model for yield and biomass simulation under conservation systems in Cambodia. Agricultural Systems, 166, 90-100. doi: https://doi.org/10.1016/j.agsy.2018.08.003

Le, K. N., Jha, M. K., Jeong, J., Gassman, P. W., Reyes, M. R., Doro, L., Tran, D.Q, and Hok, L. (2018). Evaluation of Long-Term SOC and Crop Productivity within Conservation Systems Using GFDL CM2.1 and EPIC. Sustainability, 10(8), 2665. doi: https://doi.org/10.3390/su10082665

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Cao, L.L., Q. Zhang, H. Dai, Y.C. Fu, and **Y. Li.** 2018. Separation/concentration-signal-amplification in-one method based on electrochemical conversion of magnetic nanoparticles for electrochemical biosensing. Electroanalysis 30(3):517-524. DOI: 10.1002/elan.201700653

Dai, H., Y.Q. Li, Y.C. Fu, and **Y. Li.** 2018. Enzyme catalysis induced polymer growth in nanochannels: A new approach to regulate ion transport and to study enzyme kinetics in nanospace. Electroanalysis 30(2):328-335 (available online Dec. 18, 2017). DOI:10.1002/elan.201700703

Dai, H., Y.Q. Li, Q. Zhang, Y.C. Fu, and **Y. Li**. 2018. A colorimetric biosensor based on enzyme-catalysis-induced production of inorganic nanoparticles for sensitive detection of glucose in white grape wine. RSC Advances 8:33960-33967. DOI: 10.1039/c8ra06347h

Guo, R.Y., S.Y. Wang, F.C. Huang, Q. Chen, **Y. Li;** M. Liao, and J.H. Lin. 2019. Rapid detection of Salmonella Typhimurium using magnetic nanoparticle immunoseparation, nanocluster signal amplification and smartphone image analysis. Sensors & Actuators: B. Chemical 284:134-139. doi.org/10.1016/j.snb.2018.12.110

Hu, Q.Q., R.H. Wang, H. Wang, M.F. Slavik and **Y. Li*.** 2018. Selection of acrylamide-specific aptamers by a quartz crystal microbalance combined SELEX method and their application in rapid and specific detection of acrylamide. Sensors and Actuators: B: Chemical 273:220-227. doi.org/10.1016/j.snb.2018.06.033

Lan, Lan, L.Y., D.K. Chen, Y. Yao, X.S. Peng, J. Wu, **Y. Li**, J.F. Ping, and Y.B. Ying. 2018. Phase-dependent fluorescence quenching efficiency of MoS2 nanosheets and their applications in multiplex target biosensing. ACS Applied Materials & Interfaces 10(49): 42009-42017. DOI: 10.1021/acsami.8b15677

Li, Y.Q., J. Liu, Y.C. Fu, Q.J. Xie, and **Y. Li.** 2019. Magnetic-core@dual-functional-shell nanocomposites with peroxidase mimicking properties for use in colorimetric and electrochemical sensing of hydrogen peroxide. Microchimica Acta 186:20. doi.org/10.1007/s00604-018-3116-8

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Wang, H., L.J. Wang, Q.Q. Hu, R.H. Wang, **Y. Li** and M. Kidd. 2018. Rapid and sensitive detection of Campylobacter jejuni in poultry products using a nanoparticles-based piezoelectric immunosensor integrated with magnetic immunoseparation. Journal of Food Protection 81 (8):1321-1330. doi:10.4315/0362-028X.JFP-17-381

Wang, L.J., R.H. Wang, H. Wei, and **Y. Li***. 2018. Selection of aptamers against pathogenic bacteria and their diagnostics application. World Journal of Microbiology and Biotechnology 34:149. doi.org/ 10.1007/s11274-018-2528-2

Xiao, X.N., W. Wang, Y.C. Fu, W.H. Fang, and **Y. Li***. 2018. Modeling transfer of Vibrio parahaemolyticus during peeling of raw shrimps. Journal of Food Science 83(3):756-762. DOI: 10.1111/1750-3841.14064

Xu, C.N., L.Y. Lan, Y. Yao, J.F. Ping, **Y. Li**, and Y.B. Ying. 2017. An unmodified gold nanorods-based DNA colorimetric biosensor with enzyme-free hybridization chain reaction amplification. Sensors & Actuators: B. Chemical. 273:642-648. doi.org/:10.1016/j.snb.2018.06.035

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Yu, X.F., F. Chen, R.H. Wang, and **Y. Li*.** 2018. Whole-bacterium SELEX of DNA aptamers for rapid detection of E. coli O157:H7 using a QCM sensor. Journal of Biotechnology 266:39-49. (available online, Dec. 22, 2017). doi.org/10.1016/j.jbiotec.2017.12.011

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Zheng, L.Y., G.Z. Cai, S.Y. Wang, M. Liao, **Y. Li**, and J.H. Lin. 2019. A microfluidic colorimetric biosensor for rapid detection of Escherichia coli O157:H7 using gold nanoparticle aggregation and smart phone imaging. Biosensors & Bioelectronics 124-125: 143-149. doi.org/10.1016/j.bios.2018.10.006

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Sadaka, S. Utilization of Crude Glycerin for Synthetic Gas Production and Potential Electricity Generation. 2017. Innovative Energy & Research. Volume 6. Issue 2 • 1000160. PP: 1-7**.**

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Other Peer-Reviewed Publications

Kandpal, V. and **C.G. Henry**. 2018. Evaluating Performance of Different Rice Cultivars in a Furrow-irrigated Rice Field in 2017. Arkansas Soybean Research Studies 2017. Research Series 651. University of Arkansas, Division of Agriculture, Arkansas Agricultural Experiment Station. August 2018. pp 279-287.

Kandpal, V. **C. G. Henry**, J. P. Gaspar, and A. P. Horton. 2018. Evaluating Performance of Different Cultivars and Irrigation Efficiencies in a Furrow-Irrigated Rice Field in 2016. Arkansas Soybean Research Studies 2017. Research Series 651. University of Arkansas, Division of Agriculture, Arkansas Agricultural Experiment Station. August 2018. pp 288-296.

Kandpal, V. and **C.G. Henry**. 2018. Grain Yield Response of Furrow-Irrigated Clearfield Hybrid XL745 to Different Nitrogen Sources. Arkansas Soybean Research Studies 2017. Research Series 651. University of Arkansas, Division of Agriculture, Arkansas Agricultural Experiment Station. August 2018. pp 271-278.

Henry, C.G., J.P. Gaspar, and A. P. Horton. 2018. Effectiveness of Irrigation Water Management Practices for Mid-South Furrow Irrigation. Proceedings of the Irrigation Association Annual Meeting. Long Beach Convention Center, Long Beach, CA.

Non-Refereed Publications and Articles

Austin, BJ, J.T. Scott, and **B.E. Haggard**. 2018. Managing Lake Fertility within the Guidelines of a Nutrient Management Plan and Based on Algal Nutrient Limitation. Final Report to the US Forest Service, AWRC Technical Report MSC 386, 14 pp.

Austin, B.J., B. Smith, and **B.E. Haggard**. 2018. Stream water quality to support HUC 12 prioritization in the Lake Wister Watershed, Oklahoma. Final Report to the Poteau Valley Improvement Authority, AWRC Technical Report MSC 385, 35 pp.

Reavis, M.A., and **B.E. Haggard**. 2018. Expanded Summary: Mitigating soil phosphorus release using liquid water treatment residuals. Journal American Water Works Association 110:12 (Page 34)

1-17 High Plains Journal – Ag innovation, sustainable crop practices and soil health top conference agenda (Bill Robertson, **Chris Henry**, Steve Green)
1-26 Magnolia Banner News- Irrigation water management school set for Jan. 30 at Jonesboro (**Chris Henry**)

1-26 Pine Bluff Commercial –First irrigation water management school set for Jan. 30 (**Chris Henry**)

1-26 Harrison Daily Times – Irrigation school set for Jan. 30 at Jonesboro (**Chris Henry**)

1-25 Pocahontas Star Herald – First irrigation water management school set for Jan. 30 at Jonesboro (**Chris Henry**)

1-26 Harrison Daily Times – Irrigation school set for Jan. 30 at Jonesboro (**Chris Henry**)

1-25 Pocahontas Star Herald – First irrigation water management school set for Jan. 30 at Jonesboro (**Chris Henry**)

2-27 Agfax – 9 Upcoming water management schools (**Chris Henry**)

2-28 Pine Bluff Commercial – U of A announces water management schools for 2018 growing season (**Chris Henry**)

2-28 Chicot Co Spectator – Water management skills taught throughout the state (**Chris Henry**)
2-28 Eudora Enterprise – Water management skills taught around state (**Chris Henry**)

2-27 Agfax – 9 Upcoming water management schools (**Chris Henry**)

3-7 Clay Co Times Courier – Extenson service hosting eirrigation school (**Chris Henry**)

3-2 High Plains Journal - Integrated water management schools offered for the upcoming growing season (**Chris Henry**, Stewart Runsick)

3-1 Clay Co Courier – Upcoming integrated water management schools for 2018 growing season (**Chris Henry**)

3-1 Batesville Guard – Integrated water management schools set for 2018 growing season (**Chris Henry**)

4-4 Batesville Guard – Farmers who can get the 'most crop per drop' sought (**Chris Henry**)

4-4 White Hall Journal– Most Crop per Drop irrigation contest entries due June 1 (**Chris Henry**)

4-3 Pine Bluff Commercial – Most Crop per Drop irrigation contest entries due June 1 (**Chris Henry**)

5-2 Clay Co Times - 2018 Arkansas Rice and Row Crop Irrigation Yield Contest planned (**Chris Henry**)

7-9 AgFax – Arkansas Rice Field Day, Stuttgart, Aug. 3 (Jarrod Hardke, Ehsan Shaika, Aaron Cato, Trent Roberts, Jason Norsworthy, **Chris Henry**, Nick Bateman, Yeshi Wamishe, Manuel Esguerra, Karen Moldenhauer, Xueyan Sha)

7-11 England Democrat - Cover crops, weeds, irrigation on agenda for August 3 Arkansas rice field day (Jarrod Hardke, Nick Bateman, Trent Roberts, **Chris Henry**, Aaron Cato, Yeshi Wamishe, Ehsan Shakina, Manuel Esguerra, Karen Moldenhauer, Xueyan Sha)

7-11 Pine Bluff Commercial – Arkansas rice field day to feature cover crops, weeds, irrigation (Jarrod Hardke, Nick Bateman, Trent Roberts, **Chris Henry**, Aaron Cato, Yeshi Wamishe, Ehsan Shakina, Manuel Esguerra, Karen Moldenhauer, Xueyan Sha)

7-19 Pocahontas Star Herald -- Cover crops, weeds, irrigation on agenda for Arkansas rice field day (Jarrod Hardke, Ehsan Shakiba, Nick Bateman, Aaron Cato, Trent Roberts, Jason Norsworthy, **Chris Henry**, Yeshi Wamishe, Manuel Esguerra, Karen Moldenhauer, Xueyan Sha)

8-1 England Democrat – Rice Field Day set for Aug. 3 at Stuttgart Rice Research Center (Jarrod Hardke, Trent Roberts, Nick Bateman, Manuel Esguerra, Aaron Cato, Yeshi Wamishe, **Chris Henry**)

8-2 Clay Co Courier – Rice field day August 3 (Jarrod Hardke, Trent Roberts, Nick Bateman, Manuel Esguerra, Aaron Cato, Yeshi Wamishe, **Chris Henry**)

Henry, C.G. 2018. Advancements in Furrow Irrigated Rice. Rice Technical Working Group, Long Beach, CA.

Henry, C.G. 2018. Adoption Rates for Rice Irrigation Practices in the mid-south. Rice Technical Working Group, Long Beach, CA.

Henry, C. G. 2019. Irrigation and Drainage. Corn Production Handbook. In press.

Henry, C. G., P.B. Francis, L. Espinoza, & D. M. Pickelmann. 2018. How to use Watermark Soil Moisture Sensors for Irrigation. Irrigation Information Factsheet. University of Arkansas – Division of Agriculture.

Henry, C. G. and D. M. Pickelmann. 2018. How to Prepare, Test & Install Watermark Sensors. Irrigation Information Factsheet. University of Arkansas – Division of Agriculture.

Henry, C. G., P.B. Francis, L. Espinoza and M. Ismanov. 2018. Timing the Final Irrigation using Watermark Sensors. Irrigation Information Factsheet. University of Arkansas – Division of Agriculture.

J. Batta-Mpouma, A. Sinha, A. Djioleu, J. Sakon, and **J.-W. Kim**. 2019. Interface Modification of Cellulose Nanocrystals for Multifunctional Materials. 2019 MRS Spring Meeting and Exhibit, April 22-26, Phoenix, AZ (accepted).

J.C. Henson, J. Batta-Mpouma, W. Kim, C. Chivers, A. Sinha, H.K. Jensen, M.O. Jensen, J. Kim, and **J.-W. Kim**. 2018. Nanopatterned Polycaprolactone/Cellulose Nanocrystal Composite Scaffold for Cardiovascular Tissue Engineering. IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), December 2-5, Honolulu, HI.

J. Lim, E. Jung, G. Lee, J. Lee, K. Park, **J.-W. Kim**, and H. Han. THz Vibration Spectroscoy of Crystalline a-Lactose Monohydrate. 2018. IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), December 2-5, Honolulu, HI.

G. Lee, S. Lee, J. Lim, J. Lee, **J.-W. Kim**, and H. Han. 2018. Quantitative Analysis of Tris-HCl Buffer using THz Time Domain Spectroscopy. IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), December 2-5, Honolulu, HI.

J. Batta-Mpouma, M. Iraniparast, A. Sinha, J. Sakon, V.P. Zharov, and **J.-W. Kim**. 2018. Cellulose Nanocrystal/Gold Nanoparticle Composites as Bifunctional Films for Biomolecular Sensing Applications. Nanotechnology for Health Conference, December 6-8, 2018, Winthrop Rockefeller Institute, Petit Jean Mountain, Morriton, AR.

J.C. Henson, J. Batta-Mpouma, C. Chivers, D. Romero, A. Sinha, H.K. Jensen, J. Kim, M. Jensen, and **J.-W**. **Kim**. 2018. Development of CNC/Polymer Composites for Cardiac Cell Proliferation and Differentiation. Nanotechnology for Health Conference, December 6-8, 2018, Winthrop Rockefeller Institute, Petit Jean Mountain, Morriton, AR.

G. Kandhola, A. Djioleu, H. Tchoungang, W.L. Headlee, B.A. Babst, A. Ghosh, J. Sakon, and **J.-W. Kim**. 2018. Cellulose Nanocrystals with Tunable Properties as Candidates for Healthcare Applications. Nanotechnology for Health Conference, December 6-8, 2018, Winthrop Rockefeller Institute, Petit Jean Mountain, Morriton, AR.

J. Henson**, J.-W. Kim**, H. Jensen, and M. Jensen. 2018. Size, Concentration, and Time Dependent Effects of PEGylated Gold Nanoparticles on Cardiovascular Cell Viability. 2018 BMES Annual Meeting, October 17-20, Atalanta, GA. (*accepted*)

G. Kandhola, A. Djioleu, K. Rajan, B.A. Babst, W.L. Headlee, D.J. Carrier, and **J.-W. Kim**. 2018. Effect of Source and Purity of Cellulose Pulp on the Yield adn Properties of Cellulose Nanocrystals Extracted from Forest Biomass. 256th ACS National Meeting, August 19-23, Boston, MA.

G. Kandhola, A. Djioleu, K. Rajan, B.A. Babst, W.L. Headlee, D.J. Carrier, and **J.-W. Kim**. 2018. Source-Yield -Property Interrelations for Cellulose Nanomaterials Extracted from Forest Biomass. 2018 ASABE Annual International Meeting, July 29- August 1, Detroit, MI.
Shen, Y.F., Y.W. He, Y.C. Fu, J.P. Wang, J.H. Lin, M.

Liao, and **Y. Li**. 2018. A nanomaterials-based biosensor for rapid detection of enrofloxacin in chicken products. ASABE Paper No. 1800703. ASABE 2018 Annual International Meeting, July 29-August 1, 2018, Detroit, MI. doi.org/10.13031/aim.201800703. ***ASABE-AOC Graduate Research Paper Award, 2nd Place.***

Sotero, A., R.H. Wang, T. Wen, B. Zhang, and **Y. Li**. 2018. A portable impedance aptasensing system for rapid detection of *Salmonella* Typhimurium in poultry products. ASABE Paper No. 1801147. ASABE 2018 Annual International Meeting, July 29-August 1, 2018, Detroit, MI. doi.org/10.13031/aim.201801147

Yao, P., N. Harris, R.H. Wang, X.G. Xi, J.Y. Wang, **Y. Li**, and S. Tung. 2018. 3D-printed pneumatic microfluidic mixer for colorimetric detection of *Listeria monocytogenes*. ASABE Paper No. 1800524. ASABE 2018 Annual International Meeting, July 29-August 1, 2018, Detroit, MI. doi: 10.13031/aim.201800524

Xi, G.X., R.H. Wang, Z. Chen, and **Y. Li.** 2018. Surface imprinted polydopamine based magnetic separation and quantum dots based fluorescent biosensor for detection of foodborne pathogenic bacteria. ASABE Paper No. 1801203. ASABE 2018 Annual International Meeting, July 29-August 1, 2018, Detroit, MI. doi: 10.13031/aim.201801203.

Liang, Y., Watkins, S.W. Tabler, G.T., McCreery, D**.** 2018. Sprinkler cool birds and conserve water. Engormix. Published online 10/30/2018.

Liang, Y., Tabler, G.T., **Clark**, F.D., **Kidd**, M.T. 2018. Getting broiler houses ready for the summer. University of Arkansas Systems Division of Agriculture, CES Factsheet, FSA8021

Liang, Y., Tabler, G.T., **Clark**, F.D., **Kidd**, M.T. 2018. Managing summer ventilation systems in broiler houses. University of Arkansas Systems Division of Agriculture, CES Factsheet, FSA8022.

Tabler, G.T., Moyle, J.R., Clark, F.D., **Liang**, Y., Wells, J. 2018. Setback Distances for Poultry Houses. Mississippi State University Extension. Factsheet. Publication 3209.

Liang, Y. 2018. Understanding weather essentials for smoke management. University of Arkansas Systems Division of Agriculture, CES Factsheet, In press (New).

Liang, Y., **VanDeverder**, K. 2018. Managing a livestock facility to minimize odors. University of Arkansas Systems Division of Agriculture, CES Factsheet, In review (major revision).

Reba ML, Fong BN, Teague TG, **Runkle BRK, Suvočarev K**, Eddy Covariance Measurements of Carbon Dioxide and Water Fluxes in Mid-South US Cotton, Summaries of Arkansas Cotton Research 2017, Arkansas Agricultural Experiment Station Research Series, 2018. (http://arkansas-ag-news.uark.edu/pdf/652_Summaries_Arkansas_Cotton_Research_2017.pdf#page=95)

Runkle BRK, Regionalizing Agricultural Field Evapotranspiration Observations, Arkansas Bulletin of Water Research, a publication of the Arkansas Water Resources Center, 2018 (https://arkansas-water-center.uark.edu/publications/arkansasbulletin/AWRC-journal-issue-2018-pages-compressed.pdf#page=58)

Luthra*, K., **S. Sadaka** and G. Atungulu. 2018. Experimental Study of Drying Rough Rice in a Fluidized Bed Exposed to Heating and Hold-Up Duration. An ASABE Meeting Presentation. Paper Number: 1801794. Detroit, Michigan.

Sadaka, S., K. Luthra*, & G. Atungulu. 2018. Effects of Aspect Ratio, Drying Temperature and Drying Duration on the Performance of a Custom-Made Fluidized Bed Drying System. In 2018 ASABE Annual International Meeting (p. 1). American Society of Agricultural and Biological Engineers. An ASABE Meeting Presentation. Paper Number: 1801795. Detroit, Michigan.

Beef Cattle Management For Water Quality Protection In Arkansas. 2018 revision.

D. Phillipp, Teague, K., **VanDevender, K.,** www.uaex.edu/publications/PDF/MP375.pdf

Nutrient Concentrations in Big Creek Correlate to Regional Watershed Land Use. 2018 New. J Burke, Sharpley A, Berry L, Brye K, Daniels M, Gbur E, **VanDevender K**, King S, Hays P, Haggard B., https://www.uaex.edu/publications/pdf/FSA-9537.pdf

VanDevender, K., Composting Daily Poultry Mortality: "Under the Hood" https://poultry-science.uark.edu/_resources/PDFs/November2018_AvianAdvice.pdf

Zhu, J. 2018. Nitrogen removal from swine wastewater via shortcut nitrification/denitrification using an Anammox sequencing batch reactor system. Presented at the 7th International Conference on Environmental Technology and Knowledge Transfer. June 12-13, 2018. Hefei, Anhui, China.

Professional Presentations

Invited Presentations:

Haggard, B.E. Illinois River: What, When and Where are we now? Oklahoma State Chapter of the Soil and Water Conservation Society, Grove, OK. June 2018.

Henry, C.G. Delta States Irrigation Conference. January 10-12, 2018, Memphis, TN, Keynote: Opening session, 4th Annual Delta States Irrigation Conference

J.-W. Kim and H. Han. 2018. Multifunctional Hybrid Nanomaterials in Bio/Nano medicine: Design and Assembly. IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), December 2-5, Honolulu, HI. (**Invited Talk**)

H. Han and **J.-W. Kim**. 2018. THz Biomolecular Spectroscopy. IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), December 2-5, Honolulu, HI. (**Invited Talk**)

J.-W. Kim. 2018. Programmable Molecular/Nanoscale Building Blocks and Development Strategies for Real-Time, *In Vivo* Molecular/Nano Sensing Platform. The 3rd International Conference on Manipulation, Automation and Robotics at Small Scales (MARSS 2018), July 4-8, Nagoya, Japan. (**Plenary**

S. Tung and **J.-W. Kim**. 2018. Maximizing Spatial Resolution of DNA Sequencing Using Single Carbon Chain. May 31-June 1, Advanced Genomic Technology Development Meeting, Northeastern University, Boston, MA. (**Invited Talk**)

Genomic Technology Development Meeting, Northeastern University, Boston, MA. (**Invited Talk**)

J.-W. Kim. 2018. Programmable Molecular/Nanoscale Building Blocks for Advanced Nano/Bio-Hybrid Materials. April 6, Houston Section IEEE Nanotechnology Council (NTC) Chapter (NANO 42), University of Houston, Houston, TX. (**Invited Talk** as an IEEE Nanotechnology Distinguished Lecturer)

J.-W. Kim. 2018. Multifunctional Hybrid Nanomaterials in Bio/Nano Medicine. December 18, Chonnam National University, Gwangju, Korea. (**Invited Talk**)

Li, Y. 2018. Poultry excellence in China: Improving food safety of poultry supply chain. An invited presentation at Global Food Safety Governance Forum, December 4, 2018, Beijing, China.

Li, Y. 2018. Biosensors for rapid detection of pathogens bacteria in agriculture and food. An invited presentation at International Forum of Food Safety and Health (IFFSH 2018), September 3-5, 2018, Changsha, Hunan Province, China.

Li, Y. 2018. Biosensors for agriculture and food: Challenges and opportunities. An invited presentation at Shihezi University, Shihezi, Xinjiang Province, China, August 28, 2018.

Li, Y. 2018. An international collaboration for improving food safety of poultry supply chain in China. An invited presentation at ASABE 2018 Annual International Meeting, July 29-August 1, 2018, Detroit, MI.

Li, Y. 2018. Nanomaterials-based biosensors for rapid detection of pathogenic bacteria and viruses in agriculture and food. An invited presentation for at Shanxi Agricultural University, Taigu, Shanxi Province, China, June 22, 2018.

Liang, Y. 2018. Developing crop residue burning inventory. Arkansas Fire Policy Forum hosted by ADEQ, March 29, 2018, Little Rock, AR (Invited talk)

Runkle, B.R.K. Host and organizer of symposium at the Rice Technical Working Group meeting, Long Beach CA, Feb. 2018; Rice Irrigation: Water Use and Greenhouse Gas Management

Runkle, B.R.K. Presented in UA Food Science departmental seminar, Sustainability in rice production practices, Sept 24, 2018.

VanDevender, Karl. Presented at AACD 2018 Annual Meeting (NLR, 2/14)

VanDevender, Karl. Haak Discovery Dairy Forage field tour (Haak Dairy, 5/15)

VanDevender, Karl. Speaker/Participant NRCS's Engineering Practices In-Service (Russellville, 8/14-8/17)

Zhu, Jun. Invited by the President of Northeast Agriculture University in China to give a keynote speech at 2018 China Livestock Environment and Precision Livestock Farming Symposium from September 3-5, 2018 in Harbin, China.

Other Lectures, Papers and Oral Presentations:

Austin, B.J., B. Olsen, T. Wentz, and **B.E. Haggard**. 2018. Algal blooms in Arkansas streams, ponds and lakes. Arkansas Water Resources Center Fact Sheet FS-2018-02; see: https://arkansas-water-center.uark.edu/publications/factsheets/FS-2018-02-Algal-blooms-in-Arkansas-streams-ponds-and-lakes-compressed.pdf

Burke, J., A. Sharpley, L. Berry, K. Brye, M. Daniels, E. Gbur, K. VanDevender, S. King, P. Hays, and **B. Haggard**. 2018. Nutrient concentrations in Big Creek correlate to regional watershed land use. UA Division of Agriculture Fact Sheet FSA9537

Daniels, M., B.J. Austin, and **B.E. Haggard**. 2018. How to sample: collecting water samples is so easy anyone can do it! Arkansas Water Resources Center Fact Sheet FS-2018-01; see: https://arkansas-water-center.uark.edu/publications/factsheets/FS-2018-01-How-to-collect-a-water-samples.pdf

Scott, E.E., and **B.E. haggard**. 2018. Annual Technical Report Submitted to the US Geological Survey, MSC102.2017; see: https://arkansas-water-center.uark.edu/publications/annual-reports-104b/MSC102.2017AnnualReport.pdf

PUBLICATIONS

Austin, B.J., B. Smith, and **B.E. Haggard**. Subwatershed Prioritization of Lake Wister Watershed Using Baseflow Water Quality Monitoring Data. Oklahoma Clean Lakes and Watersheds Conference, Stillwater, Oklahoma. April 2018.

Lasater, A.L., B.J. Austin, E.E. Scott, and **B.E. Haggard**. Stream Discharge Monitoring and Load Estimation for Small Scale Watersheds. University Council on Water Resources (UCOWR) 2018 Annual Conference. Pittsburgh, PA. June 2018.

Haggard, B.E., and B.J. Austin. Sediment phosphorus release sustains nuisance algal growth in a small impoundment. University Council on Water Resources (UCOWR) 2018 Annual Conference. Pittsburgh, PA. June 2018.

Henson, E., A.L. Lasater, and **B.E. Haggard**. Reducing Dissolved Phosphorus in Stream Water May Not Influence Estimation of Sediment Equilibrium Phosphorus Concentrations. Arkansas Water Resources Center Annual Water Research Conference, Fayetteville, AR. July 2018.

Henson, E., A.L. Lasater, and **B.E. Haggard**. Reducing Dissolved Phosphorus in Stream Water May Not Influence Estimation of Sediment Equilibrium Phosphorus Concentrations. University of Arkansas Honors College Research Conference, Fayetteville, AR. October 2018.

Lee, D., B.J. Austin, and **B.E. Haggard**. Microcystin and Algal Biomass in Streams Across a Land-Use Gradient in Northwest Arkansas. Arkansas Water Resources Center Annual Water Research Conference, Fayetteville, AR. July 2018.

Ledezma, H.E.O., B. Smith, B.J. Austin, and **B.E. Haggard**. Comparison of Three Methods for Measuring Chlorophyll in Water Samples. Arkansas Water Resources Center Annual Water Research Conference, Fayetteville, AR. July 2018.

Scott, E.E., B.A. Smith, and **B.E. Haggard**. Water-Quality Changes in the West Fork of the White River, Upstream to Downstream. Beaver Watershed Alliance Annual Symposium, Fayetteville, AR, September 2018.

Henry, C. G. Rice Technical Working Group. February 19-22, 2018. Long Beach, CA, Irrigation Advancements in Furrow Irrigated Rice.

Henry, C. G. Rice Technical Working Group. February 19 -22, 2018. Long Beach, CA, Adoption Rates for Rice Irrigation Practices in the mid-south.

Henry, C. G. Irrigation Association Meeting. December 5, 2018, Long Beach, CA, Effectiveness of Irrigation Water Management Practices in Furrow Irrigation.

Henry, C. G. ASABE Annual Meeting, July 29-Aug 1, 2018, Detroit, MI. Application of Irrigation Water Management Practices for Furrow Irrigation.

J. Batta-Mpouma, A. Sinha, A. Djioleu, J. Sakon, and **J.-W. Kim**. 2019. Interface Modification of Cellulose Nanocrystals for Multifunctional Materials. 2019 MRS Spring Meeting and Exhibit, April 22-26, Phoenix, AZ (accepted).

J.C. Henson, J. Batta-Mpouma, W. Kim, C. Chivers, A. Sinha, H.K. Jensen, M.O. Jensen, J. Kim, and **J.-W. Kim**. 2018. Nanopatterned Polycaprolactone/Cellulose Nanocrystal Composite Scaffold for Cardiovascular Tissue Engineering. IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), December 2-5, Honolulu, HI.

J. Lim, E. Jung, G. Lee, J. Lee, K. Park, **J.-W. Kim**, and H. Han. THz Vibration Spectroscoy of Crystalline a-Lactose Monohydrate. 2018. IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), December 2-5, Honolulu, HI.

G. Lee, S. Lee, J. Lim, J. Lee, **J.-W. Kim**, and H. Han. 2018. Quantitative Analysis of Tris-HCl Buffer using THz Time Domain Spectroscopy. IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), December 2-5, Honolulu, HI.

J. Batta-Mpouma, M. Iraniparast, A. Sinha, J. Sakon, V.P. Zharov, and **J.-W. Kim**. 2018. Cellulose Nanocrystal/Gold Nanoparticle Composites as Bifunctional Films for Biomolecular Sensing Applications. Nanotechnology for Health Conference, December 6-8, 2018, Winthrop Rockefeller Institute, Petit Jean Mountain, Morriton, AR.

J.C. Henson, J. Batta-Mpouma, C. Chivers, D. Romero, A. Sinha, H.K. Jensen, J. Kim, M. Jensen, and **J.-W. Kim.** 2018. Development of CNC/Polymer Composites for Cardiac Cell Proliferation and Differentiation. Nanotechnology for Health Conference, December 6-8, 2018, Winthrop Rockefeller Institute, Petit Jean Mountain, Morrilton, AR.

G. Kandhola, A. Djioleu, H. Tchoungang, W.L. Headlee, B.A. Babst, A. Ghosh, J. Sakon, and **J.-W. Kim**. 2018. Cellulose Nanocrystals with Tunable Properties as Candidates for Healthcare Applications. Nanotechnology for Health Conference, December 6-8, 2018, Winthrop Rockefeller Institute, Petit Jean Mountain, Morriton, AR.

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Wang, W.Q., R. Wang, and **Y. Li**. 2018. An LSPR sensor coupled with magnetic nanobeads-based immunoseparation for rapid and sensitive detection of *E. coli* O157:H7. A poster presented at AAFP 2018 Annual Meeting, September 17-20, 2018, Fayetteville, AR. *The 2nd Place of Poster Award in AAFP 2018 Graduate Students Poster Competition (Category 4).*

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Runkle BRK, Reba ML, **Suvočarev K**, Methane reductions from AWD irrigated rice production, Presentation at the Rice Technical Working Group, Feb 2018, Long Beach

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Wu, S., L. Chen, **J. Zhu**. 2018. Enhancing volatile fatty acids concentration by pre-digestion to be used as a carbon source for denitrification in liquid swine manure treatment. ASABE Annual International Meeting paper#: 1800068, Detroit, MI. July 29-Aug.1, 2018.

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Other Creative Endeavors

Haggard, B.E. The Arkansas Water Resources Center published the second issue of the Arkansas Bulletin of Water Research, see: https://arkansas-water-center.uark.edu/publications/arkansasbulletin/AWRC-journal-issue-2018-pages-compressed.pdf

Haggard, B.E. The Arkansas Water Resources Center also publishes data reports, linking data to technical reports and this year two data reports were published: DR-WQ-MSC386 and DR-WQ-MSC385; see: https://arkansas-water-center.uark.edu/publications/water-data-reports.php

US Patents issued.

Osborn, G.S., Method for improved rate and control of beverage carbonation with automatic shut-off, utility, issue date September 18, 2018, patent number 10,077,418.

US Patents applications submitted:

Henry, C. G.

Trailer, Labeling System, Control System and Program for Field Implementation of Computerized Hole Selection for Layflat Irrigation Pipe. This invention is still under review by the US patent office. It is comprised of two disclosures, "ATV Trailer for Multiple Inlet Rice Irrigation" and "Label system for Computerized Hole Selection of Lay flat Irrigation Pipe" They are two different inventions but it was decided to combine them for protection. The first is a trailer pulled by an ATV that creates a furrow and is made to transverse rice levees. The second invention take a computerized hole selection plan for furrow irrigation or multiple inlet rice from a smartphone device and prints the punch plan on the pipe as it is installed in the field. This has been submitted as a provisional patent and is still under review with the US Patent Office. In 2018, the working prototype was improved for the rice trailer system and for the toolbar version for furrow irrigation. The device was extensively tested in the field in 2018.

Variable-Flow Solar Powered Tail-Water Recovery Pump System. The device consists of an intake, sump, and supporting structure, a pump, a pump panel, and a depth sensor in its most basic form. The device can operate on grid power (electricity) or in an advanced form can operate on solar panels. Conceptually the device is placed at the tail end of a furrow or flood irrigated field and returns the tail water (runoff) back to the head of the irrigation system via above ground or below ground pipeline. It automatically adjusts to the variable flow of the tail water. The main value of this invention and concept is that it provides a new enhancement to furrow irrigation improving irrigation efficiency substantially. Thus producers using it may benefit from similar irrigation efficiencies as found in other higher efficiency and higher cost irrigation systems. This is in essence, a new type of irrigation system. The provisional patent was converted to a full utility patent application on 2017 and is still under review with the US Patent Office.

Portable Three Point Hitch Solar Panel Structure. The structure can be easily moved with a large tractor that has a category 2 or 3 hitch. The panel angle can be moved easily for maximum solar insolation capture for each season. The structure is designed to be moved to the field where a solar powered variable flow tail water pump is located around May until August and moved to a location where it can be connected to an inverter, where the panels can be used to generate electricity the rest of the year. This invention and patent application was combined with the Variable-Flow Solar Powered Tail-Water Recovery Pump System.

Advanced Surge System. This invention is a prototype of a new approach to a surge valve for furrow irrigation. There are many shortcomings with current surge valves that limit their adoption as a conservation tool. This device is meant to address these shortcomings and has new features not available that will improve the practice of surge irrigation. The device was disclosed for consideration and approved by the campus committee. A working prototype was tested and completed a test run in 2017. The patent application was submitted on 7/27/2018.

Osborn, G.S., System and Method for Improved Rate and Control of Beverage Carbonation with Automatic Shut-Off, Utility, August 16, 2018, 15/130,262, UA ID No. 15-16.

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