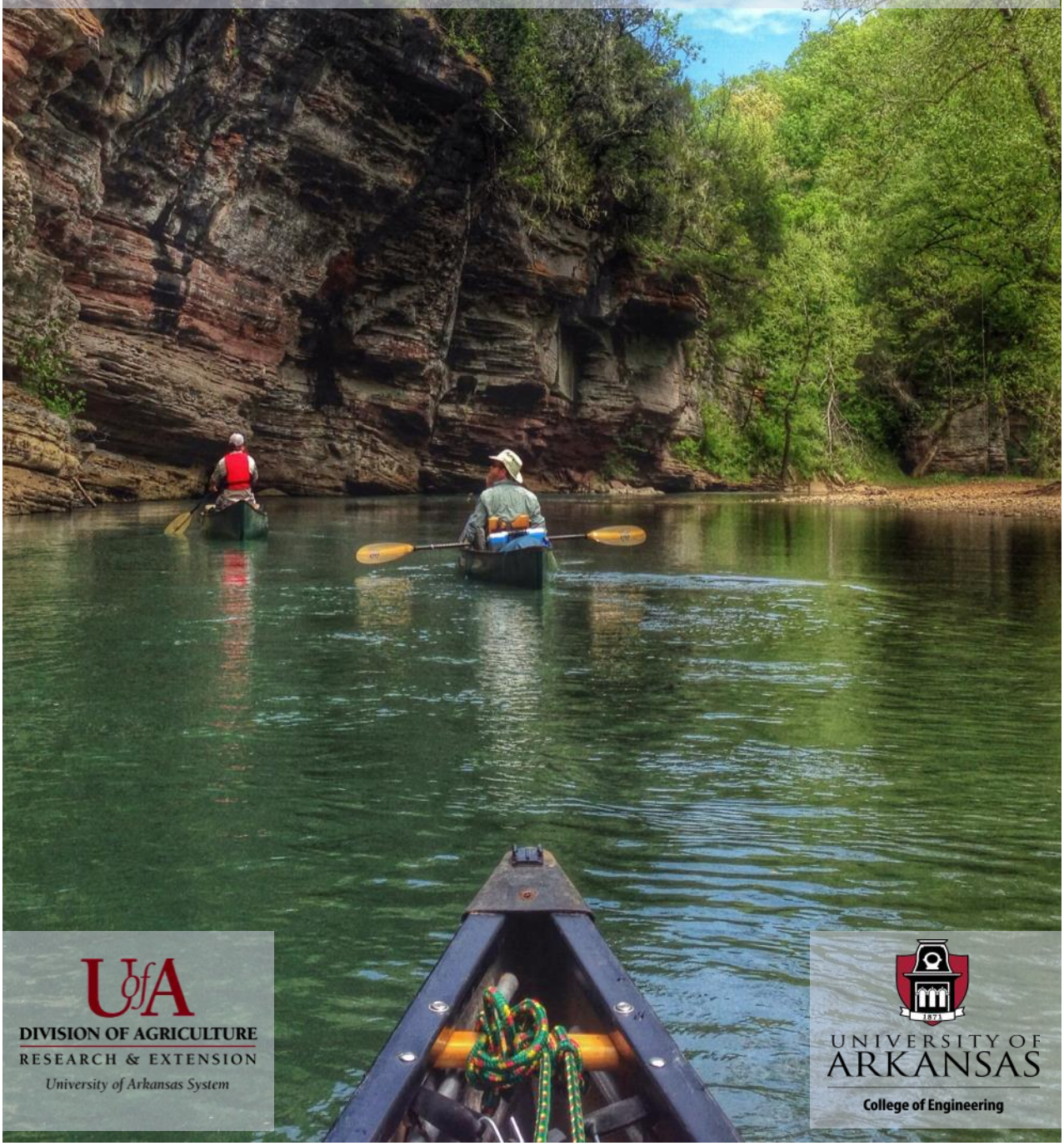
2015

Annual Report, 2015

University of Arkansas, Fayetteville. Dale Bumpers College of Agricultural, Food and Life Sciences. Dept. of Biological and Agricultural Engineering

Department of Biological and Agricultural Engineering

2015 Annual Report



UofA
DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

UNIVERSITY OF ARKANSAS
College of Engineering

2015
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

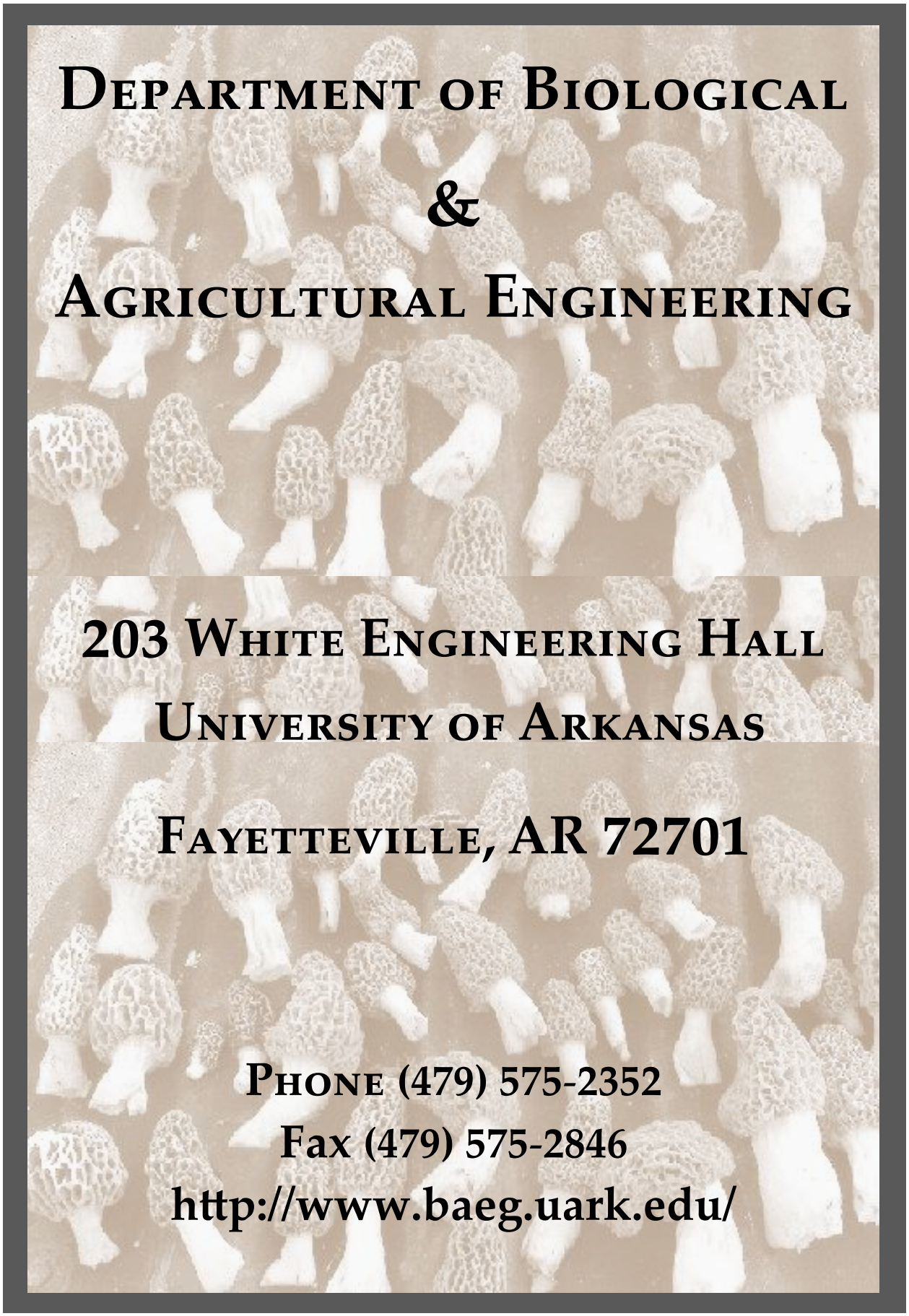
Arkansas Agricultural Experiment Station
Clarence Watson Jr.
Associate Vice President for Agriculture Research

Cooperative Extension Service
Tony Windham
Associate Vice President for Agriculture Extension

College of Engineering
John English
Dean

University of Arkansas
G. David Gearhart
Chancellor

Sharon Gaber
Provost and Vice Chancellor for Academic Affairs



Department of Biological & Agricultural Engineering

203 White Engineering Hall
University of Arkansas

Fayetteville, AR 72701

Phone (479) 575-2352
Fax (479) 575-2846
http://www.baeg.uark.edu/

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FOREWORD

FROM THE DEPARTMENT HEAD

Lalit R. Verma,
Professor and Department Head

I am proud to share the accomplishments of our faculty, students and staff during the past year. Our mission is "*to develop and disseminate engineering knowledge to address problems dealing with sustainable food, water and energy systems.*" Our faculty is delivering the Biological Engineering curriculum of sustainable food, water and energy systems. The Biological Engineering curriculum focuses on sustainable water, food and energy systems and has shown growing interest among incoming engineering freshmen. BAE Department is truly unique as it resides in both the UA System's Division of Agriculture and the UA College of Engineering. BAE research and teaching faculty are on the U of A campus, extension colleagues are in the state office of the UA System Division of Agriculture's Cooperative Extension Service in Little Rock, and one colleague is at the Rice Research and Education Center in Stuttgart. All our faculty are engaged in addressing problems important and relevant to our state and nation, dealing with challenges in sustainable water, food and energy systems in support of the Arkansas agriculture enterprise. These are very much in line with the grand challenges being faced by society in general and our profession.

The addition of an academic year Instructor and M&O support for academics from the College of Engineering have been critically helpful. Dr. Bailey Sullivan was hired as instructor for Biological Engineering. There were 108 undergraduates (sophomores to seniors) and 30 graduate students. We were notified of our successful 6-year ABET accreditation of the B.S. in Biological Engineering program. Dr. Tom Costello, ABET Coordinator deserves our gratitude and congratulations. One of our senior design teams, mentored by Drs. Tom Costello and Julie Carrier, presented "*Design of an Energy Producing Waste Treatment System Utilizing Anaerobic Co-Digestion of Organic Wastes Coupled with Algae Cultivation*" and was awarded third place in the G.B. Gunlogson Student Design Competition at the 2015 Annual International Meeting of the American Society of Agricultural and Biological Engineers (ASABE) in New Orleans, LA. The Senior Design Expo, under Dr. Tom Costello's leadership, was again very successful. Eighteen students in five teams showcased their senior design projects on May 5th in the BENG Design Expo. Mr. Christian Heymsfield was recognized as the "*Most Outstanding Graduating Senior*" in Biological Engineering in the College of Engineering.

Dr. Jin-Woo Kim received the Distinguished Achievement Award for Research from the University of Arkansas Alumni Association. He also received the College of Engineering's "The Most Engaging Research Faculty Award", which celebrates a faculty member who excels in collaborative and interdisciplinary research. Drs. Ben Runkle, Jun Zhu and Yi Liang were recognized with the departmental faculty awards for teaching, research, and service to students, respectively at the College of Engineering Spring Faculty meeting. Mr. Julian Abram received the Employee of the First Quarter Award on November 12, 2015 by the UA, the Staff Senate. Five outstanding alumni were inducted in the Arkansas Academy of Biological and Agricultural Engineering (AABAE) on April 8th. They are Mr. Ray Avery, P.E., Dr. Indrajeet Chaubey, Mr. Frederick "Anthony" Doss, P.E., Mr. Drake McGruder, and Dr. Chris Pixley. Mr. Stanley Reed (BSAGE 1973) was posthumously inducted into the College of Engineering "Hall of Fame." Mr. Mike Jones, (BSAGE 1967, MSAGE 1968) of was recognized as a Distinguished Alumnus and Dr. Chris Pixley (BSBAE 2002) was recognized as an Early Career Alumnus of the College of Engineering.

I hope you find this annual report informative and take time to review our programs www.bio-ag-engineering.uark.edu. Please continue to support our efforts and feel free to contact us with any suggestions or questions you may have.

Thank you

Lalit R. Verma, Ph.D., P.E.
Professor and Department Head

- Julie Carrier receives College of Engineering Imhoff Researcher Award.
- Thomas Costello receives College of Engineering Outstanding Teacher.
- Jin-Woo Kim receives the University of Arkansas Alumni Association Faculty Distinguished Achievement Award for Research.
- Yanbin Li was inducted into the National Academy of Inventors..
- Yanbin Li received ASAVE-ITSC 2016 Paper Award.
- Scott Osborn receives College of Engineering Outstanding Service to Students .
- Scott Osborn receives Patent 8,979,743, titled "System and Method for Dissolving Gases in Fluids and for Delivery of Dissolved Gases" was issued to Dr. S. Osborn, and Dr. M. Matlock. The patent is part of a technology manufactured by BlueInGreen LLC.
- Benjamin Runkle attended the 4th PAGE21 General Assembly (http://www.page21.eu/ga2015-iceland), funded by the European Commission to research "Changing Permafrost in the Arctic and its Global Effects in the 21st Century"; He presented a poster titled "Synthesizing surface-atmosphere energy exchange in lowland permafrost tundra". October 13-15, 2015, in Akureyri, Iceland.

ALUMNI ACCOMPLISHMENTS

- John Westerman was inducted into the Arkansas Academy of Biological and Agricultural Engineering
- Jessica Hart , Project manager with BlueInGreen was chosen as one of the Fast 15 class of 2015 by Northwest Arkansas Business Journal
- Zack Johnston, engineer with Crafton Tull was chosen as one of the Fast 15 class of 2015 by Northwest Arkansas Business Journal

Significant Accomplishments in 2015

Students

- Russell Bair was recognized as a First Ranked Senior Scholar from College of Engineering.
- Zach Callaway won 1st Place in PhD posters in Gamma Sigma Delta 2014 Students Competition. His advisor was Dr. Yanbin Li
- Kalavathy Rajan won first place in the A2C Graduate Student Research Competition. Her advisor is Dr. Danielle Julie Carrier.
- Grace Richardson named New Face of Engineering for DiscoverE (Engineers Week)
- Gurdeep Singh won second place in the A2C Graduate Student Research Competition. His advisor is Dr. Dharmendra Saraswat.
- R. Bair, T. M. McVey , C. Reavis, D. Smith. 2014. "Design an Anaerobic Digester to Produce Fuel from Food Wastes to Power Campus Transit Buses". Second place, G.B. Gunlogson National Student Design Competition, held at the 2014 annual international conference of the American Society of Agricultural and Biological Engineers (ASABE), Montreal, Canada, July 13-17, 2014. Faculty mentor: T. A. Costello.
- The freshman engineering program honors symposium award best paper, presentation and poster in various categories at the annual event – Dr .Haggard's team won best presentation in the environment and energy category in 2014
- Rossetti, M.S. and N.K. Ownby. The potential release of phosphorus in floodplains. Best Presentation, Environment and Energy Section, FEP Honors Symposium, Spring 2014. This research was also published in the journal, Discovery – The Undergraduate Research Journal of the Dale Bumpers College of Agricultural, Food and Life Sciences. The advisor is Dr. Brian Haggard.
- Sardar Abdullah, Ph.D. Student in Cell and Molecular Biology won the 3rd place of the 2014 Ph.D. Student Oral Presentation Competition sponsored by the Arkansas Chapter of Gamma Sigma Delta (***GSD***), March 12, 2014, Fayetteville, AR. His presentation title is "Aptamer and mmicroelectrode based impedance assay for detection of H5N1 influenza virus". His advisor is Dr. Yanbin Li.
- Lizhou Xu, Ph.D. Student in Biosystems Engineering won the 2nd place of AOCABFE 2014 Graduate Research Papers Competition, July 13-16, 2014, Montreal, Canada. His paper title is "A fluorescent aptasensor coupled with nanobeads-based immunomagnetic separation for simultaneous detection of four foodborne pathogens". Hi advisor is Dr. Yanbin Li.
- Zach Callaway, Ph.D. student in Biological Engineering won the SFC Intervention Honorable Mention Poster Award in AAFP 2014 Research Poster Competition, September 11-13, 2014, Fayetteville, AR. His paper title is "Modeling the electromagnetic properties of bacterial cells with different materials immobilized on microelectrodes in impedance biosensors". His advisor is Dr. Yanbin Li.
- Lizhou Xu, Ph.D. student in Biosystems Engineering won the Vivione Biosciences Rapid Detection Methods Poster Award in AAFP 2014 Research Poster Competition, September 11-13, 2014, Fayetteville, AR. His paper title is "A fluorescent aptasensor coupled with nanobeads-based immunomagnetic separation for simultaneous detection of four foodborne pathogens". His advisor is Dr. Li.
- Sardar Abdullah, Ph.D. student in Cell and Molecular Biology won the J.B. Hunt Honorable Mention Poster Award in AAFP 2014 Research Poster Competition, September 11-13, 2014, Fayetteville, AR. His presentation title is "Aptamer and microelectrode based impedance assay for detection of H5N1 influenza virus". His advisor is Dr. Yanbin Li
- Meng Xu, Ph.D. student in Biological Engineering, won the 2nd Place of Graduate Research in Food Science in University of Arkansas 2014 Graduate Student Research Poster Competition, November 14, 2014, Fayetteville, AR. His paper title is "Screen-printed electrode based aptasensor for rapid detection of E. coli O157:H7 in foods". His advisor is Dr. Yanbin Li.
- Freshman Honors Research team, Indran Kamalanathan and Isabelle Pumford won best paper award for College of Engineering Freshman Honors Colloquium Environment Section. Their advisor is Dr. Scott Osborn.

Danielle Julie Carrier, Ph.D.
Professor
B.S.(1984) McGill University, Canada
M.S. (1986) McGill University, Canada
Ph.D. (1992) McGill University, Canada
Research Areas: Processing of biological materials, biomass saccharification, inhibitory product characterization, compound fractionation and purification and biorefinery co -products development.

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.
Assistant 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; develop curricula and training materials for educational programs in 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, biocatalysis technology, environmental biotechnology, nucleic acid technology, and nano-biotechnology.

Mansoor Leh, Ph.D.
Instructor
B.S. Civil Engineering (2001) Kwame Nkrumah University of Science & Technology, Ghana
M.S. Biological Engineering (2006) University of Arkansas
Ph.D. Biological Engineering (2011) University of Arkansas

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
Ph.D. Ag.E. (1989) Pennsylvania State University
Research Areas: Biotechnology engineering, biomedical engineering, biosensor technologies, microbial predictive modeling, quantitative risk assessment, and antimicrobial technologies.

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; grain drying, handling, and storage 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 RuralSustainability
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.

Robert Morgan, Ph.D.
Adjunct Faculty
Manager of Environmental Quality, Beaver Water District
B.S. Civil Eng. (1973) University of Arkansas
M.S. Civil Eng. (2003) University of Arkansas
Ph.D. (2007) University of Arkansas

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: Biotechnology engineering, ecological engineering, dissolved oxygen and ozone technologies, Biological Modeling, drying and energy processes.

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, Surface water nutrient fluxes and source partitioning. Land-atmosphere exchange of carbon dioxide, methane, and water vapor.

Sammy Sadaka, Ph.D., P.E., P.Eng.
Assistant 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 conservation

Dharmendra Saraswat, Ph.D.
Associate Professor / Extension Engineer—Geospatial
B.S. Ag.E. (1988) Allahabad University, India
M.S. Ag.E. (1990) Indian Agricultural Research Institute, India
Ph.D.(2007) Ohio State University
Research Areas: Geospatial analysis, mobile-, web-, and cloud-based system design and development, precision agriculture for nursery plants and row crops, bio-Energy, and watershed modeling.

Bailey Sullivan, Ph.D.
Instructor
B.S. Ag.E. (1988) Allahabad University, India
M.S. Ag.E. (1990) Indian Agricultural Research Institute, India
Ph.D.(2007) Ohio State University
Research Areas: Utilization of molecular methods to investigate the fate and transport of soil and water contaminants including antibiotics, antibiotic resistant bacteria, and antibiotic resistance genes.

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

PRATHAMESH BANDEKAR
Research Associate

HOLLY BEASON
Administrative Support Supervisor, Extension

ERIC CUMMINGS
Program Associate

STACI HUDSPETH
Department Fiscal Manager

JERRY JACKSON
Skilled Tradesman

MANSOOR LEH
Instructor

JAMES MCCARTY
Research Associate

LINDA PATE
Department Administrative Manager

HEATHER SANDEFUR
Research Associate

LEE SCHRADER
Program Assistant

JIACHENG SHEN
Post Doctoral Associate

ARVIND SINHA
Post Doctoral Associate

KOSANA SUVOCAREV
Post Doctoral Associate

ERIN SCOTT
Program Associate

KAREN WITHERS
Administrative Office Supervisor, Extension

RONGHUI WANG
Post Doctoral Associate

BAEG Advisory Board
2015-2016 Members

Mark Christie
Manufacturing Services
Tyson Foods

Allen Fortenberry
Chief Executive Officer
Beaver Water District

Tyler Gipson
Hydraulic Engineer
US Army Corps of Engineers

Kevin J. Igli
SVP and Chief EHS Officer
Tyson Foods

Kyle Krueger
Garver Engineering

Jeff Madden
Director of Engineering
Riceland Foods, Inc.

Toni Peacock McCrory
Sr. Manager
EH&S Compliance Systems (Enviance)
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

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2015-2016 Members

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Tyson Foods, Inc

Anthony Doss
Tyson Foods, Inc

Toni Peacock
Stormwater Project Manager, Walmart

Christopher Pixley
VP of Operations
Pacific Vet Group-USA

Rusty Tate
Garver Engineering

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)

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)

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

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

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)

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

Glenn Davis
B.S. ('67)

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)

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)

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)

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)

Albert E. "Gene" Sullivan
B.S. ('59)
COE Distinguished Alumni 2007

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

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

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

J. Randy Young
B.S. ('71), M.S. ('75)
COE Distinguished Alumni 2006

Honorary Academy Members

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

Albert H. Miller
Posthumously

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

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

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

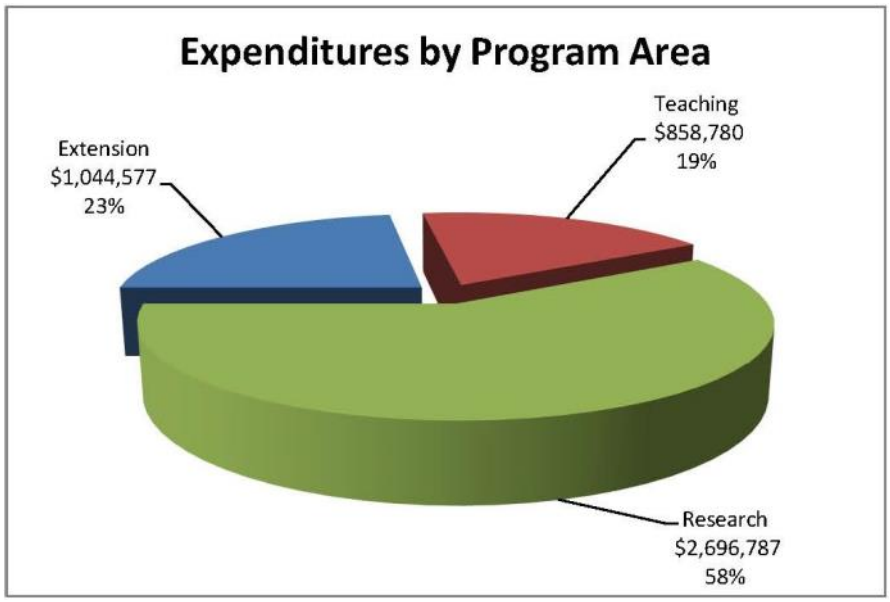
Carl L. Griffis
B.S. ('63), M.S. ('65), Ph.D. ('68)

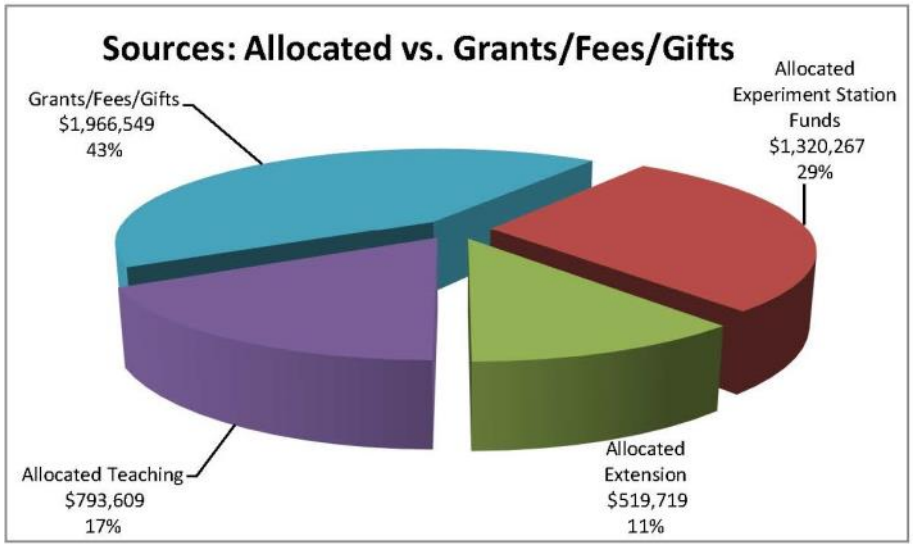
Freddie C. Stringer
B.S. ('70)

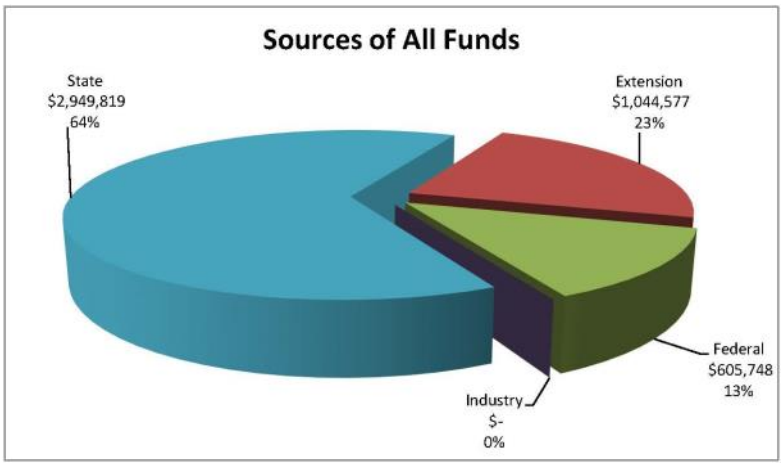
2015 Academy Inductee

John Westerman
B.S. ('94)

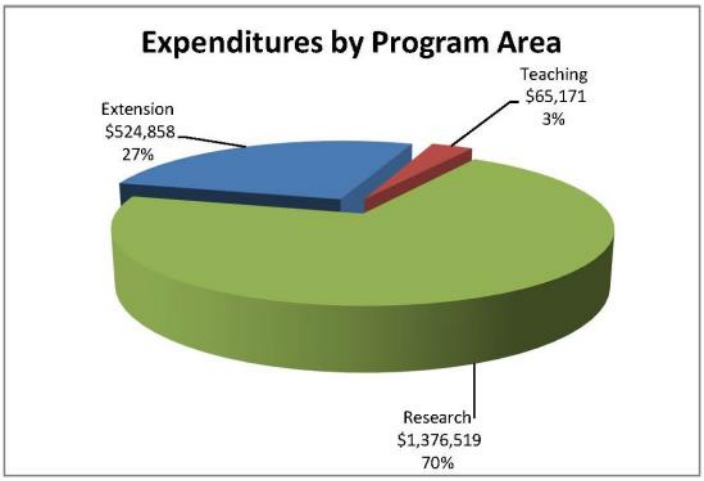
TOTAL EXPENDITURES, JULY 1, 2014 TO JUNE 30, 2015
$4,600,144

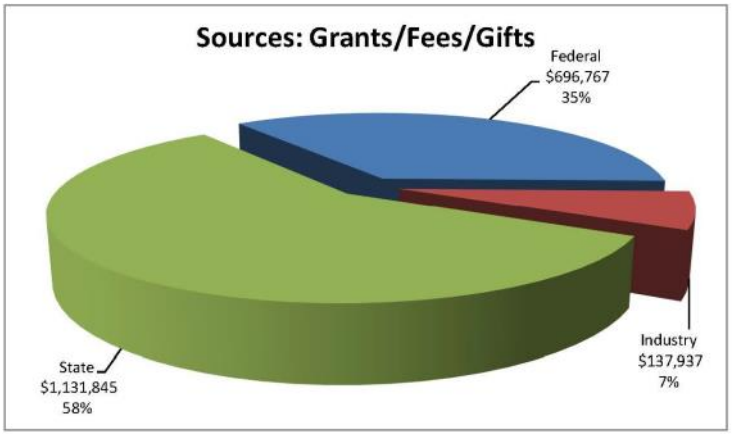






GRANTS/FEES/GIFTS
$1,966,549





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 bang 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 and white.

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 fund-raising 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 on 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

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

The City of Fayetteville recently ranked eighth in the Best Metro on *Forbes Magazine's* "Best Places for Business and Careers," boasting a ranking of 12 and 16 for cost of doing business and job growth for 2007, and rose to fourth in 2009. *Forbes* also listed Fayetteville among the "Top College Sports Towns" (sixth in 2009 and seventh in 2010), and ranked it 15th in "Top 100 Metropolitan Areas in the Nation for Business and Careers."

Kiplinger's 2008 "Best Cities to Work, Live and Play" list featured Fayetteville as its number seven choice. The Milken Institute gave the Fayetteville-Springdale-Rogers area a rank of 26 for "Best-Performing Large Cities for 2011," while *Area Development Magazine* listed the city among its "Top 100 Leading Locations" for the same year. CNBC Best States for Business honored Arkansas State with a rank of #1 in the "Cost of Doing Business" category.

According to the 2010 census, Fayetteville has a population of 73,580 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. With 2005 sales of $26 billion, Tyson Foods is the second-largest food production company in the Fortune 500, the largest meat producer in the world, and according to Forbes one of the 100 largest companies in the United States.

Teaching Program

Undergraduate Program

Scholarship Recipients for 2015

Arkansas Academy of Biological & Agricultural Engineering Scholarship

Jacob Hickman
Ryan Clark
Paul Naegle
Khoa Thai
Arlena Tran
America Sotero
Sarah Witrz

Biological & Agricultural Engineering Departmental Scholarship

Dustyn Perkins
Khoa Thai

Billy Bryan Scholarship

Brandon Kanwischer
Madeline Ludwig
Arlena Tran

J.A. Riggs Tractor Company Scholarship

Mckenna Blecher
Jacob Allen Hickman
Thomas Matthew McVey
Sarah Elizabeth Wirtz

Xzin McNeal Scholarship

Lyndsey Nicole Copley
Andrew Dugan
Aya El-Khouly
Thomas Helvick
Paul Naegle
Sophia Scalise
Andrew Shaw
Clayton Dean Shook
America Sotero
Sarah Elizabeth Wirtz

John W & Trannye Odom White Scholarship

Kami Parmenter
Sarah Elizabeth Wirtz

Mike & Yvonne Jones Scholarship

Jenna Bruick
Shelby Owens

Beaver Water District

Andrew Stephens

Graduates for 2015

Bachelor of Science in Biological Engineering

Spring 2015
Daniel Bugler
Joe Carter
Derek Daniels
Aya El-Khouly
Elizabeth Marhefka
Trenton McKenzie
Hector Ortega Lozano
Shelby Owens
Jared Schnebelen
Benjamin Sharon
Katherine Smith
Shelby Spence
Arlene Tran
Sarah Wirtz

Summer 2015
Pablo Bolanos
Barret Knutson
Benjamin Matthews
Lee Nosal

Fall 2015
Khoa Thai

Biological Engineering Student Club

2015-2016 Officers

Hailey Flatte—*President*

Bailey Smith—*Vice President*

Jacob Hickman—*Treasurer*

Casey Gibson—*Secretary*

Annie Makuch—*Public Relations*

Advisor: Dr. Scott Osborn

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 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 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.

TEACHING PROGRAM

UNDERGRADUATE PROGRAM

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 2013-2014 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 1113 University Chemistry for Engineers I (or CHEM 1103) 4 MATH 2554 Calculus I 4 PHYS 2054 University Physics I **15 Semester hours**	**Second Semester** 1 GNEG 1121 Introduction to Engineering II 3 ENGL 1023 Technical Composition II 4 Freshman Engineering Science Electives * 4 MATH 2564 Calculus II 3 U.S. History Requirement **15 Semester hours**
Sophomore Year	
First Semester 2 BENG 2632 Biological Engr Design Studio 4 MATH 2574 Calculus III 4 Sophomore Science Electives ** 4 BIOL 1543/1541L Principles of Biology and Lab 3 MEEG 2003 Statics **17 Semester hours**	**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 3733 Transport Phenomena in Biological Systems 3 BENG 3653 Global Bio-Energy Engineering 4 CHEM 3603/3601L Organic Chemistry I w/Lab 3 CVEG 3213, Hydraulics (OR MEEG 3503 OR CHEG 2133) 3 ELEG 3903 Electric Circuits and Machines **16 Semester hours**	**Second Semester** 3 BENG 3723 Unit Operations in Biological Engr 3 BENG 3113 Measurements and Controls for Biological Systems 4 CHEM 3613/3611L Organic Chemistry II w/Lab 3 BIOL 3863 General Ecology 3 CVEG 3223 Hydrology **16 Semester hours**
Senior Year	
First Semester 3 BENG 4813 Senior Biological Engineering Design I 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** 2 BENG 4822 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

* The Freshman Engineering Science Elective must be chosen from either (CHEM 1133/1131L or CHEM 1123/1121L) or PHYS 2074.

** The Sophomore Science Elective must be: PHYS 2074 if (CHEM 1133/1131L or CHEM 1123/1121L) was chosen as the Freshman Engineering Elective; or (CHEM 1133/1131L or CHEM 1123/1121L) if PHYS 2074 was chosen as the Freshman Engineering Science Elective. That is, both courses are required for the degree.

B. **Students without an Engineering Degree**

- Students to a M.S. program from a non-engineering BS 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.

Details concerning other admission requirements can be found in the BAEG Graduate Handbook.

GRADUATE STUDENTS

The following students were part of the Graduate program during 2014. 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
Adrian Beirise	Dr. G. Scott Osborn
Barrett Carter	Dr. Jun Zhu
Jason Corral	Dr. Brian Haggard
Noaa Frederick	Dr. Julie Carrier
Jaime Gile	Dr. Brian Haggard
Vaishali Kandapal	Dr. Chris Henry
Eeshan Kumar	Dr. Dharmendra Saraswat
Kaushik Luthra	Dr. Yi Liang
James McCarty	Dr. Marty Matlock
William Merritt McDougall	Dr. Chris Henry
Jay Mishra	Dr. Chris Henry
Colt Oade	Dr. Chris Henry
Sakura Phansiri	Dr. G. Scott Osborn
William Putman	Dr. Marty Matlock
Colby Reavis	Dr. Benjamin Runkle
Richard Sakul	Dr. Julie Carrier
Zachary Simpson	Dr. Brian Haggard
Amandeep Singh	Dr. Julie Carrier
Zhuo Zhao	Dr. Yanbin Li

MASTER OF SCIENCE IN CELL AND MOLECULAR BIOLOGY

STUDENT	ADVISOR
Charles Armistead	Dr. Jin-Woo Kim

DOCTOR OF PHILOSOPHY IN BIOLOGICAL ENGINEERING

STUDENT	ADVISOR
Zachary Callaway	Dr. Yanbin Li
Eric Cummings	Dr. Marty Matlock
Josef Dalaeli	Dr. Scott Osborn
Angele Mezindjou Djioleu	Dr. Julie Carrier
Mahmoud Sharara	Dr. Sammy Sadaka
Gurdeep Singh	Dr. Dharmendra Saraswat
Gagandeep Singh Ubhi	Dr. Sammy Sadaka
Meng Xu	Dr. Yanbin Li

DOCTOR OF PHILOSOPHY IN CELL AND MOLECULAR BIOLOGY

STUDENT	ADVISOR
Sardar Abdullah	Dr. Yanbin Li
Joseph N, Batta-Mpouma	Dr. Jin-Woo Kinm
Xiaofan Yu	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 2015
Willian Merritt McDougall MSBE
Mahmood Sharara Ph.D.

SUMMER 2015
Prathamesh Bandekar MSBE
James Allen McCarty MSBE
William Benjamin Putman

FALL 2015
Noaa Thankful Frederick MSBE
Eeshan Kumar MSBE
Gurdeep Singh Ph. D.
Angele Mezindjou Djioleu Ph.D.

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
Sadar Abdullah	PhD Cell and Molecular Biology	Dr. Yanbin Li
Chase Armistead	Master Science Cell and Molecular Biology	Dr. Jin-Woo Kim
Maryam Asharour	PhD Chemical Engineering	Dr. Thomas Costello
David William Astorino	Master of Science Engineering	Dr. Otto Loewer
Joseph N. Batta-Mpouma	Master Science Microelectronics-Photonics	Dr. Jin-Woo Kim
Johnny Chamberlain	PhD Environmental Dynamics	Dr. Thomas Costello
Sandeep Chalamalasetty	PhD Mechanical Engineering	Dr. Yanbin Li
Huang Dai	PhD Zhejiang University	Dr. Yanbin Li
Rebecca Gill	PhD Cell and Molecular Biology	Dr. Yanbin Li
Austin Lewis	Master of Science ASU University	Dr. Chris Henry
Zhishang Li	Master Science Zhejiang University	Dr. Yanbin Li
Dustin Lynch	PhD Biology	Dr. Brian Haggard
Xiangning Xiao	Master Science Zhejiang University	Dr. Yanbin Li
Hou Min Zhong	Master Science Food Science	Dr. Scott Osborn
Zeina Al-Dolami	PhD Microelectronics-Photonics	Dr. Jin-Woo Kim
Maryam Asharour	PhD Chemical Engineering	Dr. Thomas Costello
Hua Bai	PhD Crop, Soil & Environmental Science	Dr. Chris Henry
Sandeep Chalamalasetty	PhD Mechanical Engineering	Dr. Yanbin Li
Huang Dai	PhD Zhejiang University	Dr. Yanbin Li
Lamine Diop	PhD Ohio State University	Dr. Chris Henry
Qinqin Hu	PhD Zhejiang University	Dr. Yanbin Li
Zhanming Li	PhD Zhejiang University	Dr. Yanbin Li
Dustin Lynch	PhD Biology	Dr. Brian Haggard
David Lyon	PhD Environmental Dynamics	Dr. Benjamin Runkle
Abdollah Mosleh	PhD Microelectronics-Photonics	Dr. Jin-Woo Kim
Sangeeta Mukhopadhyay	PhD Food Science	Dr. Scott Osborn
Leigh Parette	PhD Poultry Science	Dr. Yanbin Li
Zahohui Qian	PhD Zhejiang University	Dr. Yanbin Li
Kalavathy Rajan	PhD Food Science	Dr. Julie Carrier & Dr. Thomas Costello
John Allen Ramaker	Master of Science Engineering	Dr. Otto Loewer
Gillian Simpson	SICCS MSc, University of Hamburg, Germany	Dr. Benjamin Runkle
S. Faye Smith	PhD Environmental Dynamics	Dr. Brian Haggard
Christopher Van Wanamaker	Master of Science Engineering	Dr. Otto Loewer
Annie West	PhD Environmental Dynamics	Dr. Brian Haggard
Shantae Wilson	Master Science	Dr. Sammy Sadaka
Lizhou Xu	PhD Zhejiang University	Dr. Yanbin Li
Xiaofan Yu	PhD Cell and Molecular Biology	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.

BENG2632 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).

BENG2643 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.

BENG3113 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 sensor calibration and signal conditioning, elementary control algorithms, basic electro-mechanical controls, and digital controls. Autonomous field and process monitoring and controls. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: ELEG 3903.

BENG3113H 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 sensor calibration and signal conditioning, elementary control algorithms, basic electro-mechanical controls, and digital controls. Autonomous field and process monitoring and controls. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: ELEG 3903

BENG3653 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).

BENG3723 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).

BENG3733 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.

BENG4123 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 4104.

BENG450V 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.

BENG451VH Honors Thesis (Sp, Su, Fa) Prerequisite:

Honors candidacy.

BENG452V 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.

BENG4663 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 and BENG 4743 and BENG 4933.

BENG4703 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 2622. Corequisite: Lab component.

BENG4743 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.

BENG4753L 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.

BENG4753M 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.

BENG4813 Senior Biological Engineering Design I (Fa) Design concepts for equipment and processes used in biological, food and agricultural industries. Initiation of comprehensive two-semester team-design projects; defining design objectives, development functional/mechanical criteria, standards, reliability, safety, ethics and professionalism issues. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: BENG 3723 and BENG 3733.

BENG4822 Senior Biological Engineering Design II (Sp) Continuation of BENG 4813. Design concepts for equipment and processes used in biological and agricultural industries. Completion of 2-semester team design projects. Construction, testing, and evaluation of prototypes. Written and oral design reports. Discussion of manufacturing methods, safety, ergonomics, analysis/synthesis/design methods as appropriate for particular design projects. Laboratory/design 4 hours per week. Prerequisite: BENG 4813.

BENG4933 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 or BENG 4903.

BENG500V 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.

BENG5103 Advanced Instrumentation in Biological Engineering (Even years, Sp) Applications of advanced instrumentation in biological systems. Emphasis on updated sensing and transducing technologies, data acquisition and analytical instruments. Lecture 2 hours, lab 3 hours per week. Corequisite: Lab component. Prerequisite: BENG 3113.

BENG5253 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)

BENG5303 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.

BENG5313 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.

BENG5323 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.

BENG5333 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.

BENG5343 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.

BENG5351 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.

BENG5613 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.

BENG5623 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.

BENG5633 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)

BENG5703 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.

BENG5723 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).

BENG5733 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.

BENG5743 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 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. Students may not earn credit for both BENG 5743 and BENG 4703. Prerequisite: Graduate standing. Corequisite: Lab component.

BENG5801 Graduate Seminar (Sp) Reports presented by graduate students on topics dealing with current research in biological engineering. Prerequisite: Graduate standing.

BENG5923 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.

BENG5933 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.

BENG5953 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: bioswales, 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.

BENG600V Master's Thesis (Sp, Su, Fa) (1-6) Prerequisite: Graduate standing.

BENG700V Doctoral Dissertation (Sp, Su, Fa) (1-18) Prerequisite: Candidacy.

Student Field Industry Tour FALL 2015

Visit to the Revis Farm. A row crop farm in Lonoak, AR

Visited the Rice Research Center on irrigation pumping

Visited Dr. Sammy Sadaka's bio energy research lab

Students visited LM Wind Power Plant, Little Rock, AR

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 food, water and energy systems.

- 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
- 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
- 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, energy effectiveness analysis

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; GIS-coupled sensing, web and mobile-device information delivery, modeling of watersheds, climate-change variables, and biomass resources; 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.

ALGAL BIOMASS PRODUCTION USING SWINE WASTEWATER TO IRRIGATE AND FERTILIZE

THOMAS COSTELLO, ASSOCIATE PROFESSOR

ISSUE:

Use of conventional fossil fuels (oil, coal, natural gas) is problematic because of uncertain future supplies of these finite resources, rising or uncertain costs of these fuels, concentration of major fuel supplies in parts of the world which are politically unstable, environmental impact of mining and drilling operations, and the cumulative effects of the release of carbon from the consumption of these resources. Biomass represents a renewable fuel source that can be harvested annually from available solar energy with minimal net carbon release. Algae growth can potentially capture many times more energy (per year per acre) than any other energy crop. Algae can also utilize nutrients from wastewater or from natural waters containing excess nutrients. This utilization of existing waste or by-product nutrient sources decreases the demand for commercial fertilizers that must be mined and trucked long distances. Algae growth provides biological treatment and water quality improvement of the influent flow. Hence, algae production represents a potentially sustainable energy source.

ACTION:

The UA Biological and Agricultural Engineering Department is continuing to investigate systems to produce algae using wastewater from swine production to yield biomass feedstock for biofuel production. The system grows attached periphytic algae in an open flow way with a continual stream of the inlet swine effluent. Experiments were conducted at Algae Flow Way facility adjacent to the UA Swine Grower Unit near Savoy Arkansas. Tests of the system using undiluted swine effluent were conducted with a reduced flow and a surging mode to document the productivity across the growing season in 2015.

IMPACT:

The algae flow way at Savoy is a premier algae research facility to test inland, freshwater periphytic algal productivity at mid-latitudes. The technology employed is scalable to larger areas that would be needed to produce enough biomass to feed large -scale biofuel refineries. The research will quantify the productivity of the systems and fine-tune production strategies to identify sustainable niche applications of the technology. Research results will provide data needed to perform objective economic analyses of the life cycle costs and environmental impacts of the proposed technology.

CONTACT:

Thomas Costello <tac@uark.edu> and Marty Matlock <mmatlock@uark.edu>
Department of Biological and Agricultural Engineering
479/575-2351

COLLABORATING SCIENTISTS:

Julie Carrier, Department of Biological and Agricultural Engineering
Sammy Sadaka, Department of Biological and Agricultural Engineering, UA Division of Agriculture Cooperative Extension Service
Karl VanDevender, Department of Biological and Agricultural Engineering, UA Division of Agriculture Cooperative Extension Service
Wen Zhang, Department of Civil Engineering
Charles Maxwell, Department of Animal Sciences
Greg Thoma, Department of Chemical Engineering

FUNDING SOURCES:

USDA, NIFA/AFRI
University of Arkansas Division of Agriculture, Dale Bumpers College of Agricultural, Food and Life Sciences
University of Arkansas College of Engineering

WATER QUALITY TRENDS IN STREAM REFLECT CHANGES IN THE RESERVOIR AND WATERSHEDS

BRIAN HAGGARD, PROFESSOR

ISSUE:

How does water quality change? It is improving, getting worse, or just staying the same? These are questions 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 has been monitoring water quality in almost 20 stream in Northwest Arkansas for the last several years to answer these questions.

ACTION:

The Arkansas Water Resources Center, funded by the 319 Nonpoint Source Program of the Arkansas Natural Resources Commission, collected water samples from 20 streams in the Upper Illinois River Watershed and the Upper White River Basin. 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 were evaluated using flow-adjusted concentrations and appropriate statistical techniques.

IMPACT:

The Arkansas Water Resources Center noticed three distinct findings that were important to the State. First, the increases in algae (measured as chlorophyll-a) in Beaver Lake coincided with increased nitrogen inputs from the watershed – this is important in understanding why Beaver Lake might not meet its water quality standards. Second, the recent reductions in phosphorus from the City of Springdale's wastewater treatment plant has reduced phosphorus concentrations in Spring Creek – however, these improvements have not been observed further downstream in the Illinois River yet. Finally, there is an increasing trend in chloride and sulfate concentrations in these streams – why is an important question, but it might be related to salt use during winter. These data are critical to our understanding of how we influence water quality with what we do in our watersheds.

CONTACTS:

Brian E. Haggard, Professor and Director, Arkansas Water Resources Center, University of Arkansas, Fayetteville, Arkansas

COOPERATING SCIENTISTS OR INSTITUTIONS:

FUNDING SOURCES:

DEMONSTRATING IRRIGATION WATER MANAGEMENT PRACTICES TO ARKANSAS FARMERS

CHRISTOPHER HENRY, ASSISTANT PROFESSOR, EXTENSION

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.

Success in 2015 with on-farm demonstrations in Mississippi and Arkansas shown a 28% and 25% reduction, respectively in water use while maintaining profitability. Implementation of such practices on a large scale will improve water sustainability in the region. 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:
Twenty-six on-farm demonstrations were conducted to compare Irrigation Water Management Practices to farmer managed irrigation practices. Flow meters were installed on paired fields of furrow irrigated corn, soybeans, cotton and peanut fields. IWM fields consisted of computerized hole selection, surge irrigation, ET-based scheduling with an Atmometer, and soil moisture monitoring. Agents and producers followed Extension recommendations for termination. Cost of water was determined for the irrigation pumps at each demonstration.

IMPACT:
County agent-led Irrigation Water Management (IWM) demonstrations found a 25% reduction in water use while maintaining yields in 2015 on 26 furrow corn, soybean, cotton and peanut irrigated fields. Wide-spread adoption of these IWM practices could have a dramatic impact on the overdraft of Arkansas aquifers if implemented. Additional improvements in profitability from pump evaluation and deep tillage were also proven.

CONTACTS:
Chris Henry, University of Arkansas

CONTACT EMAIL AND PHONE:
ghenry@uark.edu / 870-673-2661

COOPERATING SCIENTISTS:
Phil Horton, Jason Gaspar, Hunter James, Mike Daniels, Hank Chaney, Paul Francis, Leo Espinoza, Mukhammadzakhrab Ismanov, Amanda Free, Corey Hallmark, Mike Hamilton, Bill Robertson.

COUNTY AGENT DEMONSTRATION LEADERS:
Rick Wimberly, Grant Beckwith, Chuck Capps, Mitch Crow, Russel Parker, Stewart, Runsick, Herb Ginn, Mike Andrews, Jason Osborn, Dave Freeze, Craig Allen, Keith Perkins, Brett Gordon, Stan Baker, Anthony Whittington, Wes Kirkpatrick, Steve Kelly, Kevin Norton

FUNDING SOURCES:
United Soybean Board, Mid-south Soybean Board, Arkansas Soybean Promotion Board, and Arkansas Corn and Grain Sorghum Promotion Board.

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. The research has generated 6 peer-reviewed articles (2 invited review articles and 4 conference proceedings), 6 invited lectures, 3 conference presentations, and 2 pending patents during the year 2015.

CONTACT:
Jin-Woo Kim, Professor
Department of Biological and Agricultural Engineering
jwkim@uark.edu / 479-575-2351

FUNDING SOURCES:
National Science Foundation (NSF; award#: CMMI-1235100, ECCS-1128660 and OIA-1457888)

Bio-nanogate based Aptasensor for Rapid Detection of Avian Influenza Viruses

Yanbin Li, Professor, Tyson Endowed Chair in Biosensing Engineering

ISSUE:
Avian influenza (AI) H5N1 and H7N9 currently poses a potentially serious health threat to animals and human worldwide. Rapid, specific and sensitive detection of avian influenza virus (AIV) is becoming increasingly important and urgent. The technology for diagnosing AI infections is available, such as viral culture, diagnostic test kits, RT-PCR and ELISA methods, but these tests are either poor in specificity, low in sensitivity, time consuming, too expensive, or require a laboratory and a highly trained technician. Therefore, this research provides a bionanogate based aptasensor to rapidly detect AI virus at lower concentrations to meet the needs for rapid response to the potential pandemic of AI as described by CDC, WHO and FAO.

ACTION:
The primary goal of the present project is to design and develop an aptamer based bifunctional bio-nanogate that can (1) selectively respond to target molecules and (2) control enzymatic reactions for electrochemical measurements for sensitive, selective, rapid, quantitative, and label-free detection of virus. The specific objectives of the proposed project include: (1) design and construction of the aptamer based bio-nanogate: (a) fabrication of gold sputter coating film with nanopore arrays; (b) ssDNA probe attachment to the gold inner wall of nanopores and aptamer hybridization to the ssDNA; (2) construction of enzyme modified glassy carbon electrodes; and (3) demonstration and evaluation of the bio-nanogate controlled enzymatic reaction for sensitive and specific detection of target AIV H5N1.

IMPACT:
This aptasensor would provide the poultry industry with a very needed technology for rapid, sensitive and specific screening of AI H5N1, H5N2, H7N9 and other viruses in poultry. This will help the poultry industry be better prepared for AI, ensure poultry product safety and security and minimize the testing cost. Further, this will help our society in surveillance and control of avian influenza infections with animals and human. The aptasensor developed in this research can also be applied to the detection of other animal diseases.

CONTACT:
Yanbin Li, Professor, Department of Biological & Agricultural Engineering, Center of Excellence for Poultry Science, yanbinli@uark.edu / 479-575-2881

COOPERATORS:
Simon Ang (Electrical Engineering Dept), Ronghui Wang (Bio & Ag Engineering Dept), Huaguang Lu (Penn State University), Billy Hargis (Poultry Science Dept)

FUNDING:
ABI

ENGINEERED B-CELL BASED BIOSENSOR FOR DETECTION OF FOODBORNE PATHOGENS ISSUES

YANBIN LI, PROFESSOR, TYSON ENDOWED CHAIR IN BIOSENSING ENGINEERING

ISSUE:

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 in detection of major foodborne pathogens.

ACTION:

The specific aims of this project include were (1) Select and/ or develop membrane engineered B cells containing surface antibodies against *E. coli* O157:H7; (2) Construction of a fluorescent indicators for Ca2+ based on a pair of fluorescent proteins and transfection of the plasmid into the selected B-cells; and (3) Demonstrate and evaluate the proposed engineered B-cell biosensor for detection of *E. coli* O157:H7 in a broad range without sample pre-enrichment.

In this research, a biosensing system was developed for rapid detection of *E. coli* O157:H7 using calcium signaling of the B cell upon cellular membrane anchors anti-*E. coli* O157:H7 IgM. The binding of *E. coli* O157:H7 to the IgM on B cell surface activates the B cell receptor (BCR)-induced Ca2+ signaling pathway and results in the release of Ca2+ within seconds. The elevated intracellular Ca2+ triggers Fura -2, a fluorescent Ca2+ indicator, for reporting the presence of pathogens. The Fura-2 is transferred to B cells before detection. The study demonstrated that the developed B cell based biosensor was able to detect *E. coli* O157:H7 at the low concentration within 10 min. The specificity of the biosensor was confirmed using three non-target bacteria. Finally, the B cell based biosensor was used for the detection of *E. coli* O157:H7 in ground beef samples. With its low high sensitivity and short detection time, this B cell biosensor shows promise in future application of the high throughput and rapid food detection, biosafety and environmental monitoring.

IMPACT:

The food 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 new nanotechnology-based biosensor would enable the food industry to be benefited economically in terms of prevention of product recalls and international embargo associated with the microbial contamination of food products.

CONTACT:

Yanbin Li, Professor, Department of Biological & Agricultural Engineering, Center of Excellence for Poultry Science, yanbinli@uark.edu / 479-575-2881

COOPERATORS:

Byung-Whi Kong (Poultry Science Dept.), Ronghui Wang (Bio & Ag Engineering Dept.), Weihuan Fang (Zhejiang University)

FUNDING:

ABI, ZJU

CHARACTERISTICS OF TRAILER THERMAL ENVIRONMENT DURING COMMERCIAL POULTRY TRANSPORT

YI LIANG, ASSOCIATE PROFESSOR, EXTENSION

ISSUES:

Broilers experience high physiological stress during transport from farms to the processing plants. Complex thermal micro-environment, especially the extremes of heat and cold, has been identified as a major factor in inducing physiological stress during transportation among other stressors, such as unavailability of water, vibrations, noise, etc. However, the impact of the extreme weather conditions and management practices on the trailer thermal environment are not well understood.

ACTION:

The project aims to characterize the thermal micro-environment on commercial live-haul broiler trucks during transport and at holding sheds under different management practices at various seasons. Temperature and relative humidity of the interior of the trailers were monitored over a broad range of outdoor conditions (12 trips total). Data collected during intensive monitoring trips are used to categorize and assess broiler thermal comfort levels spatially (locations on trailer) and temporally (durations), under commonly-employed management practices. For the outdoor temperature range of 5 to 27 C, generally acceptable trailer thermal conditions were observed. Large temperature variation existed across the trailer in transit during the winter trips when ambient temperatures were between 0 and 5 C. Large variation was also found across the trailer during trips monitored when ambient temperatures were in lower 30s C, partially due to the difference of moisture evaporation and wind at different locations on the trailer.

IMPACT:

Results from this research will elucidate the prevailing thermal conditions experienced for market broiler transportation and develop an objective measure of broilers' wellbeing under mitigation methods, such as boarding percentage, fan and/or misting while loading in the Southern US.

CONTACTS:

Yi Liang, Department of Biological and Agricultural Engineering
yliang@uark.edu / 479-575-4862

Improving Drinking Water Quality and Availability

G. Scott Osborn, Associate Professor

ISSUE:

Most of the reservoirs in the U.S. that hold raw water used for drinking water were built 40 to 50 years ago. These reservoirs typically have a lifespan of 50 years. Therefore, much of this nations drinking water supply is nearing the end of its effective life. Because of land unavailability, urbanization, ecological concerns and cost, it is very difficult to build new drinking water reservoirs. Therefore, it is imperative for researchers and engineers to create methods to extend the life of our existing reservoirs.

Research being conducted by scientists in the University of Arkansas Division of Agriculture has the goal of developing reservoir treatment technology to solve current problems that impair drinking water quality. One of the greatest problems managers of drinking water reservoirs face is the buildup of nutrients (nitrogen and phosphorus) in these water bodies. Water flowing into the reservoirs naturally contains nutrients and organic matter that is absorbed as rain falls in the watershed, flows across the surface into streams and into the reservoir. Water can be contaminated with excess nutrients from fertilizer, animal waste, and wastewater treatment plant effluent if not properly managed. Excess nutrients can cause problems when reaching reservoirs by causing algae blooms. Algae can rapidly remove dissolved oxygen from the water causing fish kills that will create food for bacteria that will cause even further oxygen removal from the water. Water without oxygen will also allow metals such as iron and manganese to dissolve in water. These dissolved metal create problems when treating raw water for use as drinking water and can greatly increase the expense for treating the water. The nitrogen contained in water can be removed through natural ecological processes, but phosphorus is very difficult to remove from the reservoir once it enters the water body. As reservoirs age, more and more phosphorus will build up in the reservoir eventually overwhelming its ability to retain quality water. The key to improving water quality and extending the life of a reservoir is to not only reduce the amount of new nutrients entering the reservoir, but to create conditions to allow natural processes to remove the nitrogen and convert the phosphorus to a chemical state that is not available to algae. It is also desirable to remove the phosphorus from the reservoir.

The specific research being conducted uses a new technology developed in the Division of Agriculture to oxygenate reservoir sediments to reduce the oxygen demand that is exerted on the water and reduce the likelihood that the oxygen is removed from water. A key requirement for implementing this technology is to understand and quantify the rate of oxygen demand exerted by the water body including that from the water itself and also sediment oxygen demand.

Another application of the technology is to use ozone to treat drinking water from impacted reservoirs and help offset the negative impacts of eutrophic waters in a more cost effective manner than the treatment chemicals currently used.

ACCOMPLISHMENTS FOR 2015:

- Experiments were conducted to measure sediment oxygen demand in three lakes using a new technique that has the potential to improve the accuracy of the measurement compared to existing methods as well as reduce costs and increase the number of samples that can be collected improving the ability to accurately quantify water bodies.
- Experiments were conducted to measure the ozone concentration output from a new technology to treat water in order to verify a model. The model will be used to size the technology for specific applications and optimize operating parameters to maximize treatment capability at a minimal cost.
- Three additional patent applications received notice of allowance to be issued in 2016. Two additional patent applications received office actions and are in the process of being revised and reexamined for possible issue at a later date.

CONTACT:
Scott Osborn, Associate Professor
Department of Biological and Agricultural Engineering, gsosborn@uark.edu / 479-575-2877

DEVELOP SIMULATION MODELING APPROACH FOR EVALUATING IMPACT OF SELECTED BMP'S ON WATER QUAILTY

DHARMENDRA SARASWAT, ASSOCIATE PROFESSOR / EXTENSION ENGINEER—GEOSPATIAL

ISSUE:

Every year, billions of dollars are spent on Best Management Practices (BMPs) to alleviate or prevent water quality related concerns. A modeling study conducted by the United States Geological Survey (USGS) reported that agricultural lands in the Mississippi River Basin contribute more than 70% of nitrogen and phosphorus resulting in seasonal hypoxia in the northern Gulf of Mexico. To alleviate hypoxia situation, several million dollars worth of BMP practices have been approved under Mississippi River Basin Initiative (MRBI) for Arkansas farms. However, predicting long-term impacts of BMPs on water quality is required to assess the effectiveness of these practices.

ACTION:

It is quite common to use hydrologic/water quality (H/WQ) models to quantify the impact of various conservation practices before their actual implementation. Therefore, a long-term (1992-2012), Soil and Water Assessment Tool (SWAT) model was setup for the L'Anguille River watershed (LRW), one of the watersheds included under MRBI program, using a variety of spatial and temporal datasets. A total of 10,561 hydrological response units (HRUs- smallest modeling unit) were analyzed using high performance computing services available at the University of Arkansas. The model was projected 5 years into the future to analyze nutrient and sediment loads. The major BMPs simulated were field border, critical area planting, grade stabilization structure, irrigation land leveling, irrigation pipeline, irrigation water management, nutrient management, and sediment basin.

IMPACT:

Critical area planting conservation practice was found to be most effective in reducing nutrient loads followed by field border, irrigation land leveling, irrigation pipeline, grade stabilization structure, nutrient management, irrigation water management, and sediment basin. These results are expected to guide watershed managers and policy makers for making judicious decisions related to selection of conservation practices.

CONTACTS:

PI: Dharmendra Saraswat, Ph.D., Associate Professor/ Extension Engineer-Geospatial, University of Arkansas Division of Agriculture- Cooperative Extension Service, Department of Biological and Agricultural Engineering, dsaraswat@uaex.edu , 501-681-5987 (mobile)

FUNDING SOURCE:

USDA-NRCS through funding provided to Dr. Andrew Sharpley.

APPS FOR INFORMATION DISSEMINATION

DHARMENDRA SARASWAT, ASSOCIATE PROFESSOR / EXTENSION ENGINEER—GEOSPATIAL

ISSUE:

More than 3 out of 5 mobile subscribers in the US (61%) owned a smartphone as per recent industry estimate (Nielsen, 2013. The availability of wide variety of mobile devices (smartphones, tablets, etc.) has beginning to transform traditional one-way flow of information from research labs, to extension stations, and finally to end-users, as suggested by increasing usage of "apps" (short for "application") that does not limit information flow in one direction. Increasing usage of smartphones and other mobile devices for personal and business usage offers a great potential to provide producers with an expedited update of current production recommendations thereby reducing the risk of using out-of date information that may result in penalties, loss of yield potential, or unnecessary expenses. However, there are several scientific innovations that are needed in smartphone applications design and the associated web-based backend that will facilitate faster, robust, and more reliable systems. Along with smartphones, increasing popularity of tablet devices offer scope to develop electronic books (e-books) for providing an alternative media for delivering science based information. It calls for selection of appropriate design tools to efficiently produce e-books.

ACTION:

To harness the immense potential of providing latest information to end users in a timely and efficient manner, several projects related to design, development, and delivery of apps were initiated during the year. Two major mobile operating systems, iOS (from Apple) and Android (from Google), were targeted for developing native apps. Dissemination of current information concerning Corn, Soybean, and Cotton remained the focus of app development. Android and iOS version of apps named "Corn Advisor" and "Manure Valuator" were launched during the year. "Hort Plant" was another app launched for iOS devices and became the most downloaded app (close to 2000 downloads) in a short span of four months. An irrigation scheduler for Soybean has also been developed for both Android and iOS platform and currently undergoing final testing. Another app development effort was directed towards developing a crowdsourcing based weed identification and treatment app for both corn and soybean weeds for Android and iOS based smartphones. First version of the app has been completed for both Android and iOS platform. Preliminary testing is underway. Major extension conferences were brought to stakeholders through development of apps for Galaxy Conference, Rice Expo, and International Master Gardener's Conference.

IMPACT:

Apps were demonstrated during various meeting and the final design of some of them have greatly benefitted from the feedback received from extension specialists and county extension agents. A total of 3675 downloads for six apps launched during the year took place. Efforts made in app development has helped train two graduate students, two undergraduates, and three high school students. One graduate student was hired by Industry considering his demonstrated skills for mobile apps design. Several news outlets have covered the news of release. Arkansas Farm Bureau did a special video story on these apps.

CONTACTS:

PI: Dharmendra Saraswat, Ph.D., Associate Professor/Extension Engineer-Geospatial, University of Arkansas Division of Agriculture- Cooperative Extension Service, Department of Biological and Agricultural Engineering, dsaraswat@uaex.edu , 501-681-5987 (mobile)

COLLABORATORS:

Nilanjan Banerjee, Ph.D. Assistant Professor, Computer Science and Software Engineering, University of Maryland, Baltimore.
Leo Espinoza, Ph.D., Associate Professor, Crop, Soil, and Environmental Sciences, UACES.
Jason Kelley, Ph.D., Associate Professor, Crop, Soil, and Environmental Sciences, UACES.
Christopher Henry, Ph.D., Assistant Professor, Biological and Agricultural Engineering, U of A.

FUNDING SOURCE:

Arkansas Soybean Promotion Board and Arkansas Corn and Grain Sorghum Promotion Board

Evaluation of Chemically Coagulated Swine Manure Solids as Value-Added Products

Sammy Sadaka, Assistant Professor, Extension

ISSUE:

The total number of pigs in the United States had reached 65.9 million. The daily pig manure production was estimated to be 4.67 $kg.day^{-1}animal^{-1}$. Thus, the total amount of swine manure generated annually is more than 110 million metric tons. Disposal of the high volume of swine manure creates environmental issues associated with nutrient loss to water bodies following manure application on fields. Reviewing the available literature revealed that there are no availabe data related to the energy contents and the thermal degradation behaviousr of the chemically coagulated swine manure solids. Also, there is no data on the maximum values of coaugulants that will hinder the use of the final product as biofuel and/or compost feedstock.

ACTION:

Fresh swine manure was collected from an Arkansas farm. Three coagulants, namely agricultural lime [$CaCO_3$], hydrated lime powder [$Ca(OH)_2$], and lime slurry [$Ca(OH)_2$], were used to coagulate solids from fresh swine manure. They were added to fresh swine manure based on the calcium (Ca) mass per liter of liquid manure. Four levels of coagulants concentrations (0.00, 4.89, 9.77 and 19.77 gm Ca/ liter) were tested, in triplicates, during the course of this study. Physical, chemical, and thermochemical characteristics of the solid separated swine manure were determined in triplicates.

IMPACT:

From the experimental work described, several important arguments can be drawn. Manure separated solids contain the majority of nutrients and volatile solids. Increasing the coagulant concentration decreased the acceptability of the solid separated swine manure as a biofuel source. On the other hand, increasing the coagulant concentration increased the acceptability of the solid separated swine manure as a composting source.

CONTACT:

Sammy Sadaka, Assistant Professor, Biological & Agricultural Engineering Department. Little Rock State Office, Little Rock, AR. 501-303-0522. ssadaka@uaex.edu

COLLABORATING SCIENTISTS:

Karl VanDevender. Biological and Agricultural Engineering Department – Division of Agriculture University of Arkansas, Arkansas, USA

FUNDING SOURCES:

This research is a part of the USDA-NIFA project No. 2010-04269 titled "Integrated Resource Management Tools to Mitigate the Carbon Footprint of Swine Production in the U.S."

FOSTERING COMMUNICATION AND UNDERSTANDING WITHIN THE MANURE MANAGEMENT COMMUNITY

KARL VANDEVENDER, PROFESSOR, EXTENSION

Issue: "Why do we care?"
The production of animal derived food and products generates manure and mortality 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 and mortality byproducts must adhere too. This in turn presents challenges for regulatory agencies, service organizations, livestock producers, and the general public in understanding and navigating the interactions of the pertinent regulations and policies.

Action: "What have we done?"
In keeping with the land grant mission of dispersal of research based information, a series of functional relationships among regulatory agencies, service organizations, livestock producers have been developed and maintained over the years. These relationships serve both as access to information and conduits to the dispersal of knowledge. At times this manifests itself as an independent consultant providing input into the dialog between a regulatory agency, a design engineer, and a livestock producer seeking an acceptable management system and necessary permit to operate. At other times the interactions involve multiple organizations and result in the implementations with state wide impacts.

Impact: "What is the payoff?"
The results of these land grant institution facilitated interactions are a more informed manure/mortality management community that has an increased capacity to make and implement beneficial policies and practices. The recipients of these benefits are livestock producers, regulatory agencies, service organizations, neighbors, and consumers of animal based products.

Contacts:
Karl VanDevender Ph.D., PE
Professor - Extension Engineer
Biological and Agricultural Engineering
University of Arkansas System
Division of Agriculture
2301 S. University Avenue
Little Rock, AR 72204-4940
e-mail: kvandevender@uaex.edu
Phone: 501-671-2244
Cell: 501-944-1016

Funding Sources:
Various general base state and federal funds.

FACULTY RESEARCH & EXTENSION PROJECTS

JUN ZHU, PROFESSOR

TEACHING:

I am responsible for teaching the course, "Sustainable Biosystems Engineering", which is required of majors in Biological and Agricultural Engineering. By carefully redesigning the course to a large extent, I think that the course has accomplished good impacts on students' learning including the following aspects.

- Gaining a fundamental understanding on contemporary sustainability issues in agricultural production
- Learning analysis techniques such as life cycle analysis to study sustainability problems
- Gaining hands-on experience in studying real world production processes such as bioethanol production through case studies
- Building their decision-making skills for career planning

RESEARCH:

Research continues on poultry litter treatment using liquid anaerobic digestion technology. The success hinges on whether the water from the digester can be recycled back to the digester for further use. Therefore, developing technologies to clean up the water becomes critical, which is underway. The potential impact of this research includes the following aspects.

- Helping poultry producers grow their production by minimizing the nutrient issues associated with poultry litter
- Preventing pollution to surface and ground water resources due to nutrient leaching and runoff from land and soil receiving poultry litter applications
- Helping poultry producers transition to sustainable production practices

ADMINISTRATION:

I have 30% administration appointment in the Center for Agricultural and Rural Sustainability (CARS) serving as an Area Director in the organization (with other two area directors). I have been striving for rebuilding CARS and bringing it to a new level. To date, my work has achieved the following impacts.

- Recruiting new members for CARS to improve the representativeness of missing areas
- Enhancing collaborations among CARS faculty members via two Center-wide faculty retreats
- Increasing the CARS impact on a national sustainable organization, i.e., Field to Market by increasing our involvement in its decision-making process
- Reaching out to stakeholders by CARS members via presentations and better interactions
- Initiating collaborations of CARS with big retailers such as Walmart, etc.

CONTACTS:

Jun Zhu, Professor, Biological and Agricultural Engineering, junzhu@uark.edu, 479-575-2883

Congratulation to the Class of 2015!

Undergraduate:

Pablo Bolanos

Daniel Bugler

Joe Barrett Carter

Derek Daniels

Aya El-Khouly

Barrett Knutson

Elizabeth Marhefka

Benjamin Matthews

Trent McKenzie

Lee Nosal

Shelby Owens

Shelby Paschal

Jared Schnebelen

Benjamin Sharon

Katie Smith

Khoa Thai

Arlena Tran

Sarah Wirtz

Research Grants

The following active grants during 2015 fund research in specific areas.

RII Track-1: Arkansas ASSET Initiative III (Cellulosic)
Dr. Julie Carrier
2015
$403,408

RII Track-1: Arkansas ASSET Initiative III (Cellulosic-Student)
Dr. Julie Carrier
2015
$92,975

CPC Equipment Purchase
Dr. Julie Carrier
2015
$10,000

CPC Equipment Purchase
Dr. Julie Carrier
2015
$5,000

EPSCor
Dr. Julie Carrier
NSF
2015-2020
$112,057

Seasonal and tree size-related effects on biological activity of loblolly pine and sweetgum
Dr. Julie Carrier (Co-PI)
ASTA
2014-2015
$28,638

Decreasing severity of switchgrass pretreatment through biological pretreatment Sun Grant
Dr. Julie Carrier
SunGrant
2014-2015
$27,000

Inhibition of Enzymes with Pine Prehydrolysates
Dr. Julie Carrier
USDA
2015-2016
$63,129

Reduced Carbon Footprint for U.S. Swine Production
Dr. Thomas Costello (Co-PI)
USDA/NIFA/AFRI
2015
$62,800

Demonstration of Cross-Disciplinary Collaboration in Professional Design
Dr. Thomas Costello (Co-PI)
UA Office of Sustainability
2015
$2,900

AWRC Program Administration
Dr. Brian Haggard
USGS
2015
$4,749

AWRC Information Transfer
Dr. Brian Haggard
USGS
2015
$2,645

Water sampling and analysis at the West Fork White River
Dr. Brian Haggard
Beaver Watershed Alliance
2015
$9,794

FY15 Annual Application under Section 104 of the Water Resources Research Act of 1984
Dr. Brian Haggard
2015
$92,335

Water Quality Monitoring in the Upper Illinois River Watershed and Upper White River Basin (SGA 15-400)
Dr. Brian Haggard
ANRC EPA 319 Program
2015
$449,001

Improving Yield and Yield Stability for Irrigated Soybeans
Dr. Chris Henry
Soybean Promotion Board
2015
$60,451

Improving Irrigation Scheduling and Efficiency in Corn and Grain Sorghum
Dr. Chris Henry
Arkansas Corn and Grain Sorghum Promotion Board
2015
$96,829

Promoting the use of Multiple Inlet in Arkansas Rice Production
Dr. Chris Henry
Arkansas Rice Promotion Board
2015
$7,015

Evaluating Intermittent Flood Potential in Arkansas
Dr. Chris Henry
Arkansas Rice Promotion Board
2015
$64,280

Increasing Water Use Efficiency for Sustainable Cotton Production
Dr. Chris Henry
Cotton State Support Committee
2015
$31,500

Economics of Irrigation Technology Adoption for the Arkansas Delta Landscape
Dr. Chris Henry (Co-PI)
Arkansas Water Resources Center
2015
$0

Economics of Multiple Water-saving Technologies
Dr. Chris Henry (Co-PI)
Arkansas Soybean Promotion Board
2015
$1,000

RII Track-1: Arkansas ASSET Initiative III (Cellulosic)
Dr. Jin-Woo Kim
2015

RII Track-1: Arkansas ASSET Initiative III (Cellulosic-Student)
Dr. Jin-Woo Kim
2015

Engineering Nano-building Block Toolboxes for Programmable Self-Assembly of Nanostructures with Arbitrary Shapes and Functions
Dr. Jin-Woo Kim
2015
$412,789

Engineering Nano-Building Block Toolboxes for Programmable Self-Assembly of Nanostructures with Arbitrary Shapes and Functions
Dr. Jin-Woo Kim
NSF
2012-2015
~$116,000

Development of an Electron Tunneling Based Nanochannel System for DNA Sequencing
Dr. Jin-Woo Kim (Co-PI)
NSF
2012-2015
~$54,000

Center for Advanced Surface Engineering
Dr. Jin-Woo Kim (Co-PI)
NSF-EPSCoR
2015-2020
~$150,000

Electrically Conductive 3D Bio-Hybrid Platforms Containing Collagen and Aligned Single-Walled Carbon Nanotubes
Dr. Jin-Woo Kim
UA Honors College Undergraduate Research Grant
2014-2016
$4,000

Bio-nanogate based Aptasensor for Rapid Detection of Avian Influenza Viruses
Dr. Yanbin Li
ABI
2015-2016
$25,000

Engineered B-cell Biosensor for Detection of Foodborne Pathogens
Dr. Yanbin Li
ABI
2014-2015
$25,000

Managing Crop Residues to Reduce Particulate Matter Emissions
Dr. Yi Liang
AR Department of Environment Quality

2014-2015
$106,000

Characterizing Thermal micro-Environment during Poultry Transportation
Dr. Yi Liang
U.S. Poultry & Egg Association
2015-2016
$59,000

Low Impact Development Plan for Lake Conway Urban Watershed
Dr. Marty Matlock
2015

Home Performance Recognition Project
Dr. Marty Matlock
$70,819

Development of Metrics for Sustainable Beef
Dr. Marty Matlock
2015
$24,000

Climate change mitigation and adaptation in dairy production systems of the Great Lakes region
Dr. Marty Matlock and Dr. G. Thoma
2015
$95,180

Climate change mitigation and adaptation in dairy production systems of the Great Lakes region
Dr. Marty Matlock and Dr. G. Thoma
2015
$98,035

REWARD: Rice Evapotranspiration and Water use in the Arkansas Delta
Dr. Benjamin Runkle
USGS/104(b)
2015-2016
$25,000

Faculty Development and Enhancement Travel Assistance for AGU conference
Dr. Benjamin Runkle
Vice Provost, UARK
2015
$500

Integrated Resource Management Tool to Mitigate the Carbon Footprint of Swine. Gasification of Swine Manure and Algal Biomass
Dr. Sammy Sadaka (Co-PI)
USDA-NIFA
2015
$56,000

Prevention of Mycotoxin Development and Quality Degradation in Rice during On-Farm, In-Bin Drying and Storage
Dr. Sammy Sadaka (Co-PI)
Rice Promotion Board
2015
$1,000

Development of Effective Strategies for Simultaneously Drying and Decontamination of Corn to Maintain Quality and Prevent Mycotoxins
Dr. Sammy Sadaka (Co-PI)
Corn and Grain Sorghum Promotion Board
2015
$500

Improving germination rate of soybean seed dried using recently-introduced in-bin drying systems
Dr. Sammy Sadaka (Co-PI)
Soybean Promotion Board
2015
$1,000

Development of On-line Instructional Program for Nutrient Management Training Required by ANRC Titles XX, XXI and XXII
Dr. Karl VanDevender (Co-PI)
ANRC
2015
$

UA Sustainable Nutrient Management
Dr. Karl VanDevender
CES Subcontract of UA AES grant from NRCS
2015
$

The Effects of Algal Turf Scrubber Pre-Treatment on the Biomethane Potential of Swine Waste
Dr. Jun Zhu
2015
$2,125

Peer-Reviewed Journal Articles

Kapoor, R., K. Rajan and **D.J. Carrier**. "Elucidating the expanding role of different *Trametes versicolor* laccases in the pretreatment of biomass hydrolyzates." *Bioresource Technology* 189 (2015): 99-106.

Chen, H-H., K. Rajan, **D.J. Carrier** and V. Singh. "Separation of xylose oligomers from autohydrolyzed *Miscanthus x giganteus* using centrifugal partition chromatography." *Food and Bioproducts Processing* 95 (2015): 125-132.

Lau, C., K. Bunnell and **D.J. Carrier**. "Kinetic modeling of switchgrass-derived xylose oligomers degradation during pretreatment in dilute acid or in water" *ACS Sustainable Chemistry and Engineering* 3 (2015): 2030–2035.

Aurora, A. and **D.J. Carrier.** "Understanding the pine dilute acid pretreatment system for enhanced enzymatic hydrolysis." *ACS Sustainable Chemistry and Engineering* 3 (2015):2423-2428.

Mohanram, S., K. Rajan, **D.J. Carrier**, L. Nain and A. Arora. "Insights into biological delignification of rice straw by *Trametes hirsute* and *Myrothecium roridum* and comparison of saccharification yields with dilute acid pretreatment. *Biomass and Bioenergy* 76 (2015):54-60.

Sinha, A., E. Martin, K. Lim, **D.J. Carrier**, H. Haewook, V. Zharov, and J. Kim. "Cellulose nanocrystals as advanced "Green" materials for biological and biomedical engineering." Journal of Biosystems Engineering 40 (2015): 373-393.

Sharara, M. A., **S. S. Sadaka**, T. A. Costello, K. W. VanDevender, D. J. Carrier, M. Popp, G. Thoma, A. Djioleu. "Combustion kinetics of swine manure and algal solids." *J. Thermal Analysis Calorimetry* (2015)

Brennon, R., A. Sharpley, others, and **B. Haggard**. "The effect of dissolved phosphorus release from deposited soil on stream periphyton biomass." *Journal of the American Water Resources Association* [Under Revision] (2015).

Johnson, T., L. Edgar, **B. Haggard**, and K. Rucker. "Student Perceptions of the [State] Water Resources Center, Water Resources and Water Issues." *Natural Sciences Education* [Accepted] (2015).

Johnston, R., H.N. Sandefur, P. Bandekar, **M. Matlock**, B. Haggard and G. Thoma. "Predicting changes in yield and water use in the production of corn under climate change scenarios." *Ecological Engineering* 82 (2015): 555-565

McCarty, J.A., **B.E. Haggard**, M.D. Matlock, N. Pai, and D. Saraswat. "Post-model validation of a deterministic water model using measured data. "*Transactions ASABE* [Accepted] (2015)

Scott, J.T. and **B.E. Haggard**. "Implementing effects-based water quality criteria for eutrophication in reservoirs: linking standard development and assessment methodology." *Journal of Environmental Quality* 44 (2015):1503-1512

Raper, T. B., **C. G. Henry**, L. Espinoza, M. Ismanov and D. M. Oosterhuis. "Response of Two Inexpensive Commercially Produced Soil Moisture Sensors to Changes in Water Content and Soil Texture. " *Agricultural Sciences (6)* (2015) 1148-1163.

Henry, C. G., E.D. Vories, M.M. Anders, S.L. Hirsh, M.L. Reba, K.B. Watkins and J.T. Hardke. "Characterization of Irrigation Water Requirements for Rice Production from the Arkansas Rice Research Verification Program." Submitted to Journal *of Irrigation and Drainage*, under review for 2nd revision. (2013)

Winkler, A.S., J.M. Parfitt, Cl F. Teixeira-Gandra, **C.G. Henry** and R. J. dos Santos. "Effect of Slope on the Surface Drainage in Land Leveling Areas in Rio Grande Do Sul State." Submitted to Journal *of Irrigation and Drainage*, under review.

Henry, C. G., G.S. Sartori. L. Espinoza, P. Francis, J. Gospar, A. P. Horton, S. M. Hirsh. "Deep Tillage and Gypsum Amendment on Fully, Deficit, and Dryland Irrigated Soybeans." Submitted to the Agronomy *Journal*.

Liang, Y., R. Bautista and T.A. Costello. "Validating a multi-port, averaging Pitot tube for measuring fan airflow rates." *Applied Engineering in Agriculture*. Under review. (2015)

Fanatico, A. C., J.A. Mench, G.S. Archer, **Y. Liang**, V.B. Brewer, C. Gunsaulis, M. Owens, and A.M. Donoghue. "Outdoor structural enrichments for free-range chickens." *Poultry Science*. Under review. (2015)

Harding, A.C., D.W. Nutter, and **Y. Liang**. Unit operation energy intensities for a poultry broiler processing plant. *Journal of Energy Engineering*. 113(1) (2015): 21-52. DOI: 10.1080/01998595.2016.11657081

Sadaka, S., and K. VanDevender. "Evaluation of Chemically Coagulated Swine Manure Solids as Value added Products." *Journal for Sustainable Bioenergy Systems*. Volume 5(4) (2015):136-150. [Impact Factor: 1.33].

Sharara, M., **S. Sadaka**, T. Costello, K. VanDevender, D.J. Carrier, M. Popp, G. Thoma, and A. Djioleu. "Combustion Kinetics of Swine Manure and Algal Solids." *Journal of Thermal Analysis and Calorimetry*. 123 (2015): 687-696. [Impact Factor: 2.042].

Sadaka, S., H. Liechty, M. Pelkki and M. Blazier. "Pyrolysis and Combustion Kinetics of Raw and Carbonized Cottonwood and Switchgrass Agroforests." *BioResources* 10(3) (2015): 4498-4518. [Impact Factor: 1.425].

Wilson, S., A., Griffiths, C., Couch and **S. Sadaka**. "Radiant Heating and Tempering Treatments for Improving Rate of Moisture Removal during Drying of Shelled Corn." *Applied Engineering in Agriculture*. 31 (5) (2015):799-808. [Impact Factor: 0.717].

Griffiths, G., H. Zhong, S. Thote, A. Okeyo, A. Couch, **S. Sadaka** and T. Siebenmorgen. "Microbial Prevalence on Freshly Harvested Long-Grain Hybrid, Long Grain Pure- Line and Medium-grain Rice." *Arkansas Rice Research Studies Research Series* 626 (2015):306-313.

Ubhi, G. and **S. Sadaka**. "Temporal Valuation of Corn Respiration Rates Using Pressure Sensors." *Journal of Stored Products Research*. Volume 61 (2015), 39–47. [Impact Factor: 1.683].

Sharara, M. and **S. Sadaka**. "Gasification of Phycoremediation Algal Biomass." *BioResources*. 10(2) (2015) 2609-2625. [Impact Factor: 1.425].

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Atungulu, G. D. Smith, S. Wilkson, H. Zhong, **S. Sadaka** and S. Rogers. "Assessment of One-Pass Drying of Rough Rice with an Industrial Microwave System on Milling Quality." *Applied Engineering in Agriculture*. In Press. (2015)

Atungulu, G., A. Okeyo, S. Thote and **S. Sadaka**. "Assessment of the Performance of a Scaled-Up Continuously Fed Radiant Heating System for Rough Rice Drying." *Food and Bioprocess Technology: An International journal*. Submitted. (2015)

Sadaka, S., and K. VanDevender. "Evaluation of Chemically Coagulated Swine Manure Solids as Value added Products." *Journal for Sustainable Bioenergy Systems*. Volume 5(4) (2015). [Impact Factor: 1.33].

Sharara, M, **S. Sadaka**, T. Costello, K. VanDevender, D.J. Carrier, M. Popp, G. Thoma, and A. Djioleu. "Combustion Kinetics of Swine Manure and Algal Solids." *Journal of Thermal Analysis and Calorimetry*. (2015) 1-10. Available online: http://link.springer.com/article/10.1007/s10973-015-4970-9. [Impact Factor: 2.042].

Shen, J. and **J. Zhu**. "Optimization of methane production in anaerobic co-digestion of poultry litter and wheat straw at different percentages of total solid and volatile solid using a developed response surface model." J. *Environ. Sci. Health* Part A (2015) In press.

Lin, H, X. Wu, **J. Zhu**. "Kinetics, equilibrium and thermodynamics of ammonium sorption from swine manure by natural chabazite." *Separation Science and Technology*. (2015) In press.

Lin, H, X. Wu, C. Nelson, C. Miller, **J. Zhu**. "Electricity generation and nutrients removal from high strength liquid manure by air-cathode microbial fuel cells." *J. Environ. Sci. Health* Part A. (2015) In press.

Cheng J., **J. Zhu**, F. Kong, and C. Zhang. "Influence of temperature on the single-stage ATAD process predicted by a thermal equilibrium model." *J. Environmental Management* 156 (2015): 257-265.

Cheng J., F. Kong, **J. Zhu**, and X. Wu. "Effects of stabilization and sludge properties in a combined process of anaerobic digestion and thermophilic aerobic digestion." *Environmental Technology* 36(21) (2015): 2786-2795.

Wu, X., **J. Zhu**. "In-depth Observations of Fermentative Hydrogen Production from Liquid Swine Manure Using an Anaerobic Sequencing Batch Reactor." *Journal of Integrative Agriculture*. (2015) Accepted.

Wu, X., **J. Zhu**, J. Cheng. "Simultaneous removal of nutrients from milking parlor wastewater using an AO2 sequencing batch reactor (SBR) system." J. *Environ. Sci. Health* Part A 150 (4) (2015): 396-405.

Wu, X., **J. Zhu**, J. Cheng, and N. Zhu. "Optimization of three operating parameters for a two-step fed sequencing batch reactor (SBR) system to remove nutrients from swine wastewater." *Applied Biochemistry and Biotechnology* 175(6) (2015): 2857-2871.

Cheng J., F. Kong, **J. Zhu**, and X. Wu. "Characteristics of oxidation-reduction potential, VFAs, SCOD, N, and P in an ATAD system under different thermophilic temperatures." *Applied Biochemistry and Biotechnology* 175(1) (2015): 166-181.

OTHER PEER-REVIEWED PUBLICATIONS

Sadaka, S. H. Liechty, M. Pelkki and M. Blazier. 2015. Conversion of Cottonwood and Switchgrass to Charcoal via Carbonization. Process. Louisiana Agriculture. http://www.lsuagcenter.com/en/communications/publications/agmag/Archive/2015/Spring/

NON-REFEREED PUBLICATIONS AND ARTICLES

http://arkansas-water-center.uark.edu/publications/msc.php

Scott, E., J. Gile, and B. Haggard. 2014. Relation of chlorine demand to the water quality of Beaver Lake. Arkansas Water Resources Center, Technical Publication MSC 371. (Not listed last FSR)

Scott, T. and **B. Haggard**. 2015. Evaluating the assessment methodology for the chlorophyll-a and Secchi transparency at Beaver Lake, Arkansas. Arkansas Water Resources Center, Technical Publication MSC 372.

Scott, E., Z. Simpson, and B. Haggard. 2015. Constituent load estimation in the Lower Ouchita-Smackover Watershed. Arkansas Water Resources Center, Technical Publication MSC 373.

Scott, T. and **B. Haggard.** 2015. Simulated use of 'first-order' ponds to reduce peakflow in an eroding river system. Arkansas Water Resources Center, Technical Publication 374.

Austin, B., E. Scott, S. Entrekin, M. Evans-White, and B. Haggard. 2015. Monitoring water resources of the Gulf Mountain Wildlife Management Area to evaluate possible effects of natural gas development. Arkansas Water Resources Center, Technical Publication MSC 375.

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Other Creative Endeavors

Dharmendra Saraswat and **Chris Henry** have developed a mobile application for Multiple Inlet for Rice Irrigation. It is available on Google Play for android devices. The application provides a map for the user to draw field boundaries, levee boundaries, and pipe location. The user enters in the flow rate for the well and the application determines the pipe size, length, number of rolls required and provides a gate punch and setting plan for the field. Multiple fields can be entered and saved and the user can have the plan emailed to them and saved as a pdf. The iOS version of this application is under development.

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