2012

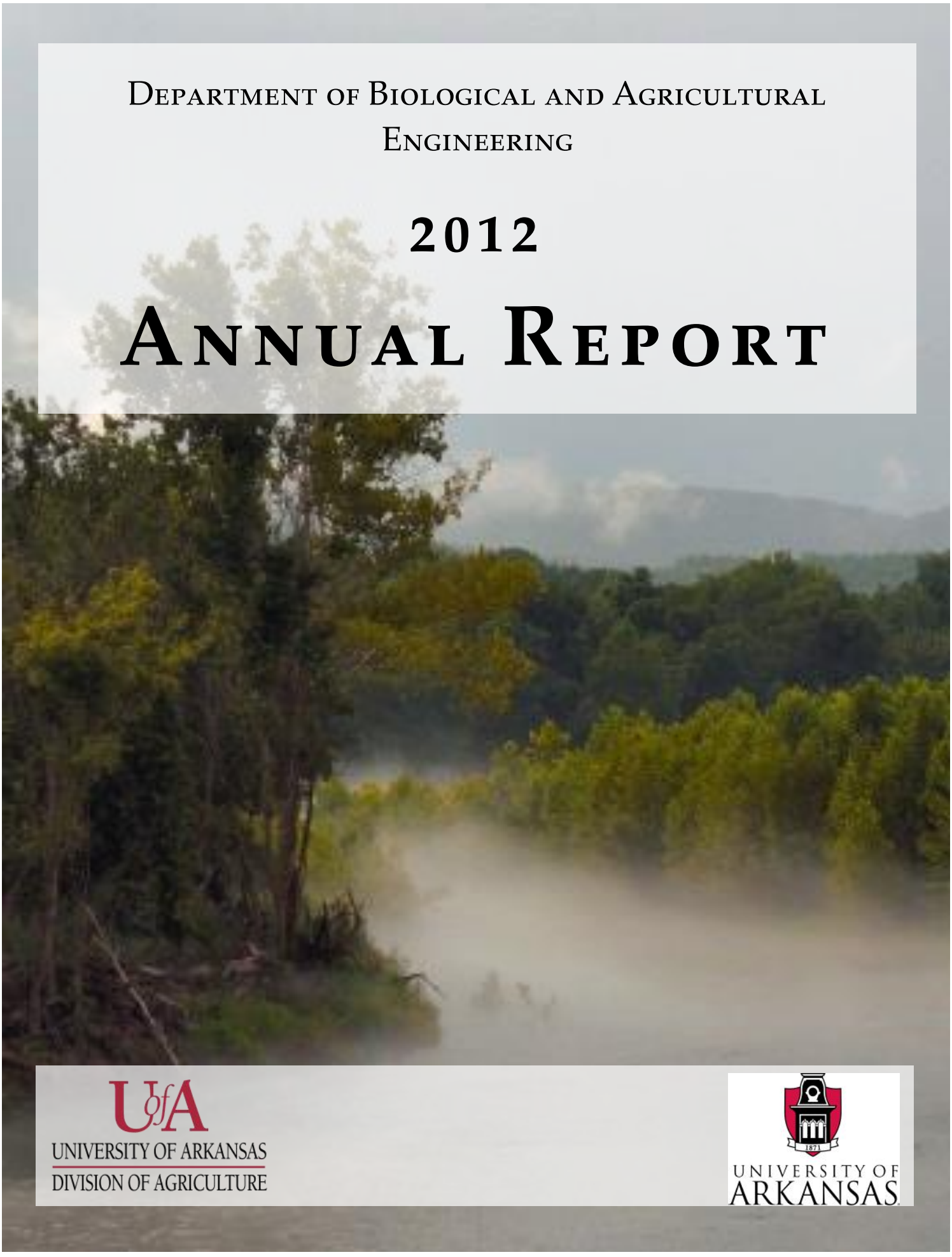
Annual Report, 2012

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

2012

Annual Report



UofA
UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE

UNIVERSITY OF ARKANSAS

2012 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

Dale Bumpers College of Agricultural, Food & Life Sciences
Michael Vayda
Dean

College of Engineering
Terry Martin
Interim Dean

University of Arkansas
G. David Gearhart
Chancellor

Sharon Gaber
Vice Chancellor and Provost

Department of Biological & Agricultural Engineering

203 Engineering Hall
University of Arkansas
Fayetteville, AR 72701

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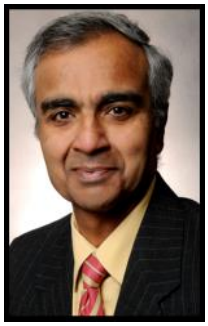
FOREWORD

FROM THE DEPARTMENT HEAD



It is a pleasure to share the accomplishments and activities of our faculty, staff and students in our 2012 Annual Report. It has been a busy year for our faculty and staff as we retooled the programs of our department with the focus on enhancing sustainable water, food and energy systems. The responsibility of delivering these programs for our stakeholders with fewer faculty and staff has been challenging but handled well by our team. The delivery of our revamped undergraduate degree program in Biological Engineering of *"Healthy Planet Healthy People"* has begun. The task of rebuilding our student numbers in this unique program addressing the challenges in sustainable food, water and energy systems will take some time. Input from our Academic Advisory Committee has been valuable and has been incorporated.

Our Department of Biological and Agricultural Engineering is truly unique as it resides in the UA Division of Agriculture and UA Dale Bumpers College of Agricultural, Food and Life Sciences and the College of Engineering. Most of our research and teaching faculty are on campus while our extension colleagues are in the state office of the UA Division of Agriculture's Cooperative Extension Service and at the Rice Research and Extension Center. The contributions of our faculty continue to receive awards and recognitions. One of our senior student design teams was invited to the final competition at the ASABE Annual International Meeting in Dallas.

Our research and extension programs address problems relevant to our stakeholders, not only dealing with food and agriculture, but also in water management, air and water quality, bioenergy and energy efficiency, geospatial technologies, grain drying and storage, and ecological engineering for sustaining ecological prosperity. The ABET accredited undergraduate degree of Biological Engineering prepares students to design engineering solutions for real-world problems in Biological (living) Systems. Engineers trained to apply their expertise to various biological systems have exciting career paths and job opportunities in areas such as ecological stewardship, sustainability, food and agriculture, biotechnology, bio-processing, bio-energy and bio-security.

Spring 2012 started with healthy enrollments in our classes. We have eight senior design teams engaged in challenging real-world problems under the guidance of their faculty mentors. Teams will be entering national competitions while completing the projects. Some of our students will participate in study-abroad programs.

ASABE awarded scholarships to 21 students. Senior Katherine Atkins was named Outstanding Student (Arkansas Section); and the one of our Senior Design Teams won Third Place at the ASABE Gunlogson Competition in Dallas at the ASABE Annual International Meeting.

Brian Haggard and Karl VanDevender received the Outstanding Team Award from the UA Division of Agriculture, Scott Osborn received an ASABE 2012 Massey-Ferguson Educational Gold Medal Award, Marty Matlock was named Executive Director of the Office for Sustainability, Brian Haggard was named President-Elect of the National Institute for Water Resources, and Lalit Verma was named President-Elect of ASABE. Dharmendra Saraswat was part of a team that received the Blue Ribbon Extension Communication Award from the Southern Region-American Society for Horticulture Sciences. Samy Sadaka received an Extension Excellence Award for Innovation. Naresh Pai, a Post-doctoral Associate, received a Presidential Citation from the American Society for Photogrammetry and Remote Sensing. Three outstanding alumni, Jeff Keeter, Billy Staton and Shawn Brewer, were inducted in the Arkansas Academy of Biological and Agricultural Engineering. Bruce Westerman was honored as a Distinguished Engineering Alumnus, and Anthony Doss and Tyler Gipson were honored as Young Engineering Alumni by the UA College of Engineering in April.

Please let us know how you would like to support our department and do not hesitate to call (479-575-2351), e-mail (lverma@uark.edu) or, if you are in the area, drop in for a visit.

Lalit R. Verma
Professor and Department Head

SIGNIFICANT ACCOMPLISHMENTS IN 2012

PROFESSIONAL AND ADMINISTRATIVE STAFF

- Dr. Julie Carrier was appointed as a member of the CREATE Selection Committee of the National Sciences and Engineering Research Council of Canada. The term of her appointment is for three years.

- Dr. Brian Haggard was named President-Elect of the National Institutes for Water Resources. He also received the John W. White Outstanding Team Award.

- Dr. Jin-Woo Kim Jin-Woo Kim won the "John Imhoff Outstanding Publication" award by the UA Chapter of Sigma Xi (April 19, 2012), which was not only selected as "Hot Paper" by the editors of *Angewandte Chemie International Edition* but also featured as a "Back Cover" of the journal issue.

- Dr. Yanbin Li received the 2012 Outstanding Engineer Alumnus Award from Pennsylvania State University. He received the 2012 Superior Paper Award from the American Society of Agricultural and Biologic al Engineers (ASABE). Dr. Li also received the 2011-2012 Outstanding Research Award in Biological & Agricultural Engineering, Engineering College, University of Arkansas.

- Dr. Otto Loewer's book, *Linkages Among Technology, Economics and Societal Values*, was published in electronic format through Apple Publishing Group.

- Dr. Marty Matlock was named as the first Executive Director of the Office for Sustainability at the University of Arkansas. Provost Sharon Gaber and Associate Vice Chancellor for Facilities Mike Johnson appointed Matlock to demonstrate the increased emphasis on sustainability across all campus activities. Additionally, received numerous awards and recognition for his work on "Low Impact Development: a Design Manual for Urban Areas," developed by UACDC and the UA Ecological Engineering Group under a grant from the U.S. EPA and the Arkansas Natural Resources Commission.

- Dr. G. Scott Osborn received the Massey-Ferguson Educational Gold Medal from the American Society of Agricultural and Biological Engineers (ASABE), awarded for advancement of engineering knowledge and practice in agriculture soil. He received the President's Citation from American Society of Agricultural and Biologic al Engineers (ASABE) for service on Future Thinking Committee to revise ASABE's structure and outreach to better serve their membership. In addition, Dr. Osborn was given the BAEG Outstanding Service to Students Award. He appeared in an advertising campaign on Cumulus radio stations for University of Arkansas to promote startup companies and jobs created by University Research.

- Dr. Samy Sadaka received the Extension Excellence Award for Innovation: Novel Auger Gasification/Pyrolzer System.

- Dr. Dharmendra Saraswat co-authored a paper with Post-Doctoral Associate Naresh Pai that received the 2012 Superior Paper Award from the American Society of Agricultural and Biologic al Engineers (ASABE). He received the Blue Ribbon Extension Communication Award from the Southern Region—American Society of Horticultural Science (SR-ASHS).

- Dr. Lalit Verma was named President-Elect of the American Society of Biological Engineers (ASABE).

- Dr. Naresh Pai, a Post-Doctoral Associate, was awarded a Presidential Citation by the American Society of Photogrammetry and Remote Sensing (ASPRS). This award is given to individuals for special, personal, and meritorious contributions to the Society President and to the operation and advancement of the Society. Naresh is supervised by Dr. Dharmendra Saraswat.

Significant Accomplishments in 2012

Students

- Mahmoud Sharara, Ph.D. student in Biological Engineering, won First Place in the BAEG division of the 2012 Student Research Poster Competition. His poster was entitled "Auger Reactor Gasification of Algal Blooms from Wastewater Treatment." Mahmoud is advised by Dr. Samy Sadaka.

- Gurdeep Singh, M.S. student in Biological Engineering, won Second Place in the research competition of the 2012 Student Research Poster Competition. His poster was entitled "Simulating Water Quality Impacts of Biofuel Crop Production." He was also awarded a 2012 Ivanhoe Foundation Award in the amount of $5,000. The award recognized Gurdeep's efforts to quantify the environmental consequences of second generation energy crop production on marginal lands using watershed modeling and spatial analysis. Gurdeep is advised by Dr. Dharmendra Saraswat.

- Luke Brockman, MS in Biomedical Engineering, won the 2nd place in category of nanotechnology at University of Arkansas 2012 Graduate Student Research Competition. His paper title is "Nanowire and Aptamer based QCM Biosensor for Rapid Detection of Avian Influenza Virus." Dr. Yanbin Li is his advisor.

- Haibo Huang, MS student in BENG 2009, won 2012 ASABE Superior Paper Award, American Society of Agricultural and Biological Engineers. Dr. Yanbin Li is his advisor and coauthor of the paper. The paper title is "Magnetic Nanoparticles based Magnetophoresis for Efficient Separation of Foodborne Pathogens," and the paper is published in Transactions of the ASABE 54(3): 1015-1024.

- Jacob Lum, Ph.D. student in Cell and Molecular Biology, won Second Place in the category of cell and molecular biology of the 2012 Student Research Poster Competition. His poster was entitled "In-vitro Selection of Aptamers Against Avian Influenza Virus Subtype 117." Jacob Lum also won 2nd place in the Graduate Student Poster Contest at AAFP 2012 annual meeting . His poster title was "Impedance aptasensor with microfluidic chips for rapid and specific detection of avian influenza H7N2." Jacob is advised by Dr. Yanbin Li.

- BENG student Jana Hindman was offered the Ashland Water Technologies Internship with the Georgia Pacific plant in Portland, OR, for the summer of 2012. She is advised by Dr. Thomas Costello.

- Six BENG students traveled to Belize in the summer of 2012 as part of a three-week program. They served as an engineering team to assist in community development project in the small city of Dangriga, where they focused on projects to either replace a concrete bridge with culverts or replace the bridge entirely, as well as to design an construct a new building or booth utilized for tourism information for the city.

- Junior BENG student Aaron Thomason traveled to Cuba for a four-week program sponsored by the Cuban and Caribbean Studies Institute of the Stone Center for Latin American Studies through Tulane University. The program takes place through the University of Havana.

- Senior BENG student Joseph Watt was recognized by the National Engineers Week Foundation's first annual *New Faces in Engineering: College Edition,* on a list entitled, "15 of the most promising college engineering students from the United States—and across the world." Students on this list were chosen based on their skills in academics, leadership, communication, and community service. Joseph was especially recognized for his participation in establishing a chapter of the American Indian Science and Engineering Society on the UA campus and his service as the chapter's president.

- BENG student Abigail Washispack was awarded the College of Engineering's Outstanding Senior of 2012. Abigail was one of three final candidates personally interviewed by Dean Ashok Saxena based on her academic and extracurricular accomplishments and career plans. Abigail was recognized during the College's Commencement Ceremony, where she was seated on stage and asked to speak on behalf of her senior class.

- Deandrae Smith, an undergraduate BENG major with minors in Mathematics & Sustainability, participated in

a REU program entitled "Dynamics of Water and Societal Systems: An Interdisciplinary Research Program at the Virginia Tech StREAM Lab." Her team traveled to the American Ecological Engineering Society conference in Syracuse where her team's design to build a mesochosm for a crayfish won the design competition. She and her partner also presented their project poster at VTech's first undergraduate research symposium. In addition to this honor, Deandrae has been hired to work in The Sustainability Consortium at the Engineering Research Center—the first undergraduate to be hired by ENRC.

- The American Society of Agricultural and Biological Engineers (ASABE) has awarded Katherine Atkins, a senior in Biological Engineering, with the Outstanding Student Award (Arkansas Section) for 2012.

- The Senior Design Team of Iain Bailey, Samantha Puckett, Jessica Hart, and Ismael Mojica was chosen to present their Design of a Small Scale Water System for a Kenyan Orphanage at the ASABE Gunlogson Competition in Dallas, Texas. The team placed third with their design. Dr. Thomas Costello served as the team's mentor.

- Grace Richardson, an MSBE student, was chosen as student representative for National Agriculture Biotechnology Conference held in Fayetteville AR. She is advised by Dr. Scott Osborn.

- Iain Bailey, senior BENG major, was named Outstanding Student—Arkansas State Section by ASABE.

Departmental Resources

Faculty

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 purifica-tion 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 nanobiotechnology.

Yanbin Li, Ph.D., P.E.
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.
Assistant 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 Rural Sustainability
B.S. Soil Chemistry (1984) Oklahoma State University
M.S. Plant Physiology (1989) Oklahoma State University
Ph.D. Biosystems Engineering (1996) Oklahoma State University
Research Areas: Ecological engineering, ecological watershed modeling, biological assessment and monitoring, ecosystem design and management.

SCOTT OSBORN, PH.D., P.E.
Associate Professor
B.S. Ag.E. (1984) University of Kentucky
M.S. Ag.E. (1987) University of Kentucky
Ph.D. Bio & Ag.E. (1994) North Carolina State University
Research Areas: Biotechnology engineering, ecological engineering, dissolved oxygen and ozone technologies, Biological Modeling, drying and energy processes.

SAMY 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.

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.

Departmental Resources

Professional and Administrative Staff

Julian Abram
Program Technician

Prathamesh Bandekar
Program Associate

Rusty Bautista
Program Associate

Holly Beason
Secretary II, Extension

Megan Colbert
Administrative Specialist III

Eric Cummings
Program Associate

Mary Fennel
Program Technician

Steve Green
Research Associate

Staci Hudspeth
Department Fiscal Manager

Jerry Jackson
Skilled Tradesman

Jeong Hwan Kim
Post Doctoral Associate

Mansoor Leh
Post Doctoral Associate

Betty Martin
Program Technician

Vicki Martin
Fiscal Support Specialist

Leslie Massey
Program Associate

James McCarty
Program Associate

John Murdoch
Program Technician

Linda Pate
Department Administrative Manager

Lee Schrader
Program Assistant

Amy Walker
Fiscal Support Specialist

Aaron Wilson
Department Fiscal Manager

Karen Withers
Administrative Office Supervisor, Extension

Ronghui Wang
Post Doctoral Associate

BAEG Advisory Board
2012-2013 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

Academic Advisory Committee
2012-2013 Members

Mark Christie
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

Departmental Resources

Academy Members and Inductees

Active Academy Members

David Anderson
B.S. ('70)

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

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

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)

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)

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)

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

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)

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)

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

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

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

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

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)

Honorary Academy Members

Albert H. Miller
Posthumously

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

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

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

2012 Academy Inductees

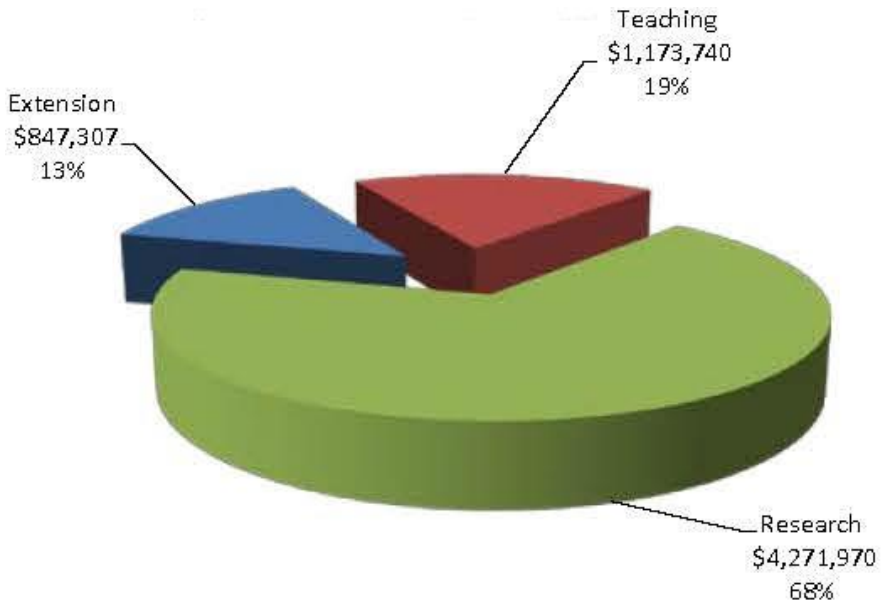
Shawn Brewer
B.S. ('94), M.S. ('98)

Jeff Keeter
B.S. ('84)

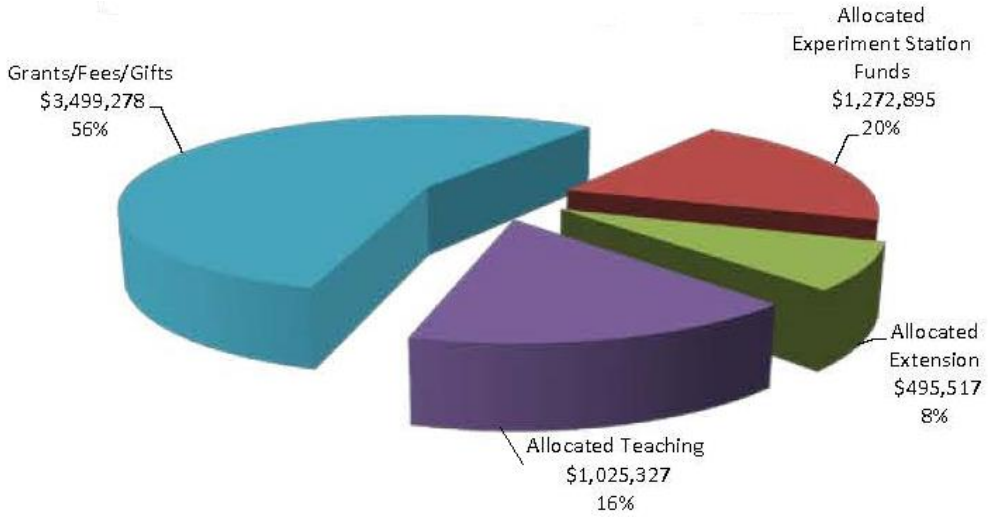
Billy Straton
B.S. ('91), M.S. ('95)

TOTAL EXPENDITURES, JULY 1, 2011 TO JUNE 30, 2012
$6,293,017

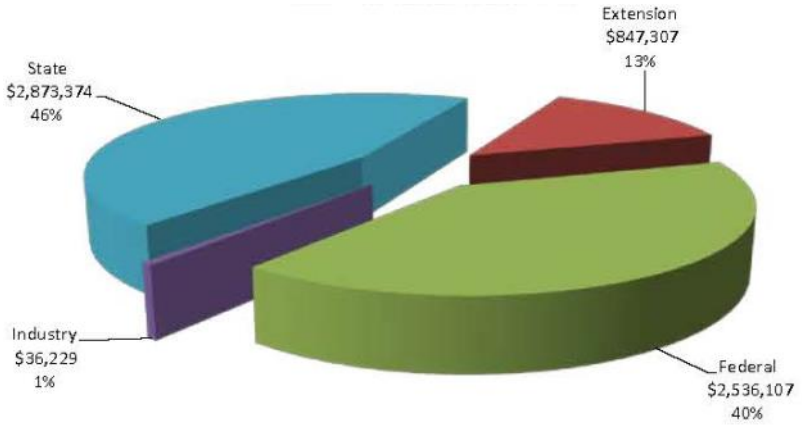
EXPENDITURES BY PROGRAM AREA



SOURCES:
ALLOCATED VS. GRANTS/FEES/GIFTS

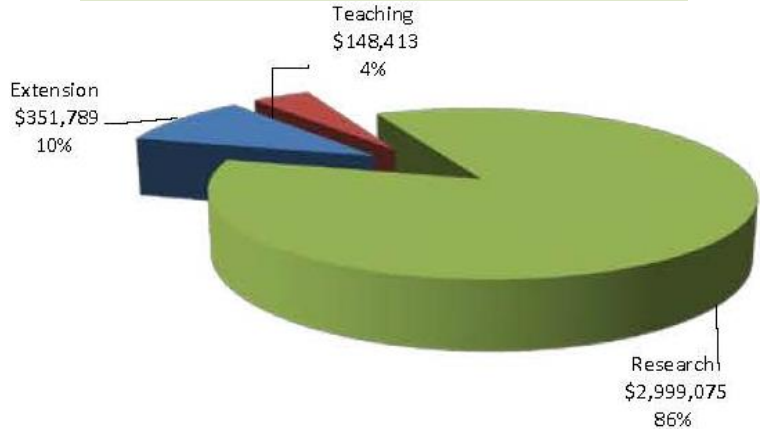


Sources of All Funds

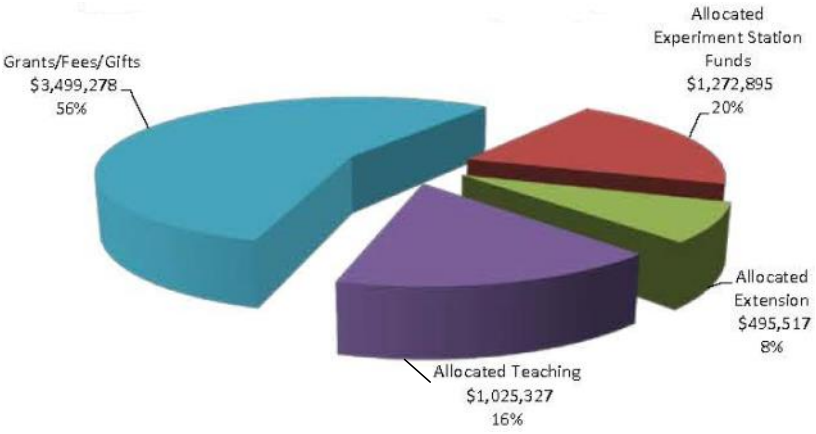


Grants/Fees/Gifts
$3,499,277

Expenditures by Program Area



Sources: Grants/Fees/Gifts



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.

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.

Biomedical Engineering was established as a separate department and program in 2012.

The Biological and Agricultural Engineering Department is housed on the second floor of 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 Engineering Research Center, located off South School Street.

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.

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.

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.

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

2012-2013 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. Students should note the BIOL 1543/1541L is a pre– or co-requisite to BENG 2632 in Fall 2 semester. Students should earn advanced college credit for BIOL 1543/1541L, obtain placement from the Biological Sciences Department, or take the course for non-degree credit.

Freshman Year, Fall Semester	Freshman Year, Spring 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**	1 GNEG 1121 Introduction to Engineering II 3 ENGL 1023 Technical Composition II 4 Freshman Engineering Science Elective* 4 MATH 2564 Calculus II 3 U.S. History Requirement **15 Semester hours**
Sophomore Year, Fall Semester	**Sophomore Year, Spring Semester**
2 BENG 2612 Biological Engineering Design Studio II 4 Sophomore Science Elective** 4 MATH 2574 Calculus III 4 CHEM 3603/3601L Organic Chemistry I w/Lab 2 MEEG 2003 Statics **16 Semester Hours**	3 BENG 2643 Biological Engineering Methods 4 MATH 3404 Differential Equations 4 CHEM 3613/3611L Organic Chemistry II w/Lab 3 CVEG 3213 Hydraulics (or MEEG 3503 or CHEG 2133) 3 MEEG 2403 Thermodynamics (or CHEG 2133) **17 Semester Hours**
Junior Year, Fall Semester	**Junior Year, Spring Semester**
3 BENG 3723 Unit Operations in Biological Engr 3 BENG 3733 Kinetics and Transport Phenomena in Biological Systems 3 CHEM 3813 Introduction to Biochemistry 4 BIOL 2013/2011L General Microbiology w/Lab 3 CVEG 3223 Hydrology **16 Semester Hours**	3 BENG 3653 Global Bio-Energy Engineering 3 BENG 3743 Food and Bio-Product Systems Engineering 3 BENG 3933 Sustainable Watershed Engineering 4 BIOL 3863/3861L General Ecology w/Lab 3 ELEG 3903 Electric Circuits and Machines **16 Semester Hours**
Junior Year, Fall Semester	**Junior Year, Spring Semester**
3 BENG 4813 Senior Biological Engineering Design I 3 BENG 4663 Sustainable Biosystems Design 3 BENG 4103 Measurements and Controls for Biological Systems 6 Humanities/Social Science Electives **15 Semester hours**	2 BENG 4822 Senior Biological Engineering Design II 3 Engineering Elective 9 Humanities/Social Science Electives 3 Technical Elective **17 Semester Hours** **128 TOTAL HOURS REQUIRED**

* 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.

SCHOLARSHIP RECIPIENTS FOR 2012

ARKANSAS ACADEMY OF BIOLOGICAL & AGRICULTURAL ENGINEERING SCHOLARSHIP

Anh Vu
Jackson Daniel

BIOLOGICAL & AGRICULTURAL ENGINEERING DEPARTMENTAL SCHOLARSHIP

Iain Bailey
Ashley Kiene
Colby McWhorter
Kristin Perrin
Nathan Redding
Heather Sandefur
Saumil Shah

BILLY BRYAN SCHOLARSHIP

Colby McWhorter
Hanna Perkins
Kristin Perrin
Christopher Randall
Lauren Tessaro

J.A. RIGGS TRACTOR COMPANY SCHOLARSHIP

Shiloh Hurd
Christopher McDaniel
Charles Walker
Lauren Wilson

XZIN MCNEAL SCHOLARSHIP

Alvareo Claure
Heather Sandefur
Lauren Wilson

GRADUATES FOR 2012

BACHELOR OF SCIENCE IN BIOLOGICAL ENGINEERING

SPRING 2012

Iain Bailey
Andrea Banks
Mary Bonaduce
James Buchta
Jessica Hart
Shiloh Hurd
Casey Johnson
Ashley Kiene
Chelsea Long
Michael Long
Christopher McDaniel
Ismael Mojica
Hanna Moreland
Rachel Petty
Christopher Randall
Heather Sandefur
Lauren Tessaro
Abigail Washispack
Shane Weindel
William M. Welch
Joseph Wyatt

Summer 2012

Ashley Artis
Jason Corral
William McDougall
Samantha Puckett
Dawn Shoemaker
Vanessa Van Wilpe

Fall 2012

Jana Hindeman

BIOLOGICAL ENGINEERING STUDENT CLUB

2012-2013 OFFICERS

William Putman—*President*
Nicholas Stoddart—*Vice President*
Paul Goodchild—*Treasurer*
Jaime Gile—*Secretary*
Paige Heller—*Public Relations*
Advisor: Dr. Scott Osborn

MASTER OF SCIENCE 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 PhD 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

Admission to the M.S.B.E. program is a three-step process. First, the prospective student must be granted admission to the University of Arkansas Graduate School. Second, the prospective student must be accepted into the department's program which depends on transcripts, recommendations, a statement of purpose, and the following additional requirements:

- A cumulative GPA in the last sixty hours of course work of 3.0.
- A cumulative GRE score of 301 or higher (verbal and quantitative combined).
- A TOEFL score of at least 550 (paper-based), 213 (computer-based), or 80 (internet-based). This requirement is waived for applicants whose native language is English or earned a bachelor's or master's degree from a U.S. institution.
- An eligible member of the faculty (graduate status of group II or higher) must agree to serve as the major advisor to the prospective student.

Third, the prospective student will only be admitted to the M.S. program provided engineering competence can be demonstrated by satisfying one of the following criteria:

- Receipt of a B.S. degree in engineering from a program accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET) or equivalent.
- Completion of 18 hours of additional undergraduate course work (deficiency courses) in addition to the Master's program requirements (additional hours may be required for course pre-requisites).

More detail on admission requirements may be found at http://catalogofstudies.uark.edu/.

DOCTOR OF PHILOSOPHY IN BIOLOGICAL ENGINEERING

ADMISSION REQUIREMENTS

In addition to the requirements of the University of Arkansas Graduate School, admission to the departmental aspect of the PhD program depends strongly on the judgment of the individual professor who will serve as the graduate advisor. The minimal admission criteria are as follows:

- A GRE score of 301 or above (verbal and quantitative).
- A TOEFL score of at least 550 (paper-based), 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.
- 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.
- A Master of Science degree in Engineering with a thesis.

Prospective PhD students may decide to go directly from a bachelor's degree to the PhD program if the following criteria are met:

- A cumulative GPA in the last sixty hours of 3.5.
- A minimum GRE score of 307.
- A Bachelor of Science in Engineering from an ABET accredited program.

Students with a non-engineering B.S. degree may be considered for conditional admissions into the Ph.D. program provided they meet the criteria outlined below. Otherwise, they need to start an M.S. program first. The Departmental Graduate Committee will make a specific recommendation to the Department Head.

Conditional admission criteria: The following are the minimum criteria for the conditional admission to PhD program for students with non-engineering B.S. degree:

- GPA: 3.50 or higher for the baccalaureate degree
- GRE Scores: 307 or higher
- Writing: 4.5
- TOEFL: 580 (or equivalent) or higher (for international applicants only)
- Students must earn credit for the following 18 hours of coursework including credit for all prerequisites listed in the undergraduate catalog

A minimum of 15 credit hours of 2000 level or above of engineering courses (with course prefix BENG, CHEG, CVEG, CENG, ELEG, INEG, or MEEG) currently allowed for credit within the BENG undergraduate program.

Minimum of 3 credit hours of 3000 level or above of BENG engineering ***design*** courses currently allowed for credit within the BENG undergraduate program.

Specific deficit courses are to be determined in consultation with the student's major advisor and advisory committee. Additional deficiency courses may be required for students with insufficient coursework in a critical area (such as life sciences).

Upon completion of the required conditions, the conditional status will be removed and the students will be fully admitted to the BAEG PhD program.

More detail on admission requirements may be found at http://catalogofstudies.uark.edu/.

Teaching Program

Graduate Program

Graduate Students

The following students were part of the Graduate program during 2012. 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*
Hua Bai	Dr. Yanbin Li
Prathamesh Bandekar	Dr. Thomas Costello and Dr. Yi Liang
Eric Boles	Dr. Marty Matlock
Jason Corral	Dr. Brian Haggard
Nathan Holeman	Dr. Thomas Costello
Min Lei	Dr. Yi Liang
James McCarty	Dr. Marty Matlock
William Merritt McDougall	Dr. Chris Henry
Angele Mezindjou Djioleu	Dr. Julie Carrier
Caroline Powell	Dr. Marty Matlock
Grace Richardson	Dr. G. Scott Osborn
George Sakhel	Dr. Jin-Woo Kim
Gurdeep Singh	Dr. Dharmendra Saraswat
William Morgan Welch	Dr. Brian Haggard

Doctor of Philosophy in Biological Engineering

Student	*Advisor*
Kris Bunnell	Dr. Julie Carrier
Zachary Callaway	Dr. Yanbin Li
Ching-Shuan Lau	Dr. Julie Carrier
Angele Mezindjou Djioleu	Dr. Julie Carrier
John Judkins	Dr. Jin-Woo Kim
Pratyush Rai	Dr. Vajay Vardan
Mahmoud Sharara	Dr. Samy Sadaka
Gurdeep Singh	Dr. Dharmendra Saraswat
Yixiang Wang	Dr. Yanbin Li

Master of Science in Cell and Molecular Biology

Student	*Advisor*
Rebecca Gill	Dr. Yanbin Li

Master of Science in Environmental Engineering

Student	*Advisor*
Amber Brown	Dr. Marty Matlock
Ryan Johnston	Dr. Marty Matlock
John Metrailor	Dr. Brian Haggard

Doctor of Philosophy in Cell and Molecular Biology

Student	*Advisor*
Jacob Lum	Dr. Yanbin Li

GRADUATE STUDENT ADVISEES IN OTHER AREAS

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

STUDENT	PROGRAM	ADVISOR
Jacob Anderson	MS Horticulture	Dr. Brian Haggard
Joseph N. Batta-Mpouma	MS Microelectronics-Photonics	Dr. Jin-Woo Kim
Luke Brockman	MS Biological Engineering	Dr. Yanbin Li
Siva Chalamalasetty	MS Microelectronics-Photonics	Dr. Yanbin Li and Dr. Kaiming Ye
John Fohner	MS Crop, Soil & Environmental Science	Dr. Brian Haggard
Andreas Haukas	MS Biomedical Engineering	Dr. Yanbin Li
Orain Hibbert	MS Micoelectronics– Photonics	Dr. Jin-Woo Kim
Jacob Hohnbaum	MS Mechanical Engineering	Dr. Jin-Woo Kim
Benjamin Holden	MS Engineering	Dr. Yi Liang
Lucas Leshe	MS Horticulture	Dr. Samy Sadaka
Iaryna Masniuk	PhD Biomedical Engineering	Dr. Yanbin Li
Katherine McCoy	MS Civil Engineering	Dr. Brian Haggard
Irene Pagana	MS Food Science	Dr. Julie Carrier
Leigh Parette	PhD Poultry Science	Dr. Yanbin Li
Soloman Parker	MS Civil Engineering	Dr. Brian Haggard
Kalavathy Rajan	PhD Food Science	Dr. Julie Carrier
Balaji Srinivasan	PhD Mechanical Engineering	Dr. Jin-Woo Kim and 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 2012

Hua Bai—MSBE

Summer 2012

Ching-Shuan Lau—PhD

Fall 2012

Angele Mezindjou Djioleu—MSBE
Gurdeep Singh—MSBE
Alexander Ziegler—MSBMEN—Biomedical

COURSES

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

BENG1012 Biological Engineering Design Fundamentals (Irregular) Introduction to the profession of Biological Engineering including a definition, and demonstration through field trips, guest speakers, examples of job opportunities and internships. Basic engineering methodologies, including analysis and design, as applied to biological systems. Introduction to problem solving, data analysis, report writing, presentations, and engineering record keeping. Group activities and team design efforts. Lecture 1 hour, laboratory 3 hours per week. Corequisite: Lab component.

BENG1022 Biological Engineering Design Studio I (Irregular) Practice of biological engineering design in the Biological Engineering Design Studio. Design projects explore the unique problems associated with engineering applied to biological systems. Group activities to teach teamwork skills in the context of engineering practice, including reporting, project management, time management, communication and balancing individual and team accountability. Introduction and application to a computer aided graphics package. Lecture 1 hour, laboratory 3 hours per week. Prerequisite: BENG 1012 or GNEG 1103. Corequisite: Lab component.

BENG2612 Biological Engineering Design Studio II (Fa) Applications of biology, chemistry and physics to the design of life support for enclosed biological systems involving people, animals, plants and microbes. Design process will be based upon engineering analyses such as quantifying bio-energetics and growth, energy and mass balances, solar energy and use of watershed modeling tools. Student teams will be presented multiple design modules that include literature/experimental discovery, open-ended design and prototype testing. 4 hours of design studio per week. Pre- or Corequisite: PHYS 2054, BIOL 1543/1541L, GNEG 1111 or GNEG 1103.

BENG2622 Biological Engineering Design Studio III (Sp) Continuation of BENG 2612. Design Studio experience includes additional life support system design modules. Design process will include discussion of social issues and ethics, use of engineering economics as a tool to evaluate design alternatives. Use of descriptive statistics and regression to analyze experimental data. Improve written and oral communication skills through presentation of design project results. 4 hours of design studio per week. Pre- or Corequisite: GNEG 1121 or GNEG 1103, BIOL 2013/2011L or BIOL 2533/2531L. Prerequisite: BENG 2612.

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.

BENG3104 Electronic Instrumentation for Biological Systems (Sp) Theory and advanced applications of analog circuits, digital circuits, and commercial instruments involving biological materials and systems. Lecture 3 hours, laboratory 3 hours per week. Prerequisite: PHYS 2074.

BENG3104H Honors Electronic Instrumentation for Biological Systems (Sp) Theory and advanced applications of analog circuits, digital circuits, and commercial instruments involving biological materials and systems. Lecture 3 hours, laboratory 3 hours per week. Prerequisite: PHYS 2074 .

BENG3213 Biomedical Engineering: Emerging Methods and Applications (Sp) Introductory course for undergraduate biomedical engineering students. Emerging biomedical engineering topics including: tissue engineering, stem cell engineering, biomedical nanotechnology, medical imaging and biosensing, single molecule imaging, biomarker discovery and proteomics, gene therapy, drug delivery, and protein engineering. Design of components for tissue engineering processes, nanodrug delivery and nanotechnology based disease detection. Lecture 3 hours per week. Pre- or Corequisite: BENG 3723. Prerequisite: BIOL 2533/2531L, or BIOL 2013/2011L.

BENG3653 Global Bio-Energy Engineering (Sp) 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).

BENG3712 Engineering Properties of Biological Materials (Fa) Measuring and predicting the physical, chemical, and biological properties of biological materials necessary for the analysis and design of production and processing systems. Lecture 2 hours per week. Prerequisite: BENG 2622.

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.

BENG3743 Food and Bio-Product Systems Engineering (Sp) 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 bio-process 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.

BENG3803 Mechanical Design in Biological Engineering (Sp) Introduction to the mechanical design process applied to biological engineering, with examples of mechanical components interfacing with biological systems. Engineering properties of materials, loading, combined stress analysis, theories of failure. Systems approach in design, including safety, reliability and cost. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: MEEG 3013 and GNEG 1122.

BENG3933 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.

BENG4103 Measurement and Control for Biological Systems (Fa) 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.

BENG4103H Honors Measurement and Control for Biological Systems (Fa) 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.

BENG4113 Risk Analysis for Biological Systems (Odd years, Fa) Principles of risk assessment including exposure assessment, dose response, and risk management. Methods of risk analysis modeling and simulation with computer software. Applications of risk analysis in medical, animal, food and environmental systems. Prerequisite: MATH 2564 and BIOL 2013.

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.

BENG4133 Digital Remote Sensing and GIS (Irregular) Basic digital image processing techniques and geo-spatial analysis applied to monitoring of natural processes and resources. Course topics include introduction to electromagnetic radiation, concept of color, remote sensing systems, and light attenuation by atmosphere, objects and sensors. Advanced topics include data models, spectral transforms, spatial transforms, correction and calibration, geo-rectification, and image classification with hyperspectral and multi-spectral images acquired with aerial and satellite sensors. Raster GIS is integrated into the course throughout the semester. Will use software such as ENVI, ArcGIS and ArcView. Lecture 2 hours, lab 3 hours per week.

BENG4203 Biomedical Engineering Principles (Fa) Engineering principles applied to the design and analysis of systems affecting human health. This is an introductory course focusing on fundamentals of physiological systems and modeling and how this relates to analysis and equipment design. Topics include: brief overview of anatomy and physiology; bioelectric phenomena, physiological modeling, cardiovascular system, biomechanics, computational biology. Requires a background in circuits, fluid dynamics, mechanics, biology, and chemistry. Lecture 3 hours per week. Prerequisite: MATH 2584 and Senior standing.

BENG4223 Numerical Methods in Biomedical Engineering (Sp) Application of mathematical techniques and numerical methods for analyzing biological data and solving biological problems. The emphasis will be computer simulation and mathematical modeling applications in biomedical engineering. Prerequisite: MATH 2584.

BENG4233 Tissue Engineering (Fa) Introduction to tissue engineering. Topics include quantitative cell and tissue biology, tissue dynamics, cellular-fate processes, coordination of cellular-fate processes, stem cell differentiation and organ regeneration, biomaterials and tissue scaffolding, gene therapy, and clinical implementation of tissue engineered products. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: CHEM 3613.

BENG4243 Biomaterials (Sp) Study of different classes of biomaterials and their interactions with human tissues. From absorbable sutures to Zirconium alloy hip implants, biomaterials science influences nearly every aspect of medicine. Topics include: biocompatibility factors; natural and synthetic biopolymers, ceramics and metals; orthopedic, dental and cardiovascular implants; ophthalmological and dermatological materials; degradable polymers for drug delivery; nanobiomaterials; smart biomaterials and the regulation of devices and materials by the FDA. Three lectures per week. Prerequisite: (BENG 3712 or MEEG 2103) and MEEG 3013.

BENG4283 Electronic Response of Biological Tissues (Irregular) Understand the electric and magnetic response of biological tissues with particular reference to neural and cardiovascular systems. Passive and active forms of electric signals in cell communication. We will develop the central electrical mechanisms from the membrane channel to the organ, building on those excitation, dielectric models for tissue behavior, Debye, Cole-Cole models. Role of bound and free water on tissue properties. Magnetic response of tissues. Experimental methods to measure tissue response. Applications to Electrocardiography & Electroencephalography, Microwave Medical Imaging, RF Ablation will be discussed that are common to many electrically active cells in the body. Analysis of Nernst equation, Goldman equation, linear cable theory, and Hodgkin-Huxley Model of action potential generation and propagation. High frequency response of tissues to microwave. Prerequisite: ELEG 3703 or equivalent; MATH 2584 or equivalent; basic biology. (Same as ELEG 4773)

BENG450V Special Problems (Sp, Su, Fa) (1-4) 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) (1-6) Prerequisite: Honors candidacy.

BENG452V Special Topics in Biological Engineering (Irregular) (1-6) 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 3743 and BENG 3933.

BENG4703 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. Prerequisite: BENG 2622. Corequisite: Lab component.

BENG4733 Kinetics and Transport Phenomena in Biological Systems (Fa) Applications of the principles of kinetics and heat and mass transfer to the analysis and design of biological engineering processes. Biological engineering processes will encompass examples in the realms of biotechnology, ecological, and biomedical engineering. Lecture 3 hours per week. Prerequisite: MATH 2584 and BENG 3723. Pre- or Corequisite: CHEM 3813.

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, developing functional/mechanical criteria, standards, reliability, safety, ethics and professionalism issues. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: BENG 3723. Pre-or Corequisite: BENG 4733.

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.

BENG4903 Watershed Eco-Hydrology (Sp) Engineering principles involved in assessment and management of surface water flow and hydrologic processes within ecosystems. Includes frequency analysis of rainfall, infiltration, runoff, evapotranspiration. Use of GIS/mathematical models to quantify hydrologic processes at the watershed-landscape scale. Design/implementation of best management practices and ecological engineering principles and processes for advanced ecological services. Lecture 3 hours per week. Prerequisite: CVEG 3213.

BENG4923 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, and 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 coexistence of urban and agricultural land uses. Lecture 3 hours per week. Prerequisite: BENG4903.

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 4104.

BENG5113 DIGITAL Remote Sensing and GIS (Irregular) Basic digital image processing techniques and geo-spatial analysis applied to monitoring of natural processes and resources. Course topics include introduction to electromagnetic radiation, concept of color, remote sensing systems, and light attenuation by atmosphere, objects and sensors. Advanced topics include data models, spectral transforms, spatial transforms, correction and calibration, geo-rectification, and image classification with hyperspectral and multi-spectral images acquired with aerial and satellite sensors. Raster GIS is integrated into course throughout the semester. Will use software such as ENVI, ArcGIS and ArcView. Requires a class project in the student's area of interest. Lecture 2 hours, lab 3 hours per week. Students may not earn credit for both BENG 5113 and BENG 4133. Corequisite: Lab component. Prerequisite: MATH 2584.

BENG5203 Mathematical Modeling of Physiological Systems (Sp) Application of mathematical techniques to physiological systems. The emphasis will be on cellular physiology and cardiovascular system. Cellular physiology topics include models of cellular metabolism, membrane dynamics, membrane potential, excitability, wave propagation and cellular function regulation. Cardiovascular system topics include models of blood cells, oxygen transport, cardiac output, cardiac regulation, and circulation. Background in biology and physiology highly recommended. Lecture 3 hours per week. Prerequisite: MATH 2584. (Same as BMEG 5203)

BENG5213 Introduction to Bioinformatics (Irregular) Application of algorithmic techniques to the analysis and solution of biological problems. Topics include an introduction to molecular biology and recombinant DNA technology, biological sequence comparison, and phylogenetics, as well as topics of current interest. (Same as CSCE 5213)

BENG5223 Biomedical Engineering Research Internship (Sp, Su, Fa) Minimum six-week program (possibly up to several months) in a medical research environment working on an original engineering research project. Possible specialty areas include Anesthesiology, Cardiology, Informatics, Ophthalmology, Orthopedic Surgery, and Radiology. Prerequisite: Graduate standing and approval of coordinator.

BENG5233 Tissue Engineering (Fa) Introduction to tissue engineering. Topics include quantitative cell and tissue biology, tissue dynamics, cellular-fate processes, coordination of cellular-fate processes, stem cell differentiation and organ regeneration, biomaterials and tissue scaffolding, gene therapy, and clinical implementation of tissue engineered products. Lecture 2 hours, laboratory 3 hours per week. Students may not earn credit for both BENG 5233 and BENG 4233. Corequisite: Lab component. Prerequisite: CHEM 3613.

BENG5243 Biomaterials (Sp) Study of different classes of biomaterials and their interactions with human tissues. From absorbable sutures to Zirconium alloy hip implants, biomaterials science influences nearly every aspect of medicine. Topics include: biocompatibility factors; natural and synthetic biopolymers, ceramics and metals; orthopedic, dental and cardiovascular implants; opthamological and dermatological materials; degradable polymers for drug delivery; nanobiomaterials; smart biomaterials and the regulation of devices and materials by the FDA. Three lectures per week. Students may not earn credit for both BENG 5243 and BENG 4233. Prerequisite: BENG 3712 or MEEG 2303, and MEEG 3013.

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)

BENG5263 Biomedical Engineering Principles (Fa) Engineering principles applied to the design and analysis of systems affecting human health. This is a course focusing on fundamentals of physiological systems and modeling. Topics include: brief overview of anatomy and physiology, bioelectric phenomena and neuronal model, compartmental modeling, cardiovascular system and blood flow, biomechanics, computational biology and signal transduction. Requires a background in circuits, fluid dynamics, mechanics, biology, and/or biochemistry. Lecture 3 hours per week. Students may not earn credit for both BENG 5263 and BENG 4203. Prerequisite: MATH 2584 or equivalent and graduate standing.

BENG5273 Numerical Methods in Biomedical Engineering (Sp) Application of mathematical techniques and numerical methods for analyzing biological data and solving biological problems. The emphasis will be computer simulation and mathematical modeling appli-

cations in biomedical engineering. Lecture 3 hours per week. Students may not earn credit for both BENG 5273 and BENG 4223. Prerequisite: MATH 2584.

BENG5283 Electronic Response of Biological Tissues (Irregular) Understand the electric and magnetic response of biological tissues with particular reference to neural and cardiovascular systems. Passive and active forms of electric signals in cell communication. We will develop the central electrical mechanisms from the membrane channel to the organ, building on those that are common to many electrically active cells in the body. Analysis of Nernst equation, Goldman equation, linear cable theory, and Hodgkin-Huxley Model of action potential generation and propagation. High frequency response of tissues to microwave excitation, dielectric models for tissue behavior, Debye, Cole-Cole models. Role of bound and free water on tissue properties. Magnetic response of tissues. Experimental methods to measure tissue response. Applications to Electrocardiography & Electroencephalography, Microwave Medical Imaging, RF Ablation will be discussed. Students may not receive credit for both BENG 4283 and BENG 5283. Prerequisite: MATH 2584, ELEG 3703 or PHYS 3414, BIOL 2533 or equivalent. (Same as ELEG 5773)

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 con-

trol and/or conceptual understanding. Prerequisite: AGST 4023 or STAT 4003 or INEG 3333.

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.

BENG5943 Watershed Eco-Hydrology (Sp) Engineering principles involved in assessment and management of surface water flow and hydrologic processes within ecosystems. Includes frequency analysis of rainfall, infiltration, runoff, evapotranspiration. Use of GIS/

mathematical models to quantify hydrologic processes at the watershed-landscape scale. Design/implementation of best management practices and ecological engineering principles and processes for advanced ecological services. Lecture 3 hours per week. Students may not earn credit for both BENG 5943 and BENG 4903. Prerequisite: CVEG 3213 or equivalent.

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.

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
- 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.

CONVERSION OF BIOMASS INTO LIQUID FUELS: UNDERSTANDING THE DEPOLYMERIZATION OF HEMICELLULOSE

DANIELLE JULIE CARRIER, PROFESSOR

ISSUE:

To convert biomass into liquid fuels or other biobased products using the biochemical platform, biomass must first be broken down, through pretreatment and enzymatic hydrolysis, into its individual sugar component. Unfortunately during pretreatment, inhibitory compounds are formed from the degradation of hemicellulose into furfural, acetic acid and formic acid; or lignin-derived phenolic compounds and oligomers. The listed inhibitory compounds inhibit the sugar release step, which, in turn, impedes the conversion of biomass into biofuels or other biobased products. Understanding how to release the sugars from biomass, without producing the plethora of inhibitory compounds, is critical for maximizing biofuel and biobased production yields.

ACTION:

Our group is studying herbaceous and wood hemicellulose. We pretreat and enzymatically hydrolyze the biomass and then calculate the sugar release. We also track the release of inhibitory compounds. We are determining the rates of sugar release and of inhibitory compound production. Our goal is to determine which processing conditions will minimize the release of inhibitory compounds, while maximize the sugar concentration.

IMPACT:

The payoff is quite important in the sense, that an increase of sugar release and a decrease of inhibitory compound concentration will set the stage for better use of our biomass resources. In other words, more gallons of ethanol will be produced from a said amount of feedstock. This, in turn, will help the US march towards the goal of 21 billion gallons of advanced biofuels to be produced by 2022.

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COOPERATING SCIENTISTS OR INSTITUTIONS:

Drs. Kevin Chambliss and Matt Pelkki

FUNDING SOURCES:

NSF, NSF EPSCoR – P3, DOE and DOT

ALGAE PRODUCTION RESEARCH MOVES TO LARGER SCALE

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 which 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) that any other energy crop. Algae can also utilize nutrients from waste water or from natural waters containing excess nutrients. This utilization of existing waste or by-product nutrient sources decreases the demand for commercial fertilizers which must be mined and shipped long distances. The production 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 investigating systems to produce algae using waste water or nutrient-containing natural waters to yield biomass feedstock for biofuel productions. The chosen approach cultures the growth of mixed species indigenous (or wild) strains of algae in an open water flow way. Algal cells are attached to a growth medium and are bathed with a continual stream of the inlet water. Periodically the cells, rich in energy from solar based photosynthesis, are harvested, quantified and evaluated for use as a potential biofuel feedstock. Biological and Agricultural Engineering faculty have received funding for a third generation algal production system. The new system will capitalize on experience from two previous systems, one using stream water in Springdale, and another using effluent from the Fayetteville wastewater treatment plant. The team received research funding from the USDA as part of an integrated approach to mitigate the carbon footprint of swine production. Algae will be used to convert nutrients from swine waste water to a renewable energy source. The new algae flow way was constructed at the UA Swine Grower Unit near Savoy Arkansas. Currently, pilot studies are being done to determine wastewater dilution rates needed to optimize algal production. The system represents a unique research facility for quantifying potential commercial algae productivity.

IMPACT:

The new 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. Research results will provide data needed to do objective economic analyses of the life cycle costs and environmental impacts of the proposed technology.

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COLLABORATING SCIENTISTS:

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Samy 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 SHOW EFFECTS OF WATERSHED MANAGEMENT

BRIAN HAGGARD, PROFESSOR

ISSUE:

The state of Arkansas through various state and federal programs has been investing millions of dollars into activities to improve water quality, and our studies have used long-term water quality databases to see what changes might have occurred. The efforts to improve water quality transcend through all stakeholders, from farmers through urban municipalities. This problem is extremely important, because water quality concerns exist locally, across state boundaries, and downstream all the way to the Gulf of Mexico.

ACTION:

We compiled various water quality databases, organizing the data over time, and then matched collected water samples to the river discharge on the sampling date. Concentrations of nitrogen, phosphorus and sediment are strongly related to discharge, so you have to flow-adjust concentrations to look at water quality trends. We used a simple flow-adjustment procedure, and then looked at changes in flow-adjusted concentrations over time to see if nitrogen, phosphorus and sediment were increasing, staying about the same, or decreasing.

IMPACT:

We clearly showed that flow-adjusted concentrations of nitrogen, phosphorus and sediment are decreasing in rivers across northwest Arkansas and into northeast Oklahoma, including the Eucha-Spavinaw Watershed, Illinois River Watershed, and the Upper White River Basin. Our studies have particularly focused on phosphorus, because the poultry industries and municipal effluent discharges have been suggested as primary phosphorus sources. Our results have shown that improvements in wastewater treatment have resulted in dramatic decreases in phosphorus levels in area streams, and evidence suggests that implementation of best management practices on the landscape has improved water quality. The bottom line is that phosphorus, as well as nitrogen and sediment, are decreasing in many of our regional streams because of the efforts of the watershed stakeholders.

CONTACTS:

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

COOPERATING SCIENTISTS OR INSTITUTIONS:

J. Thad Scott, Assistant Professor, Crop, Soil, and Environmental Sciences Department, University of Arkansas, Fayetteville, Arkansas

Andrew N. Sharpley, Professor, Crop, Soil, and Environmental Sciences Department, University of Arkansas, Fayetteville, Arkansas

U.S. Geological Survey Arkansas Water Sciences Center, Little Rock, Arkansas

FUNDING SOURCES:

The funding for these trend analyses came from multiple state and federal agencies, including the Section 319 Program of the Arkansas Natural Resources Commission, the U.S. Geological Survey (USGS) 104B Program, and the University of Arkansas System's Division of Agriculture; some of the data used in these studies came from the U.S. Geological Survey National Water Information Systems (NWIS), and these efforts were funded by various federal, state and local partners through the USGS's state cooperative program.

UNDERSTANDING IRRIGATION WATER USE IN ARKANSAS ROW CROP AGRICULTURE

CHRISTOPHER HENRY, ASSISTANT PROFESSOR, EXTENSION

ISSUE:

In recent years there has been an increasing awareness that ground water withdraws for irrigation are not sustainable. As an increasing proportion of Arkansas' row crop production areas are designated as 'critical water areas' there is a need to develop conservation management practices and technology to improve water use efficiency. These practices include but are not limited to things such as, irrigation scheduling, tail water recovery, multiple inlet irrigation for rice, pipe planning for furrow irrigation, and other practices that conserve water or improve irrigation efficiency. However, to assess the impact of a practice on conservation, one must have a benchmark to compare the efficacy of conservation practices on a state-wide scale. Currently irrigation water use for the four major commodities in Arkansas, rice, corn, soybeans, and cotton is not measured annually. Yet producers are required to report water use to the state, based simply on the number of times a crop is irrigated.

ACTION:

In 2012, an effort was made to bolster and begin collecting data on irrigation water use on farmer fields participating in the University of Arkansas commodity research verification programs. Where possible farms are fitted with portable turbine style flow meters for the growing season and total water use and precipitation is recorded. In addition, farmers participating in the Arkansas Discovery Farms program have also been instrumented with more sophisticated data logging flowmeters to better understand irrigation water use through the season. These sites are more intensely monitored and often include a comparison or treatment effect for evaluation. Maintaining a long term history of water use is valuable for assessing trends, climate impacts, irrigation system types and practices, and understanding water use changes and demands over time. The rice research verification program has the longest standing history of measuring water use in the verification program, and this dataset was analyzed for the period of 2003 to 2011.

IMPACT:

An analysis of rice water use has revealed that rice farmers use about 29.8 acre-inches of water per year on average. There is no significant difference in water use between silt loam and clay soil types. Zero-grade rice fields use about 40% less water than contour and precision graded fields. Fields with multiple-inlet, a conservation practice, had 10 bushel per acre higher yields than fields without the multiple inlet practice. Irrigation costs were $25/acre higher for groundwater sources than surface water sources when adjusted for the producer price index to 2012. Producers utilizing electricity for an energy source saved on average $29/acre compared to diesel powered units, but used six acre-inches more water. This data is valuable to Extension specialists, agents, consultants, and producers and can improve their profitability and sustainability. Using this data, improved decision making is possible about irrigation system types and management practices.

CONTACTS:

Chris Henry, Sarah Hirsh, Merle Anders, Bradley Watkins, Tajana Hristovska, University of Arkansas Rice Research and Extension Center, Stuttgart, Arkansas

Verification Program PI's and coordinators

Jeremy Ross, Chris Grimes, Steve Kelley, Soybean Research Verification Program

Jason Kelly and Kevin Lawson, Corn and Grain Sorghum Research Verification Program

Tom Barber and Blake McClelland, Cotton Research Verification Program

Chuck Wilson, Ralph Mazzanti, and Lance Schmidt, Rice Research Verification Program

Arkansas Discovery Farms Program

Andrew Sharpley, University of Arkansas

Mike Daniels, and Pearl Daniel, University of Arkansas Extension.

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COOPERATING SCIENTISTS:

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FUNDING SOURCES:

University of Arkansas, Arkansas Rice Research and Extension Board, Soybean Promotion Board, Corn and Grain Sorghum Promotion Board, and Cotton Incorporated.

MICRO/NANOSCALE BIO/ABIO INTERFACING TECHNOLOGY

JIN-WOO KIM, PROFESSOR

ISSUE:
The biomaterials, including DNA, proteins, and cells, are well optimized through evolution, exhibiting unique recognition, transport, catalytic, and replication properties. In stead of reinventing the wheels, the integration of such pre-engineered biomaterials into nano systems would lead to the realization of the next generation bio/abio hybrid engineered systems for applications ranging from MEMS/NEMS to biosensing and nanomedicine. However, the major challenges for making this merger feasible are integration and interfacing of the micro- and nano-scale biological and abiological materials at similar scales. The successful development of interfacing techniques for their integration is imperative to overcome the challenges.

ACTION:
Currently, we are in the process of developing technical platforms for 'controllable' interfaces between biological materials, such as nucleotides, proteins, cells, and abiological materials, such as MEMS/NEMS channels and nanoparticles, at the micro/nanoscale. Also a series of nano hybrid devices are being developed through the stable and controllable interfacing technology: (a) a nano flagellar motor based AC dynamo (nFMD), (b) a nano flagellar motor based TNT detection system (nFMTNT), (c) an electron tunneling based nanochannel system for DNA sequencing, and (d) a photoacoustic and photothermal biosensing as well as diagnostic systems.

IMPACT:
These projects are important steps towards realization of the bio/nano nanotechnology that bridges the sciences of biology, medicine, nano-materials, and MEMS/NEMS by pairing their advantages. The research has generated 5 journal articles published or *in press* and 3 presentations, and 1 provisional patent pending during the year 2012.

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National Science Foundation (NSF; award #: ECCS-1128660 and ECCS-1137948)
Arkansas Biosciences Institute (ABI)

SELF-ASSEMBLY OF MULTIFUNCTIONAL NANOCOMPOSITES FOR MULTIPLEX, MULTIMODAL NANOTHERANOSTICS

JIN-WOO KIM, PROFESSOR

ISSUE:
Many therapeutic and diagnostic – termed "theranostic" – modalities have been developed to detect and treat fatal diseases such as tumors and infections. However, it is still far from ideal to realize their early diagnosis and treatment despite recent progresses. There is a great need for new technologies, which will enable us to overcome these huddles and serve as innovative, integrated theranostic tools with increased sensitivity and specificity for the early diagnosis and treatment of such life-threatening diseases. Recent advances in nanotechnologies have shown promises to address this significant clinical need. However, there are still many challenges that persist and most of the existing nanotechnology-based approaches are not clinically relevant as of yet. Significant challenges of the current nanotechnology-based approaches include low targeting sensitivity and specificity, treatment efficiency, toxicity concerns, and insufficient theranostic devices among many others.

ACTION:
To meet the challenge, our group is in the process of engineering noninvasive theranostic platforms by uniquely combining novel nanoparticles (NPs) and their composites, and real-time integration of various theranostic modalities for effective diagnosis and treatment. This includes developing a versatile and environmentally friendly means to synthesize and assemble various NPs and their composites with control over their structural configuration, and realizing accurate, scalable and high-rate self-assembly of biocompatible hybrid nanotheranostic agents with desirable multifunctionalities.

IMPACT:
This technology, if successfully developed, would provide an effective and efficient route to a "second-generation" multifunctional nano-architecture with properties that are "programmable/customizable" on the basis of the target sensing and theranostic applications. The research has generated 4 journal articles published or *in press* and 9 invited presentations, 1 patent issued, and 1 pending patent during the year 2012.

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Arkansas Biosciences Institute (ABI)

APTAMERS FOR USE IN RAPID DETECTION OF AVIAN INFLUENZA VIRUS

YANBIN LI, PROFESSOR, TYSON ENDOWED CHAIR IN BIOSENSING ENGINEERING

ISSUE:

Avian influenza (AI) virus H5N1 has been reported by WHO in more than 46 countries for animal cases and in 15 countries for human cases with 610 people infected and 360 died since 2003. Outbreaks of low pathogenic AI in 2001 and 2002 in US resulted in the depopulation of over 4.5 million chickens and turkeys and cost the poultry industry more than $125 million. World Bank estimated that more than 140 million birds had died or been destroyed due to AI H5N1 and losses to the poultry industry are in excess of $10 billion worldwide. Immunoassays are commonly applied for rapid screening of avian influenza virus, but are limited by the temperature sensitive and high cost antibodies that are used in the tests.

ACTION:

Aptamers showed great potential to provide higher affinity for target virus and better thermal stability than antibodies. Aptamers to specifically bind avian influenza H5N1 and H7 virus were selected using SELEX method, and their affinity and specificity were evaluated using Dot Blot and SPR and compared with polyclonal and monoclonal antibodies against AI H5N1. Three DNA-apatmer sequences were obtained for H5N1 and two for H7. Those aptamers have better specificity and stronger binding affinity to AI subtype H5N1 and H7 than monoclonal antibodies. The selected aptamers are also being tested for the detection of AI subtype H5N1 and H7 at low concentrations in poultry swab samples using a biosensor method such as SPR, impedance and QCM biosensors.

IMPACT:

Since the applications of immunoassays for in-field screening of avian influenza virus are limited by the use of temperature sensitive antibodies, the aptamer sensing material would provide a better option to the biosensor technology as well as diagnostic kits for in-field rapid, sensitive and specific screening of avian influenza H5N1 and H7 in poultry swab samples. This will help the poultry industry more effectively monitoring avian influenza H5N1, H7, different subtypes and other poultry diseases with lower testing cost.

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FUNDING:

ABI

PORTABLE BIOSENSOR FOR IN-FIELD DETECTION OF AVIAN INFLUENZA

YANBIN LI, PROFESSOR, TYSON ENDOWED CHAIR IN BIOSENSING ENGINEERING

ISSUE:

Avian influenza (AI) virus H5N1 was discovered in the late 1990s, and it has been reported by WHO in more than 46 countries for animal cases and in 15 countries for human cases with 610 people infected and 360 died since 2003. In the US, a recent outbreak of low pathogenic AI in 2001 and 2002 resulted in the depopulation of over 4.5 million chickens and turkeys and had cost the poultry industry approximately $125 million. World Bank estimated that more than 140 million birds had died or been destroyed due to AI H5N1 and losses to the poultry industry are in excess of $10 billion worldwide. A key in controlling the spread of AI is to rapidly detect the disease, and then eradicate infected animals, quarantine and vaccinate animals. The technology for detection of AI H5N1 is mature, but many tests are complex, some are liable to error, and some can be performed safely only in BSL3 facilities. A simple, rapid, robust and reliable AI test, suitable for use in the field, is urgently needed.

ACTION:

A portable biosensor has been developed for in-field sensitive and specific detection of AI virus H5N1 in poultry swab samples. Magnetic nanobeads are coated with specific antibodies to target virus and used in the sampler to separate and concentrate target virus from a poultry swab sample. Red blood cells, as biolabels, are mixed with the captured target virus to form the bio-nanobead-virus-red blood cell complex. A microfluidic biochip is designed and fabricated as a flow-through device to deliver the complex to an embedded interdigitated array microelectrode for impedance measurement. The change in impedance of the bionanobead-virus-red blood cell complex is correlated to the concentration of AI virus H5N1 in the original swab sample. Our results showed that a positive signal was clearly obtained when the concentration of AI virus H5N1 in cloacal swabs was equal to or more than 100 EID50/mL. The test on live H5N2 virus in infected chickens indicated the biosensor presented the same results as that by RT-PCR. A US patent has been filed. A research prototype of this biosensor has been designed, fabricated and evaluated with viable AI H5N1 in a BSL-3 lab. Field tests are being tested.

IMPACT :

Since currently there is no any in-field AI test instrument available, this biosensor would provide the poultry industry with a very needed technology for rapid, sensitive and specific screening of AI H5N1 in poultry. This will help the poultry industry be better prepared for AI H5N1, 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 animal and human. The biosensor technology developed in this research can also be applied to the detection of other poultry and animal diseases.

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FUNDING:

USDA/NIFA, ABI, MoST

ENGINEERED B-CELL BASED BIOSENSOR FOR DETECTION OF FOODBORNE PATHOGENS

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 method 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 Ca^{2+} 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 range from 10^0 to 10^6 cfu/ml within 15 min without sample pre-enrichment.

In this research, the B-cells (B lymphocytes) were engineered with the genetically encoded fluorescent Ca^{2+} reporter (FCR) for the rapid and sensitive detection of pathogens. The FCR consisted of a pair of fluorescent proteins (FPs) engineered for fluorescence resonance energy transfer (FRET) which carry calcium probes with more specialized calcium-binding proteins. A rise in Ca^{2+} concentration in the B-cell cytoplasm lead to an increase in fluorescence emission from fluorescent protein 1 and a decrease of fluorescence protein 2 owing to the FRET. The genetically encoded FCR sensitively reported fluctuations of the cytoplasmic Ca^{2+} concentration. The B-cell membrane could be further engineered with receptors (such as antibodies) specifically against target pathogens. Briefly, when the target pathogen is attached to its specific receptors on B-cell surface, the cross-linking of B-cell receptors (BCRs) will produce a signal, and the signaling pathways will be activated, resulting in the release of Ca^{2+} within seconds. The elevated intracellular Ca^{2+} concentration will activate FCR to report the fluorescence signal change and indicate the presence of target pathogen.

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.

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FUNDING:

ABI

SPRINKLERS COOL BROILERS AND CONSERVE WATER

YI LIANG, ASSISTANT PROFESSOR, EXTENSION

ISSUES:

Tunnel ventilation and evaporative cooling system are the current methods used by poultry industry to overcome heat stress during hot and humid weather. The high moisture, as a result of inlet air saturation, is counterproductive to the bird's natural ability to cool itself by evaporative heat loss through the air a bird breaths out. A second challenge with recirculating cool cell system is the significant water usage that is directly correlated to outside temperature and air movement.

ACTION:

Low pressure overhead sprinklers spray variable amount of water intermittently as large water droplets into the barn according to the total live weight of the birds and thermal conditions inside the house, beginning flock age of 21 days under normal stocking density. The sprayed water does not cool the barn air, but rather wet the birds' feathers, absorbing heat directly from the birds as water evaporates into the air moving at 500+ feet per minute. Two sprinkler systems were used either as primary cooling supplemented by evaporative cooling pads, or as the only cooling method during five summer flocks in 2009, 2010 and 2011. Cooling water usage of each flock averaged 7,000, 21,000 or 32,000 gallon from sprinkler-only, sprinkler-cool_pads combination or cool_pads only houses, respectively. Equivalent livability, feed conversion, weight gain, litter moisture conditions were achieved during the field trials. This technology was demonstrated in a field day at the Broiler Research Farm of Division of Agriculture in 2009, and presented at the International Poultry Symposium in 2012. A fact sheet summarizing the concept of sprinkler cooling, the difference of sprinklers versus foggers, and its general layout and operations was published in 2012.

IMPACT:

Drought conditions during the 2012 summer was a wake-up call for many producers regarding the need to better conserve water yet maintain good bird performance. Sprinkler systems were installed on 200 growers' farms in Arkansas and used as the primary cooling method in summer 2012. The growers were satisfied with the performance of their flocks used sprinklers and the tremendous water savings. Growers who face water shortage, or who use city or rural water could benefit from reduced water footprint at their farm. With an estimated 17,000 poultry houses in the state of Arkansas and Oklahoma, water footprint of poultry live production can be greatly reduced if each house uses 50,000 gallon less water each summer for bird cooling.

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FUNDING:

Division of Agriculture, University of Arkansas

Sustainable Metrics for Agriculture

Marty Matlock, Professor and Area Director, Center for Agricultural and Rural Sustainability

ISSUE:
Agricultural producers are under increased pressure to demonstrate sustainability of their practices to the public, either from regulatory agencies such as USEPA, support agencies such as NRCS, or customers such as consumer packaged goods manufacturers. The frameworks for demonstrating sustainable practices are not well defined. My research through the Center for Agricultural and Rural Sustainability has focused on defining effective metrics for sustainable agricultural production outcomes.

ACTION:
I have worked with Field to Market: The Keystone Alliance for Sustainable Agriculture as well as the Stewardship Index for Specialty Crops to define appropriate metrics for sustainable agriculture. I have worked with these groups to benchmark production metrics for cotton, wheat, soybeans, and corn across the US, and to create a framework for setting goals for reduction of impacts. I have received competitive funding from USDA and other agricultural research sources to develop and implement Life Cycle Assessments of the impacts of pork and dairy production on greenhouse gas emission, water use, and feed production efficiency.

IMPACT:
Field to Market published the Benchmark for US Agriculture in 2006, with a 2011 update. They developed a fieldprint calculator tool for farmers to inform their efforts. I am implementing a pilot from FAO for Cotton Incorporated.

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National collaboration, University of Wisconsin, NC State, Purdue, Virginia Tech.

FUNDING SOURCES:
USDA NIFA; National Pork Board; Dairy Management, Inc.; Cotton Incorporated; National Corn Growers Association

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.

ACTION:

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.

IMPACT:

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. This technology can also be used to float existing algae that are distributed throughout the entire water body to the surface so it can be removed. By physically removing the algae, phosphorus is removed from the reservoir and is no longer available for future algae growth. In other words, the source for the cure is found in the disease.

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GASIFICATION OF FRESH AND TORREFIED COTTON GIN WASTE IN AN AUGER REACTOR

SAMY SADAKA, ASSISTANT PROFESSOR, EXTENSION

ISSUE:

Cotton gin wastes are the byproduct of the cotton ginning process. CGW may include plant parts, immature seeds, and fibers normally removed by seed cotton cleaners such as cylinder cleaners and stick machines. The annual production of CGW in the United States is estimated to be about 2.2 million metric tons. This vast amount of waste creates a significant disposal problem in the ginning industry. Consequently, may be more than half of cotton producers pay for CGW disposal.

ACTION:

A 10 $kW_{thermal}$ externally heated auger gasification reactor was constructed and tested in the Rice Research and Extension Center, University of Arkansas, Stuttgart, AR. The reactor was used to achieve thermal decomposition of cotton gin wastes (CGW) into producer gas and biochar. Raw and torrefied CGW were gasified to assess the effects of the torrefaction process on the producer gas composition and yield. The effects of reactor temperature (750, 850 and 950 ^{o}C) and cotton wastes pretreatment (raw and torrefied) on the producer gas, biochar and condensable liquids quality and quantity were investigated.

IMPACT:

Torrefying cotton gin wastes reduced their moisture content and volatile solids, whereas it increased their bulk density, heating value and stoichiometric air required for complete combustion. At the reactor temperature of 950 ^{o}C, the biochar production rate decreased by 21% and 10% during gasification of raw and torrefied CGW, respectively as compared to their corresponding value at the reactor temperature of 750 ^{o}C. The maximum producer gas heating value reached 5.4 MJ/m^3 during gasification of torrefied CGW.

The potential green electricity generation from raw and torrefied CGW during the ginning season (1500 h/season) would be about 5.0 MWe and 4.7 MWe, respectively based on a 40 bale per hour ginning facility. Therefore, if the torrefaction-gasification technologies and electricity generation processes were integrated and implemented, the power generated from CGW in ginning facilities could exceed the 2 MW threshold power requirement.

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FUNDING SOURCES:

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SWAT Modeling for Priority Watersheds in Arkansas

Dharmendra Saraswat, Associate Professor / Extension Engineer—GeoSpatial

ISSUE:

Poteau River watershed (556 mi^2), Strawberry River watershed (761 mi^2), and Upper Saline River watershed (1,715 mi^2) have been selected by the Arkansas Natural Resource Commission (ANRC) as priority watersheds for the implementation of USEPA Clean Water Act (CWA) 319h grant-funded conservation projects. However, financial resources available are not sufficient to implement conservation practices for the entire watershed.

ACTION:

Soil and Water Assessment Tool (SWAT), a USDA-ARS model is being setup for these three watersheds. The model captures variations in land uses, topography, climate, and management practices over space and time. The models are being calibrated and validated, using existing measured datasets. Subsequently, the spatial and temporal outputs from the model will be used to identify critical areas in the watershed that contribute disproportionately to excessive sediment, total phosphorus, and nitrate-nitrogen. This approach has been successfully implemented for other priority watersheds in Arkansas in the past and has been accepted for publication by a peer-reviewed journal.

IMPACT:

The results from this project will allow ANRC to target areas efficiently and economically in these large watersheds for conservation planning. Use of a calibrated and validated world-renowned watershed model for prioritizing will provide credibility and allow ANRC to justify the use of limited financial resources. The same modeling protocol being used in the current project was used in modeling another priority watershed i.e. Bayou Bartholomew Watershed in previous years. The modeling outputs for BBW were used by Arkansas office of Natural Resources Conservation Service (NRCS) to secure approximately $900,000 in federal funding for providing incentives to land owners and crop producers to "help them have a positive impact on streams with impaired water quality."

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Funding Source

Arkansas Natural Resources Commission through 319(h) program of the Environmental Protection Agency (EPA).

RIPARIAN FOREST BUFFER DELINEATOR TOOL

DHARMENDRA SARASWAT, ASSOCIATE PROFESSOR / EXTENSION ENGINEER—GEOSPATIAL

ISSUE:

Riparian Forest Buffer (code 391) is a standard conservation practice recommended by the Natural Resources Commission Services (NRCS) to maintain and improve the quality of water entering waterways. Conservation personnel from the NRCS work with streamside landowners to implement this practice by providing technical as well as financial (cost-share) assistance. However, these personnel lack a method for screening segments along waterway that are in need of this practice.

ACTION:

A novel method using geospatial technologies has been developed to automatically identify stream segments along a river that lacks adequate riparian buffer. The method has been incorporated in a free and standalone graphical user interface tool for use by NRCS personnel and other stakeholders. The tool uses a novel streambank-delineation algorithm that was developed in-house and was accepted for publication in a renowned international journal (Environmental Modeling & Software). During the tool development, we are consulting with a multi-agency Scientific Advisory Committee that includes representation from NRCS, Arkansas Natural Resources Commission, Arkansas Forestry Commission, University of Arkansas-Monticello, Arkansas Rural Development, and University of Arkansas-Cooperative Extension Service

IMPACT:

The output from this tool will highlight those segments along a waterway that are not meeting Code 391 prescribed criteria for Riparian Forest Buffer. This output will reduce groundwork by NRCS personnel for implementing this practice. In addition, the tool will allow NRCS personnel to communicate better with those streamside landowners whose land are not meeting the code 391 standards. Evaluations are underway to find out potential of this tool for formulating streamside protection ordinance, thereby, helping county extension agents to more actively and efficiently engage in this process.

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FUNDING SOURCE:

Arkansas Natural Resources Commission through 319(h) program of the Environmental Protection Agency (EPA).

SWAT2009_LUC: Evaluating land Use Land Cover Categorical Uncertainty

Dharmendra Saraswat, Associate Professor / Extension Engineer—GeoSpatial

ISSUE:

The use of models for various decision-making calls for scrutiny over its output uncertainty. One of the sources of output uncertainty is the error in input data. The soil and water assessment tool (SWAT) model uses various input datasets including the land use land cover (LULC) map of the study area. The contribution of LULC data error to SWAT output uncertainty is currently unknown and could have important implication on overall model uncertainty.

ACTION:

We have developed a new algorithm that uses published LULC errors and propagates it through the SWAT model. This algorithm was used to understand the uncertainty in the Illinois River watershed SWAT model developed in 2010. This algorithm was integrated within a free and standalone graphical user interface tool titled SWAT2009_LUC. A paper describing this new development is being reviewed by the Transactions of the ASABE journal for publication.

IMPACT:

The algorithm will allow water quality modelers to quantify SWAT model uncertainty resulting from LULC errors. The algorithm has been incorporated in a tool that can be installed on windows based computer for free. Results showed that at monthly time-scale, the Illinois River watershed SWAT model output could vary from 0% to 19.9% when the LULC is perturbed within its published error range. These results demonstrate the importance of LULC-related uncertainty in SWAT model and highlight the need for evaluating uncertainty from all input data source. The full impact of this research could be realized in next few years in assessing the errors associated with environmental impacts of land use under climate change scenarios.

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FUNDING SOURCE:

Arkansas Natural Resources Commission through 319(h) program of the Environmental Protection Agency (EPA).

Flag the Technology Cloud Tool (FTTCloud)

Dharmendra Saraswat, Associate Professor / Extension Engineer—GeoSpatial

ISSUE:

Flag the Technology (FTT) program was launched on a statewide basis in 2011. The program involved distribution of four different types of color coded bicycle-type flags, with each color representing the technology of the crop planted, near entry area or near field borders of many Arkansas soybean and rice fields. The program was initiated because of a need to identify planted fields in such a way that protects the grower, his workers, or a custom applicator from improper herbicide application. It has been adopted by other states as well as endorsed by the Southern Weed Science Society. Despite a tremendous success of the program within a short span of time, some challenges have also been reported. Use of similar colored flags by producers to mark structures like culverts, risers or variety changes, etc. in the field have been reported. Concerns regarding stolen or removed flags and difficulty in spotting fields with different technologies by aerial applicators have also been raised during producer's meetings.

ACTION:

To respond to the challenges, development of a cloud based tool, Flag the Technology Cloud (FTTCloud), was undertaken during 2012. The primary purpose of the tool is to prevent misapplication of pesticides by identifying fields that represent a particular herbicide technology which could be sensitive to potential off-target drift. The tool enables producers and their consultants to interactively register fields under various herbicide technologies. The service providers can also easily locate registered fields of their clients before application of pesticides.

IMPACT:

The first version of FTTCloud has been developed by duly incorporating suggestions received from associated extension specialists and county extension agents. A full demonstration of FTTCloud was conducted before the members of Arkansas Soybean Board on December 3, 2012. The tool will be released for testing purposes sometime during early next year.

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FUNDING SOURCE:

Arkansas Soybean Promotion Board

APPS FOR ARKANSAS CORN AND SOYBEAN PRODUCERS

DHARMENDRA SARASWAT, ASSOCIATE PROFESSOR / EXTENSION ENGINEER—GEOSPATIAL

ISSUE:

More than half of the US population (123.3 million or 53%) is connected through smartphones as per recent industry estimate. 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 and Soybean remained the focus of developments for this year. Android version of app for Corn was completed during the year and at the time of this reporting, was undergoing testing by subject matter specialists. An irrigation scheduler for Soybean has also been developed on Android platform and currently being modified as per feedback received during initial testing. Another app development effort was directed towards developing a crowdsourcing based weed identification and control app for both corn and soybean for Android, iOS and Windows based smartphones. First version of the app was completed for all the three major platforms. Preliminary testing revealed some practical challenges related to its field use therefore alternative strategies have been thought out for implementation during next year.

All of these projects have allowed us to research, design, and implements solutions that facilitate faster information exchange in a secure and reliable manner.

Three e-books were designed using iBooks app software. These books are interactive and allow a unique perspective of various topics compared to static content available in printed copies and also provide links to various relevant publications from within the e-books.

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. It has allowed training 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.

CONTACTS:

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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

Novel Modeling Framework for Assessing Environmental Impacts of Biofuel Crops

Dharmendra Saraswat, Associate Professor / Extension Engineer—GeoSpatial

ISSUE:

Economic recession and lower prices for petroleum products has not affected the growth of the U.S. biofuel industry. National Academy of Sciences has expressed the optimism that the industry "is expected to grow until production capacity reaches the 2007 Energy Independence and Security Act (EISA) mandated 36 billion gallons of biofuel in 2022". The Section 204 of EISA calls for Environmental Protection Agency (EPA) to report to Congress on the environmental and resource conservation impacts associated with biofuel production and use that include water quality and quantity impacts among others.

Watershed modeling is commonly used to assess hydrologic and water quality impacts associated with various crop production scenarios that cannot be otherwise investigated using field experiments. Since sustainability of biofuel production also hinges on avoiding fuel versus food debate, policy makers and scientists agree that production of second generation biofuel crops such as switchgrass and miscanthus, on marginal lands could be a way forward in the future. However, the Soil and Watershed Assessment Tool (SWAT), a watershed model developed by the United States Department of Agriculture (USDA)- Agricultural Research Service (ARS), that has also been used for federally funded Conservation Effects Assessment Project (CEAP) and is regarded suitable for analyzing agricultural watersheds, does not have a mechanism to represent targeted land use change. The targeted land use change mechanism is needed in order to simulate production of second generation biofuels crops on marginal lands before assessing their environmental impacts on water quality.

ACTION:

A targeted land use change framework was developed for SWAT model. It was accomplished by integration of marginal land use data in the 2006 Arkansas land use land cover (LULC) data set to represent existing LULC under broad category of marginal and non-marginal land types. This modified LULC was used for model setup (1986 to 2008) to identify the smallest modeling unit that defines marginal and non-marginal land type. The model was first calibrated and validated for total flow, surface flow, base flow, sediment, total phosphorus, and nitrate-nitrogen using the modified LULC data set. Two scenarios were analyzed - existing row crops on marginal HRUs were first replaced by switchgrass followed by miscanthus to simulate environmental impacts on an area-weighted average annual basis. The model outputs suggest that the novel simulation approach allowed implementation of targeted land use change for simulating bioenergy crop production at smallest modeling unit level and resulted in lower sediment, total phosphorus, and total nitrogen losses than that obtained by conventional SWAT modeling application.

IMPACT:

The modified approach was used for assessing environmental impacts of second generation biofuel crop production in L'Anguille River Watershed (LRW) in north east Arkansas. The LRW is considered as a priority watershed by Arkansas Natural Resources Commission (ANRC) due to water quality impairments mostly tied to nonpoint sources. Preliminary results were shared through an oral presentation during 2012 Annual Meeting of American Society of Agricultural and Biological Engineers. A poster presented on this work was awarded "Second Place" in 5th Annual Graduate Research Poster Competition at University of Arkansas. This work has potential to be used by various individual SWAT modelers and agencies engaged in assessing environmental impact of biofuel crop production on selected land types.

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:

Department of Energy and Arkansas Natural Resources Commission (ANRC) through 319(h) program of the Environmental Protection Agency

POULTRY HOUSE ELECTRICAL TRAINING PILOT PROJECT

KARL VANDEVENDER, PROFESSOR, EXTENSION

Issue: "Why do we care?"
Poultry production is by far the largest agriculture industry in Scott county with 120 farms holding over 6 million birds at any given time. This level of contribution to county economies will be similar for much of Arkansas. In Scott County many producers expressed to their County Extension Agent a lack of knowledge in basic electrical issues with their poultry farms. Producers felt they were forced to pay for service calls on minor issues many farmers should be able to solve themselves.

Action: "What have we done?"
The need for basic electrical education was born out by program planning done yearly by the local Scott County Extension Office. Extension Engineers BAEG were consulted, and a pilot program was developed to provide education to fit the needs of producers. A hands-on program with training boards for producers to actually use electrical meters and solve simple problems was developed. Two-hour training sessions were conducted in Scott county with participants troubleshooting and solving common electrical problems observed in poultry houses.

Impact: "What is the payoff?"
Thirty producers attended the training sessions held in April. Participant response showed each producer had an average of 6 service calls a year at $145 per call. Respondents also indicated that they would be able to avoid three calls a year after attending the workshop. This would yield an approximate savings of $580 per farm. Over the 30 farms represented at the training, a total impact of $16,000 in service call savings were indicated. One participant said, "It is great to have a program that helps us save money in the real world". The presentations and hands-on training materials developed for this pilot are now available for use and refinement as opportunities present themselves.

Contacts:
Karl VanDevender, Professor – Extension Engineer, kvan@uaex.edu, 501-671-2244
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Yi Liang, Assistant Professor - Extension Engineer, yliang@uark.edu, 479-575-4862
Rick Fields, Program Associate, rfields@uaex.edu, 501-671-2151

Funding Sources:
General Extension Funding via BAEG and Scott County

Research Grants

The following active grants during 2012 fund research in specific areas.

Can Understory from Managed Pine Forests be Used as Feedstock in the Biochemical Biorefinery?
Dr. Julie Carrier
Oklahoma State University
2010
$35,000

Characterization and Quantification of Monomers, Oligomers and By-Products from Hemicellulose during Pretreatment (GDRS Supplement)
Dr. Julie Carrier
NSF CBET
2012
$24,000

Characterization and Quantification of Monomers, Oligomers and By-Products from Hemicellulose during Pretreatment (Travel Supplement)
Dr. Julie Carrier
NSF
2012
$2,000

Characterization and Quantification of Monomers, Oligomers and By-Products from Hemicellulose during Pretreatment
Dr. Julie Carrier
NSF
2009
$9,750

Characterization and Quantification of Monomers, Oligomers and By-Products from Hemicellulose during Pretreatment
Dr. Julie Carrier
NSF
2008
$296,186

Decreasing Severity of Switchgrass Pretreatment Through Biological Pretreatment
Dr. Mark Wilkins and Dr. Julie Carrier
Sun Grant Board of Trustees, Oklahoma State University
2012-2013
$53,944

Kinetics of Hemicellulose Depolymerization
Dr. Julie Carrier
Arkansas Science & Technology Authority
2012
$2,125

Second Generation Biofuels: The Need to Minimize Water Usage During Processing
Dr. Julie Carrier
ADHE
2012
$2,125

All Natural Antimicrobials
Dr. Phil Crandall and Dr. Julie Carrier
SBIR USDA
2012-2016
$450,000

Reduced Carbon Footprint for Swine Production
Dr. Thomas Costello and others
USDA NIFA/AFRI
2012-2013
$2,000,000

Gasification of Algae
Dr. Thomas Costello, Dr. Marty Matlock, Dr. Karl Vandevender, Dr. Samy Sadaka, and others
NIFA
2011-2015
$4,900,000

Assessing Physical, Chemical and Biological Effects Before, During, and After Gas Well Construction in the Main Stem and Tributaries of the Little Red River
Dr. Brian Haggard
University of Central Arkansas
2012
$151,524

AWRC IT Program
Dr. Brian Haggard
USGS 104B
2012
$7,554

AWRC IT Program
Dr. Brian Haggard
USGS DOI
2011
$17,439

AWRC Program Administration
Dr. Brian Haggard
USGS 104B
2012
$9,320

Research Grants

Identifying and Evaluating Best Practices for the Adaptive Management of Water Resources
Dr. Brian Haggard
University of Minnesota
2011
$9,999

Nutrient Criteria Development Support
Dr. Brian Haggard and others
TCEQ
2012-2013
$428,928

Program Administration / Management Description
Dr. Brian Haggard
USGS
2013
$55,525

Program Administration / Management Description
Dr. Brian Haggard
NIH
2012
$9,230

Program Administration / Management Description
Dr. Brian Haggard
USGS DOI
2011
$27,870

Scale Dependent Phosphorus Leaching in Alluvial Floodplains
Dr. Brian Haggard
Oklahoma State University
2011
$62,124

Water Quality Monitoring for Selected Priority Watersheds in Arkansas, Upper Saline, Poteau and Strawberry Rivers
Dr. Brian Haggard
ANRC
2011
$175,2000

Water Quality Monitoring in the Upper Illinois River Watershed and Upper White River Basin
Dr. Brian Haggard
ANRC
2011
$649,097

Biological Validation of Self-Assembled Multimodal Nanotheranostics
Dr. Jin-Woo Kim and Dr. David Zaharoff
ABI
2011-2012
$47,000

Development of an Electron Tunneling Based Nanochannel System for DNA Sequencing
Dr. Jin-Woo Kim and Dr. Steve Tung
NSF
2012-2015
$359,717

Development of Flagellar Motor Biosensor Prototype for Trace Level TNT Detection
Dr. Jin-Woo Kim and Dr. Steve Tung
NSF
2011-2013
$79,953

Engineering Nano-Building Block Toolboxes for Programmable Self-Assembly of Nanostructures with Arbitrary Shapes and Functions
Dr. Jin-Woo Kim and D2r Russell Deaton
NSF
2012-2015
$412,789

Highly Sensitive Method for Detecting and Separating Pathogens Using Paramagnetic Particles and a Micro-Fluidic System
Dr. Jin-Woo Kim
SURF, ADHE
2012
$2,600

Highly Sensitive Method for Detecting and Separating Pathogens Using Paramagnetic Particles and a Micro-Fluidic System
Dr. Jin-Woo Kim
ADHE
2012
$2,090

Integrating Nanotechnology into Undergraduate Engineering Education at the University of Arkansas
Dr. Jin-Woo Kim and others
NSF
2011-2013
$200,000

Integrating Nanotechnology into Honors Education
Dr. Jin-Woo Kim and others
Honors College
2012-2013
$25,000

Multi-Color and Multi-Functional Gold Nano-Agents for Multiplex Cancer Detection and Therapy
Dr. Jin-Woo Kim
ABI
2011-2012
$50,000

Engineered B-cell Biosensor for Detection of Food-borne Pathogens
Dr. Yanbin Li and others
ABI
2012
$50,000

Microelectrode-based Impedance ELISA for Detection of Avian Influenza Virus
Dr. Yanbin Li
ABI
2012
$50,000

Printed Microelectrode for Biosnesors to Detect E. coli
Dr. Yanbin Li
New Concepts LLC
2012-2013
$30,000

Treatment of Poultry Processing Water Using Hydropath Technology
Dr. Yanbin Li
Hydroflow LLC
2012
$3,500

Nanotechnology-based Biodetection
Dr. Yanbin Li
Ocean Nanotech LLC
2012
$3,000

Development of Research Ethics Program for Undergraduate Students
Dr. Marty Matlock and others
NSF
2011-2013
$98,000

REU Sites: Ecosystem Services
Dr. Marty Matlock and Dr. Michelle Evans-White
NSF
2011-2014
$247,000

REU Site: Assessment and Sustainable Management of Ecosystem Services
Dr. Marty Matlock
NSF
2011
$171,310

REU Site: Assessment and Sustainable Management of Ecosystem Services
Dr. Marty Matlock
NSF
2013
$85,655

Measuring and Reducing Swine Greenhouse Gas Footprint in the US
Dr. Marty Matlock and Dr. G. Thoma
USDA-NIFA
2011-2016
$5,000,000

Measuring and Managing the Water Footprint of US Swine
Dr. Marty Matlock and Dr. Rick Ulrich
NPB
2011-2013
$450,000

Irrigation Pumping Plant Efficiency
Dr. Christopher Henry and Dr. Samy Sadaka
Soybean Promotion Board
2012
$44,800

Improving Yield and Yield Stability for Irrigated Soybeans
Dr. Chris Henry, Dr. Dharmendra Saraswat and others
Soybean Promotion Board
2012
$109,000

Demonstration and Validation of Irrigation Management Tools to Preserve Water Availability for Row Crop Agriculture
Dr. M. Reba and Dr. Christopher Henry
Arkansas NRCS CIG
2012-2015
$75,000

Energy Balance Analysis of a Poultry Processing Plant
Dr. Yi Liang and Dr. Darin Nutter
US Poultry and Egg
2012-2013
$39,224

A Multi-Component Ammonia Emission Mitigation Strategy for Commercial Broiler Houses
Dr. Sreekala Bajwa, Dr. Yi Liang, Dr. Thomas Costello, Dr. Watkins, and Dr. Dharmendra Saraswat
USDA-NRI
2009-2012
$97,251

Systematic Evaluation of In-House Broiler Litter Windrowing Effects on Production Benefits and Environmental Impact
Dr. Yi Liang, Dr. Karl Vandevender, and others
US Poultry and Egg
2011-2012
$40,213

Research Grants

Energy Audits for Contract Broiler Production in NW Arkansas and NE Oklahoma
Dr. Yi Liang, Dr. Thomas Costello, and Dr. S. Watkins
USDA Energy for Rural America
2012-2013
$2,000,000

Biochar Production
Dr. Samy Sadaka
University of Tennessee
2012
$4,150

Arkansas Captains and Corporals Program
Dr. Mike Daniels, Dr. Dharmendra Saraswat and others
EPA/ANRC
2012-2014
$189,808

Technological Aids for Information Dissemination to Soybean Producers
Dr. Dharmendra Saraswat
AR Soybean Promotion Board
2012-2013
$37,318

Flag the Technology GPS/GIS Support
Dr. Dharmendra Saraswat and Dr. Bob Scott
AR Soybean Promotion Board
2012-2013
$39,000

Smartphone Apps for Information Dissemination to Corn Producers
Dr. Dharmendra Saraswat and others
AR Corn and Grain Sorghum Board
2012-2013
$36,000

Field Scale Evaluation of Precision Agriculture Sensors for Corn Production
Dr. Dharmendra Saraswat and others
AR Corn and Grain Sorghum Board
2012-2013
$36,000

Development of Comprehensive Watershed Modeling for 12-digit Hydrologic Unit Code "HUC" in Selected Priority Watersheds in Arkansas- Phase II
Dr. Dharmendra Saraswat and others
Arkansas Natural Resources Commission
2011-2013
$170,393

Enhancement of Riparian Buffer Inventorying Algorithm for Field Use
Dr. Dharmendra Saraswat and others
Arkansas Natural Resources Commission
2011-2013
$98,059

The Arkansas Watershed Steward Program
Dr. Karl Vandevender and others
EPA 319h via ANRC
2012-2013
$189,808

BOOKS AND BOOK CHAPTERS

"Biorefinery Co-Products: Phytochemicals, Primary Metabolites and Value-Added Biomass Processing" (Wiley Series in Renewable Resource). Chantal Bergeron, **Danielle Julie Carrier** and Sri Ramaswamy editors. John Wiley & Sons. 2012, 384 pp.

Sharara M, C. Clausen and **D. J. Carrier** (2012). "*An overview of biorefinery technology" in Biorefinery Co-Products: Phytochemicals, Primary Metabolites and Value-Added Biomass Processing*" (Wiley Series in Renewable Resource). Bergeron C, Carrier DJ and Ramaswamy S. (eds). John Wiley & Sons. Pp.1-18.

Loewer, O. J. (2012, Aug. 27). "*The Linkages among Technology, Economics and Societal Values - Understanding Change, Sustainable Prosperity and the Emerging Chaos*". Apple Publishing Group. 1342 pages. ISBN 9781620508077, https://itunes.apple.com/us/book/linkages-among-technology/id548532106?mt=13&ls=1.

Jones, Carol, Mark Casada and **Otto Loewer** (Sept. 2012). Chapter 10: "*Drying, handling, and storage of raw commodities in Stored Product Protection*". S156 - Stored Product Protection. Gerrit Cuperus, David W. Hangstrum, and Thomas W. Phillips, editors. Published by Kansas State University Research and Extension. http://www.ksre.ksu.edu/library/entml2/s156.pdf .

PEER-REVIEWED JOURNAL ARTICLES

Djioleu A, E Martin, M Pelkki and **D. J. Carrier** (2012). "Xylose and glucose yields from dilute acid pretreatment and enzymatic hydrolysis of sweetgum (*Liquidambar styraciflua* L.)." *Agricultural and Analytical Bacterial Chemistry* 2: 175-186

Drake, W.M., J.T. Scott, M. Evans-White, **B. Haggard**, A. Sharpley, and E.M. Grantz. 2012. "The effect of periphyton stoichiometry and light on biological immobilization and release in streams". Limnology 13:97-106.

Haggard, B.E., J.T. Scott, and S. Patterson. 2012. "Sediment phosphorus flux in an Oklahoma reservoir suggests reconsideration of watershed management planning. Lake and Reservoir Management 28:59-69.

Ludwig, A.L., M.D. Matlock, **B.E. Haggard**, and I Chaubey. 2012. "Periphyton nutrient limitation and maximum potential productivity in the Beaver Lake Basin", USA. Journal of the American Water Resources Association 48(5):896-908.

Toland, D.C., **B.E. Haggard**, and M.E. Boyer. 2012. "Evaluation of nutrient concentrations in runoff water from green roofs, conventional roofs, and urban streams". Transactions ASABE 55:99-106.

Galanzha, E. I., E. Shashkov, M. Sarimollaoglu, S. Forster, K. Beenken, A. Basnakian, J**.-W**. **Kim,** M. Smeltzer, & V. P. Zharov, "In *vivo* magnetic enrichment, photoacoustic diagnosis, and photothermal purging of infected blood using multifunctional gold and magnetic nanoparticles". *PLoS ONE* **7**(9), e45557. DOI: 10.1371/journal.pone.0045557 (2012). *[JIF: 4.411].*

Kim, J.-W., J.-H. Kim, & R. Deaton, "Programmable construction of nanostructures: assembly of nanostructures with various nanocomponents". *IEEE Nanotechnology* **6**(1), 19-23 (2012). *[JIF: N/A].*

Kotagiri, N., J. S. Lee, & J**.-W. Kim, "**Selective pathogen targeting and macrophage evading carbon nanotubes through dextran sulfate coating and PEGylation for photothermal theranostics". *Journal of Biomedical Nanotechnology* **9**, doi: 10.1166/jbn.2013.1531 (2013). *[JIF: 4.268]* (*Accepted on March 4, 2012*).

Judkins, J., H. H. Lee, S. Tung, & **J.-W Kim,** Diffusion of single-walled carbon nanotubes under physiological conditions. *Journal of Biomedical Nanotechnology* **9**, doi: 10.1166/jbn.2013.1527 (2013). *[JIF: 4.268]* (*Accepted on April 26, 2012*).

Kim, J.-W. & R. Deaton, Review: "Molecular self-Assembly of multifunctional nanoparticle composites with arbitrary shapes and functions: challenges and strategies". *Particle & Particle Systems Characterization* **30**, doi: 10.1002/ppsc.201200129 (2013). *Invited paper*. This article was **featured as** an "**Inside Front Cover**" of the journal issue. (*Accepted on November 15, 2012*).

Kim, J.-W. & S. Tung, Review: **"**Bio-hybrid micro/nanodevices powered by flagellar motor: challenges and strategies". *Medical & Biological Engineering & Computing* (*Accepted for publication*). *[JIF: 1.878] Invited paper*.

PUBLICATIONS

Lee, J.S., J. J. Song & **J.-W. Kim**, "Assessing detection capacity of microarray". *Medical & Biological Engineering & Computing* (*Accepted for publication*). *[JIF: 1.878] Invited paper*.

Bai, H., R. Wang, B. Hargis, H. Lu and **Y. Li**. 2012. "A SPR aptasensor for detection of avian influenza virus H5N1". Sensors 12:12506-12518.

Kanayeva, D., R. Wang, D. Rhoads, G. Erf, M. Slavik, S. Tung, and **Y. Li**. 2012. "Efficient separation and sensitive detection of Listeria monocytogenes using an impedance immunosensor based on magnetic nanoparticles, microfluidics and interdigitated microelectrode". Journal of Food Protection 75(11):1951-1959.

Li, M., A. Pradhan, W. Wang, and **Y. Li.** 2012. "Prediction of Listeria innocua in fully cooked chicken breast products during post-package hot water treatment". Poultry Science (accepted November 25, 2012).

Lu, H., L. Lin, R. Wang and **Y. Li,** B. Scheuchenzuber, J. Liu, Z. Xie and J. Rosebrock. 2012. "Development of H5 subtype-specific monoclonal antibodies (MAb) and MAb-based assays for rapid detection of H5 avian influenza". Health 4:923-926.

Lum, J., R. Wang, K. Lassiter, B. Srinivasan, D. Abi-Ghanem, L. Berghman, B. Hargis, S. Tung, H. Lu, and **Y. Li.** 2012. "Rapid detection of avian influenza H5N1 virus using impedance measurement of immunoreaction coupled with RBC amplification". Biosensors & Bioelectronics 38(1):67-73.

Pradhan, A.K., M. Li, **Y. Li,** L.C. Kelso, T.A. Costello, and M.G. Johnson. 2012. "A modified Weibull model for growth and survival of Listeria innocua and Salmonella Typhimurium in chicken breast during refrigerated and frozen storage". Poultry Science 91:1482-1488.

Wang, R., and **Y. Li.** 2012. "Hydrogel based QCM aptasensor for detection of avian influenza". Biosensors & Bioelectronics 42:148-155.

Xu, X., Y. Ying, and **Y. Li.** 2012. "One-step and label-free detection of alpha-fetoprotein based on aggregation of gold nanorods". Sensors and Actuators B: Chemical 175:194-200.

Zhou, L., D. Li, L. Gai, J. Wang, and **Y. Li.** 2012. "Electrochemical aptasensor for the detection of tetracycline with multi-walled carbon nanotubes amplification". Sensors and Actuators B: Chemical 162:201-208.

Sadaka Samy, Ahn Heekwon. "Evaluation of a Biodrying Process for Beef, Swine, and Poultry Manures Mixed Separately with Corn Stover". 2012. Applied Engineering in Agriculture. Vol. 28(3): 457-463.

Sharara, Mahmoud, **Samy Sadaka**, Thomas Costello, Karl VanDevender. "Influence of Aeration Rate on the Physio-Chemical Characteristics of Biodried Dairy Manure - Wheat Straw Mixture". 2012. Applied Engineering in Agriculture. Vol. 28(3): 407-415.

Lysenko, Steve, **Samy Sadaka**, Robert Brown. "Comparison of Mass and Energy Balances for Air Blown and Thermally Ballasted Fluidized Bed Gasifiers". 2012. Biomass and Bioenergy. Vol. 45: 95-108.

Lysenko, Steve, **Samy Sadaka**, Robert Brown. "Comparison of the Cost of Hydrogen from Air-Blown and Thermally Ballasted Gasifiers". 2012. Biofuels, Bioproducts and Biorefining. 6: 673-685.

Davis, Jason, Donald. Johnson, Don Edgar, George Wardlow, **Samy Sadaka**. "NOx Emissions and Performance of a Single-Cylinder Diesel Engine with Emulsified and Non-Emulsified Fuels". 2012. Applied Engineering in Agriculture. Vol. 28(2): 179-186.

Pai, N. and **D. Saraswat**. 2012. "A Geospatial Tool for Delineating Streambanks". Environmental Modeling and Software, http://dx.doi.org/10.1016/j.envsoft. 2012. 08.012.

Sharara, M., S. Sadaka, **K. VanDevender** and T. Costello. 2011. "Influence of Aeration Rate on the PhysioChemical Characteristics of Biodried Dairy Manure — Wheat Straw Mixture". Applied Engineering in Agriculture Vol. 28(3):407-415.

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Kim, J.-W. & R. Deaton, Review: "Molecular self-Assembly of multifunctional nanoparticle composites with arbitrary shapes and functions: challenges and strategies". *Particle & Particle Systems Characterization* **30**, doi: 10.1002/ppsc.201200129 (2013). *Invited paper*. This article was **featured as** an "**Inside Front Cover**" of the journal issue. (*Accepted on November 15, 2012*).

Kim, J.-W. & S. Tung Review: "Bio-hybrid micro/ nanodevices powered by flagellar motor: challenges and strategies". *Medical & Biological Engineering & Computing* (*Accepted for publication*). *Invited paper.*

Kim, J.-W., E.I. Galanzha, D. Zaharoff, R. J. Griffin, & V.P. Zharov Review: **"**Nanotheranostics of circulating tumor cells and other pathological cells *in vivo"*. *Molecular Pharmaceutics* (*in review – revision submitted after initial referees' recommendations of 'minor revisions'*). *[JIF: 4.782] Invited paper*.

Kotagiri, K. & **J.-W. Kim,** Review: **"**Stealth nanotube theranostic agents: strategies of shielding carbon nanotubes to evade opsonization and improve biodistribution". *Nanotube Therapy* (2012) (*in review*). *Invited paper*.

Lu, H., L. Lin, R. Wang, **Y. Li**, and B. Scheuchenzuber. 2012. "Development of H5 subtype-specific monoclonal antibodies (Mab) and Mab-based assays for rapid detection of H5 avian influenza". Paper No. 178 in the Proceedings of the 8th International Symposium on Avian Influenza: Avian Influenza in Poultry and Wild Birds, April 1-4, 2012, Royal Holloway, UK.

Xu, X., Y. Ying and **Y. Li**. 2012. "A simple, competitive biosensor for rapid detection of aflatoxin B1 based on aggregation of gold nanorods". Paper No. 1817 in the Proceedings of IEEE Sensors 2012 Conference, October 28-31, 2012, Taipei, Taiwan.

Xu, X.H., **Y. Li**., J. Zhou, Z. Nie, and S. Yao. 2012. "Peptide inhibitor based QCM biosensor for rapidly detecting protein kinase activity". Paper No. 1754 in the Proceedings of IEEE Sensors 2012 Conference, October 28-31, 2012, Taipei, Taiwan**.**

Liang, Y., G.T. Tabler, S.E. Watkins and I. Berry. 2012. "Heat and moisture production of commercial broilers under pad cooling or surface wetting in summer". Proceedings of the Ninth International Livestock Environment Symposium, Valencia, Spain. July 2012. St. Joseph, MI: ASABE**.**

McGlade, J., B. Werner, M. Young, **M. Matlock,** D. Jefferies, G. Sonnemann, M. Aldaya, S. Pfister, M. Berger, C. Farell, K. Hyde, M. Wackernagel, A. Hoekstra, R. Mathews, J. Liu, E. Ercin, J.L. Weber, A. Alfieri, R. Martinez-Lagunes, B. Edens, P. Schulte, S. von Wirén-Lehr, D. Gee, 2012. "Measuring water use in a green economy, A Report of the Working Group on Water Efficiency to the International Resource Panel", United Nations Environmental Program, Geneva, Switzerland.

Matlock, M., FAO, 2012. "Sustainability Assessment of Food and Agricultural Systems (SAFA)". Natural Resources Management and Environment Department, Food and Agriculture Organization of the United Nations, Rome, Italy, January, 2012.

Matlock, M., Expert Reviewer, World Economic Forum, 2012. "Putting the New Vision for Agriculture into Action: A Transformation Is Happening". Sarita Nayar and Lisa Dreier, Editors. World Economic Forum, Geneva, Switzerland.

NON-REFEREED PUBLICATIONS AND ARTICLES

Henry, C. G., E. Vories, M. Anders, M. Reba, C. Wilson and S. Hirsh. 2012. 'Characterizing Irrigation Water Requirements for Rice Production from the Arkansas Rice Research Verification Program'. Presented at the 2012 ASABE Annual International Meeting. July 29-August 1, Hilton Anatole, Dallas Texas. ASABE, St Joseph, MI.

Daniels, M., A. Sharpley, **C. Henry**, P. Daniel, and S. Hirsh. 2012. 'The Arkansas Discovery Farm Program'. Presented at the Mississippi Water Resources Institute Proceedings. Jackson, Mississippi, April 3-4, 2012.

Kim, J.W. "Building a Better Nano Block." By Holt, S. in *WorldPress.com*, September 13, 2012.

McCarty, J., H. Sandefur, **M. Matlock**, G. Thoma, and D. Kim, 2012. "National Scan-level LCA for Production of US Peanut Butter". Center for Agricultural and Rural Sustainability, UA Division of Agriculture, Fayetteville, AR.

Johnson, R., P. Bandekar, **M. Matlock**. 2012. "US Corn Yield Under Climate Change Scenarios". Prepared for the National Corn Growers Association and The Sustainability Consortium. Center for Agricultural and Rural Sustainability, UA Division of Agriculture, Fayetteville, AR.

PUBLICATIONS

Brown, A., C. Powell, **M. Matlock**, 2012. "A US Food Processing Facility Water Risk Framework". Prepared for The Sustainability Consortium. Center for Agricultural and Rural Sustainability, UA Division of Agriculture, Fayetteville, AR.

Brown, A., C. Powell, **M. Matlock**, 2012. "A Water Risk Assessment for Tyson Foods, Inc." Prepared for Tyson Foods, Inc. and The Sustainability Consortium. Center for Agricultural and Rural Sustainability, UA Division of Agriculture, Fayetteville, AR.

Brown, A., C. Powell, **M. Matlock**, 2012. "A Water Risk Assessment for MARS Corp." Prepared for MARS Corp. and The Sustainability Consortium. Center for Agricultural and Rural Sustainability, UA Division of Agriculture, Fayetteville, AR.

Brown, A., C. Powell, **M. Matlock**, 2012. "A Water Risk Assessment for Miller Brewing Company." Prepared for Miller Brewing Company and The Sustainability Consortium. Center for Agricultural and Rural Sustainability, UA Division of Agriculture, Fayetteville, AR.

Powell, C., P. Bandekar, E. Cummings, A. Brown, and **M. Matlock**, 2012. "A Water Risk Assessment Framework and Tool for US Dairy Producers". Prepared for Dairy Management Inc., Center for Agricultural and Rural Sustainability, UA Division of Agriculture, Fayetteville, AR.

Leh, M., E. Cummings, **M. Matlock**, and L. Nalley. 2012. "Analysis of Ecosystem Services Change in West Africa." Prepared for the World Cocoa Foundation, Center for Agricultural and Rural Sustainability, UA Division of Agriculture, Fayetteville, AR.

Saraswat, D. UAEX Website (October 26, 2012): "Engineer brings New Software and Attention to University of Arkansas" http://www.uaex.edu/news/october2012/1026ArkSaraswat.html).

Saraswat, D. "Arkansas Land & Life (Spring-Summer, 2012) Farming Goes Mobile" (http://arkansasag news.uark.edu/spring12.pdf).

Saraswar, D. Agrocourier Magazine (February, 2012)" The Internet Takes to the Fields" (http://www. agrocourier.com/bcsweb/cscmsde.nsf/id/1A1A824C8D0B1FC6C125799900179487) (Internationally Circulated).

Saraswat, D. Growers Magazine (January, 2012)" Smartphones help Tech-Savvy Growers Improve Crop Management" (http://www.thegrower.com/issues/the-grower/Smartphones-help-tech-savvy-growers-improve-crop-management-136509623.html.

PUBLISHED ABSTRACTS OF CONFERENCE PRESENTATIONS

Lee, J.-H., **J.-W. Kim**, R. Deaton, S.H. Lee, T.H. Park, and B.-T. Zhang. 2012. "Molecular Machine Learning *In vitro*," 18th International Meeting on DNA Computing (DNA 18), Aarhus, Denmark.

Ryan, W., A. Plucinski, and **J.-W. Kim**. 2012 "Highly Sensitive Method for Detecting and Separating Pathogens Using Paramagnetic Particles and a Micro-Fluidic System," 17th Annual Conference of Institute of Biological Engineering (IBE), Indianapolis, Indiana.

Kim, J.-W. 2012. Self-Assembling Multifunctional Nano-Composites for Multiplex, Multimodal Nanotheranostics. IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), Bangkok, Thailand.

Kim, J.-W., 2012. Self-Assembling Multifunctional Nano-Composites with Arbitrary Shapes and Functions. IEEE International Conference on Nanotechnology Materials and Devices (IEEE-NMDC), October 16-19, Waikiki Beach, Hawaii.

Kim, J.-W., 2012. Self-Assembly of Multifunctional Nano-Composites for Nanotheranostics. Nanotechnology for Healthcare Conference, September 26-29, Winthrop Rockefeller Institute, Petit Jean Mountain, AR.

Zou, M., G. Salamo, S. Tung, K. Roper, **J.-W. Kim**, J. Chen, and A. Huang. 2012. "Integrating Nanotechnology into Undergraduate Engineering Education at the University of Arkansas". NSF Engineering Education Awardees Conference, Mar. 4-6, Arlington, Virginia.

Liang, Y., G.T. Tabler, S.E Watkins and I. Berry. 2012. "Field evaluation of controlled surface wetting system to cool broiler chickens". 2012 International Scientific Forum, Atlanta, GA.

PUBLICATIONS

EXTENSION PUBLICATIONS AND LITERATURE

Stone, N., J.L. Shelton, **B.E. Haggard**, and H.K. Thomforde. 2012. "Interpretation of Water Analysis Reports", Southern Region Aquaculture Center Fact Sheet [In Press].

Liang, Y., S.E. Watkins, G.T. Tabler and D. McCreery. 2012 "Sprinkler cool birds and conserve water", University of Arkansas Division of Agriculture, Factsheet FSA1073.

Saraswat, D., N. Pai, and M. Daniels. "Watershed Prioritization for Managing Nonpoint Source Pollution in Arkansas". (Fact Sheet- Under Print).

PROFESSIONAL PRESENTATIONS

Carrier, D. J., Deconstructing biomass into a useable sugar stream, University of Sao Paulo, Lorena Campus, June 2012 (keynote).

Carrier, DJ., The extraction of high value phytochemicals in the context of a biorefinery: Sweetgum as a possibility.

Carrier, D. J., American Council for Medicinally Active Plants, Jonesboro AR, May 2012 (invited referred).

Carrier, DJ., Biomas into fermentable sugars, American Society of Biological and Agricultural Engineering, Dallas, TX, August 2012. (referred).

Carrier, D. J. Biobased Sustainable Technology online graduate certificate program, S-1041 Multi-State Annual Meeting, Washington, DC, August 2012. (invited referred).

Carrier, D. J., Biomass into bioproducts, Frontiers in Biorefinery, St Simons Island, GA (invited referred), November 2012.

Haggard, B. 2012. Water quality and nutrient management Issues: Informing decision makers, lawyers, and stakeholders? Annual Meeting, National Institute of Water Resources, Washington, DC.

Haggard, B., T. Scott, S. Longing, and J. Metrailer. 2012. Red River Nutrient Criteria Development Project, USEPA Region 6 RTAG, Dallas, TX.

Haggard, B. and T. Scott. 2012. Phosphorus concentrations have been declining in the Illinois River: was it point sources, farm-level nutrient management, or what? Oklahoma Governor's Water Conference, Tulsa, OK.

Haggard, B. and T. Scott. 2012. Getting started with nutrient criteria. Texas Commission on Environmental Quality Technical and Stakeholders Workshop, Austin, TX.

Haggard, B. and T. Scott. 2012. Regional Red River project update. Texas Commission on Environmental Quality Technical and Stakeholders Workshop, Austin, TX.

Jarvie, H. A. Sharpley, **B. Haggard**, T. Scott, M. Bowes, and L. Massey. 2012. Within-river phosphorus retention in the Illinois River: a missing piece in the watershed phosphorus puzzle? Oklahoma Governor's Water Conference, Tulsa, OK.

Scott, T. and **B. Haggard.** 2012. Informing the development of numeric water criteria for nutrients using threshold analysis of stressor-response dat. 20th National Nonpoint Source Monitoring Workshop, Tulsa, OK.

Scott, T. and **B. Haggard**. 2012. Evaluating stressor response relationships. Texas Commission on Environmental Quality Technical and Stakeholders Workshop, Austin, TX.

Kim, J.-W., 2012. Self-Assembling Multifunctional Nano-Composites for Multiplex, Multimodal Nanotheranostics. IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), Bangkok, Thailand (as a "Keynote Speaker").

Kim, J.-W., 2012. Self-Assembling Multifunctional Nano-Composites with Arbitrary Shapes and Functions. IEEE International Conference on Nanotechnology Materials and Devices (IEEE-NMDC), Waikiki Beach, Hawaii.

Kim, J.-W., 2012. Functional Self-Assembly of Nanocomposites and THz Technology. 2nd Workshop for THz Bio-Quantum, Pohang University of Science and Technology (POSTECH), Pohang, Korea.

PUBLICATIONS

Kim, J.-W., 2012. Self-Assembly of Multifunctional Nano-Composites for Nanotheranostics. Nanotechnology for Healthcare Conference, Winthrop Rockefeller Institute, Petit Jean Mountain, AR.

Kim, J.-W., 2012. Nanotheranostics of Circulating Tumor and Other Pathological Cells *In Vivo*: Challenges and Strategies. Seoul National University, Seoul, Korea.

Kim, J.-W., 2012. Nano-Building Block Toolboxes for Self-Assembly of Nano-Composites with Arbitary Shapes and Functions. Chung Ang University, Seoul, Korea.

Kim, J.-W., 2012. Multifunctional Nano-Composite Self-Assembly and Their Applications. Myongji University, Seoul, Korea.

Kim, J.-W., 2012. Nano-Building Block Toolboxes ("Nano-Toolboxes") for Self-Assembly of Nano-Composites with Arbitrary Shapes and Functions. Physics Colloquium, University of Arkansas, Fayetteville, AR.

Kim, J.-W., 2012. Nanoparticles and Self-Assembled Nanocomposites for Multiplex, Multimodal Nanotheranostics. Biomedical Engineering Seminar, University of Memphis, Memphis, TN.

Li, Y. 2012. Biosensing technologies and their applications in agriculture and food. An invited presentation at Shenyang Agricultural University, November 19, 2012, Shenyang, Liaoning Province, China.

Li, Y. 2012. Nanotechnology-based biosensors for rapid detection of pathogenic bacteria and virus in agriculture and food. An invited presentation at Shandong University of Technology, June 27, 2012, Zibo, Shandong Province, China.

Matlock, M. January 10, 2012. National Farm Bureau Meeting, Honolulu, HI, "The Field to Market Framework for Sustainable Agriculture "– Invited

Matlock, M., January 17, 2012. International Dairy Forum, Chicago, IL, "Water Usage and Policy in US Dairy Production" – Invited

Matlock, M., February 8, 2012. National Pork Council, Dallas, TX, "Water and Greenhouse Gas Footprints in US Pork" – Invited

Matlock, M., February 14, 2012. Association of Ag Production Executives Annual Meeting, Key Biscayne, FL, "Global Trends and Challenges in Sustainable Agriculture – Keynote

Matlock, M., March 11, 2012, North American Millers Association, Naples, FL "Sustainability Metrics for US Grains" – Keynote

Matlock, M., March 20, 2012, NC State's Sustainable Agriculture Executive Course, Bayer Crop Sciences, Raleigh, NC, "Frameworks for Sustainability in Agriculture" –Keynote

Matlock, M., April 12, 2012, NSF REU Workshop, Washington, DC "Organized and led the workshop on teaching ethics in biological sciences research for NSF"– Moderator

Matlock, M., May 17, 2012, Novus Sustainability Conference, St. Charles, MO "Global Trends and Challenges in Sustainable Agriculture" – Keynote

Matlock, M., June 12, 2012, North American Biotechnology Conference – Fayetteville, AR, "The role of biotechnology in water resources conservation in agriculture" – Moderator

Matlock, M., June 17, 2012, American Peanut Council Annual Meeting, Charlotte, "SC Greenhouse gas footprint of peanuts, from field to factory" – Invited

Matlock, M., July 25, 2012, Well Fargo Investment Co. Agriculture Strategies Workshop, Hershey, PA, "Global Trends and Challenges in Sustainable Agriculture"– Keynote

Matlock, M., August 1, 2012, ASABE International Conference, Dallas, TX, "Frameworks for Sustainability in Agriculture" –Invited

Matlock, M., September 27, 2012, Pfizer Animal Health Summit, "Metrics for Animal Health Sustainability"

Matlock, M., October 4, 2012, EcoSummit - Ohio State, "Ecosystem Services Sustainability Index"

Matlock, M., October 30, 2012, Water Summit – Monsanto, "Water Risk Metrics Development"

Matlock, M., Dec 12-13, 2012, Pfizer Animal Health Conference, "The role of animal agriculture in feeding 9.25 billion people"

Osborn, G. Scott, Invited presentation to Entrepreneurial Faculty group led by Dr. Reaves in Walton College

Osborn, G. Scott, Session Moderator for "Source Water Protection to Reservoir Restoration" for Arkansas Water Resources Center Annual Watershed and Research Conference, Fayetteville, AR.

J. Owen, J. Robbins, R. Ehsani, **D. Saraswat**, J. Maja, H. Stoven, S. Doane, C. Landgren . 2012. "Future Opportunities of Using an Unmanned Aerial Platform as a Management Tool for Nurseries". In Southern Region International Plant Propagators Society (SR-IPPS), Auburn, AL, October 18.

Saraswat, D. 2012. "StreBanD: A Tool for Conservation Planners". In Arkansas Non-Point Source Task Force Meeting, Little Rock, AR, September 26.

Saraswat, D. 2012. "GLEAMS-NAPRA: A Web-based Screening Tool for Conservation Planners". In Arkansas Non-Point Source Task Force Meeting, Little Rock, AR, September 26.

Saraswat, D. 2012. "Introduction to Mobile Applications ("Apps")". In Community and Economic Development Retreat, Little Rock, AR, April 18.

Saraswat, D. 2012. "Share Your Data Globally Without Knowing Programing". Brown-Bag Seminar, Clinton School of Public Service, Little Rock, AR, April 11.

Saraswat, D. and T. Ramick. 2012. "Watershed Prioritization in Arkansas- Integrated Participatory and Modeling Based Approach". USDA-NRCS Meeting on National EQIP Water Quality Initiative, Little Rock, AR, March 22.

Owen, J. , J. Robbins, R. Ehsani, **D. Saraswat**, J. Maja, H. Stoven, S. Doane, and C. Landgren. 2012. "Development of an Inventory Management Tool for Nurseries Using an Unmanned Aerial Platform". In SR-ASHS, Birmingham, AL, February 6.

Robbins, J., J. Owen, R. Ehsani, J. Maja, **D. Saraswat**, H. Stoven, S. Doane, and C. Landgren. 2012. "Development of an Inventory Management Tool Using Visual Imagery from a Multirotor Aerial Platform". In 57th Southern Nursery Assoc. (SNA) Research Conference, Mobile, AL, January 18 (Reviewed).

Saraswat, D. and N. Banerjee. 2012. Crowdsourcing App for Precision Agriculture Decision Making. In 2012 ASABE Annual International Meeting, Dallas, TX, July 31- August 2.

Saraswat, D. 2012. Smartphones App Framework for Potential Use by Cooperative Extension Service. In 2012 ASABE Annual International Meeting, Dallas, TX, July 31- August 2.

Pai, N. and **D. Saraswat**. 2012. Quantifying Water Quality Benefits of Wetlands in Bayou Bartholomew Watershed Using SWAT2009. In 2012 ASABE Annual International Meeting, Dallas, TX, July 31- August 2.

Singh, G., and **D. Saraswat**. 2012. A Watershed Scale Evaluation of Selected Second Generation Biofeedstocks on Water Quality. In 2012 ASABE Annual International Meeting, Dallas, TX, July 31- August 2.

Saraswat, D. and N. Pai. 2012. Evaluating Land Use-Land Cover Uncertainty using SWAT2009_LUC Tool. In 2012 SWAT International Conference and Workshop, New Delhi, India, July 16-20.

Owen, J., R. Ehsani, J. Robbins**, D. Saraswat**, J. Maja, H. Stoven, S. Doane, and C. Landgren. 2012. Development of an Inventory Management Tool for Nurseries Using an Unmanned Aerial Platform. In 72nd Annual Meeting of Southern Region of American Society for Horticultural Science, Birmingham, AL, February 4-6.

ORAL OR POSTER PRESENTATIONS

Lau, Ching-Shuan, Kris Bunnell, Edgar Clausen and **Danielle Julie Carrier**. 2012. Kinetic modeling of xylose oligomers degradation during dilute acid hydrolysis. 34th Symposium on Biotechnology for Fuels and Chemicals. New Orleans, LA. April 30 to May 3. 2012.

Bunnell, Kris, Ashley Rich, Jackson O. Lay Jr., William Oliver and **Danielle Julie Carrier** Plant maturity effects on the physicochemical properties of switchgrass (*Panicum virgatum*, L.) hemicellulose. 34th Symposium on Biotechnology for Fuels and Chemicals. New Orleans, LA. April 30 to May 3. 2012.

PUBLICATIONS

Hurd, Shiloh A., LaRae D. Brown, Elizabeth M. Martin, and **Danielle Julie Carrier**. Sweetgum bark (*Liquidambar styraciflua* L.): saccharification and co-product extraction. 34th Symposium on Biotechnology for Fuels and Chemicals. New Orleans, LA. April 30 to May 3. 2012.

Djioleu, Angele C., Elizabeth M. Martin, Matthew Pelkki and **Danielle J. Carrier**. Xylose and glucose yields from dilute acid pretreatment and enzymatic hydrolysis of mixed hardwood. 34th Symposium on Biotechnology for Fuels and Chemicals. New Orleans, LA. April 30 to May 3. 2012.

Lau, Ching-Shuan, Kris Bunnell, Edgar Clausen, Gregory Thoma, Jackson Lay, Jennifer Gidden, and **Danielle Julie Carrier**. Kinetic modeling of xylose oligomers degradation during dilute acid hydrolysis. American Society of Agricultural and Biological Engineers (ASABE) Annual Meeting, Dallas, TX July 2012

Bunnell, Kris, Ashley Rich, Curtis Luckett, Ya-Jane Wang, and **Danielle Julie Carrier**. Plant maturity effects on the physicochemical properties of switchgrass hemicelluloses. American Society of Agricultural and Biological Engineers (ASABE) Annual Meeting, Dallas, TX July 2012

Djioleu, Angele, Elizabeth Martin, Mathew Pelkki and **Danielle Julie Carrier**. Effects of biomass contamination on xylose and glucose yields from dilute acid pretreatment and enzymatic hydrolysis of sweetgum wood. American Society of Agricultural and Biological Engineers (ASABE) Annual Meeting, Dallas, TX July 2012

Bailey, I., **B. Haggard** and D. Zaharoff. 2012. Chitosan reduces water solubility of phosphorus in poultry litter. Oklahoma State Student Water Conference, Stillwater, OK

Entrekin, S., G. Adams, R. Adams, B. Austin, M. Evans-White, C. Gallipeau, E. Hagenbuch**, B. Haggard**, E. Inlander, N. Jensen, B. Johnson, J. Kelso, L. Lewis, L. Massey, and L. Stearman. 2012. Rapid gas development in the Fayetteville Shale Basin, Arkansas. Special Session: Exploring the Effects of Gas Extraction from Shale Plays on Freshwater Ecosystems, Society of Freshwater Science, Louisville, KY

Entrekin, S., N. Jensen, A. Musto, J. Kelso, B. Austin, M. Evans-White, C. Gallipeau, **B. Haggard**, and L. Massey. 2012. Sediment concentrations and macroinvertebrate response to natural gas extraction in north-central Arkansas. Southeastern Association of Fish and Wildlife Agencies Annual Meeting, Hot Springs, AR

Entrekin, N. Jensen, J. Kelso, A. Musto, B. Austin, M. Evans-White, G. Adams, R. Adams, L. Stearman, J. Green, C. Gallipeau, **B. Haggard**, E. Inlander, L. Lewis, and L. Massey. 2012. Assessing potential effects of natural gas development on streams in the Fayetteville Shale. Arkansas Game and Fish Commission Arkansas Wildlife Action Plan, Mt. Magazine, AR

Grantz, E., T. Scott, and **B. Haggard**. 2012. Nitrogen retention and denitrification efficiency in reservoirs. Annual Meeting, Oklahoma Clean Lakes and Watershed Association, Lake Acadia, OK

Haggard, B., L. Massey, B. Austin, M. Evans-White and S. Entrekin. 2012. Establishing chemical baselines in streams draining the Fayetteville Shale areas. Special Session: Exploring the Effects of Gas Extraction from Shale Plays on Freshwater Ecosystems, Society of Freshwater Science, Louisville, KY

Haggard, B., T. Scott, S. Longing, and J. Metrailer. 2012. Stream Nutrient Thresholds with Sestonic Chlorophyll in the Red River Basin. Annual Meeting, Oklahoma Clean Lakes and Watershed Association, Lake Acadia, OK

Haggard, B., L. Massey, C. Koch, T. Scott, M. Evans-White, B. Austin, E. Scott, and D. Procyk. 2012. Phosphorus slug dynamics in an urban stream. American Society of Agricultural and Biological Engineers Annual Meeting, Dallas, TX

Heeren, D., G. Fox, D. Storm, P. Storm, **B. Haggard**, T. Halihan, and R. Miller. 2012. Quantification and heterogeneity of infiltration and transport in Ozark floodplains. American Society of Agricultural and Biological Engineers Annual Meeting, Dallas, TX

Massey, L., B. Bailey, and **B. Haggard**. 2012. Water quality trends in northwest Arkansas. 20th National Nonpoint Source Monitoring Workshop, Tulsa, OK

Massey, L., **B. Haggard**, C. Koch, T. Scott, M. Evans-White, B. Austin, and E. Scott. 2012. Real-time phosphorus concentrations in an urban stream. American Society of Agricultural and Biological Engineers Annual Meeting, Dallas, TX

Peterson, J., **B. Haggard**, J. Junkhouser, L. Massey, S. Entrekin, M. Evans-White, and S. Filipek. 2012. Establishing baseline water quality conditions and potential changes in streams within the Gulf Mountain Wildlife Management Area in north-central Arkansas. Southeastern Association of Fish and Wildlife Agencies Annual Meeting, Hot Springs, AR

Scott, T., A. Sharpley, **B. Haggard**, and H. Jarvie. 2012. Toward sustainable phosphorus management in the anthropocene: quantifying potentially recyclable pools and fluxes in the landscape. INTECOL, Orlando, FL

Smart, A., M. Evans-White, **B. Haggard**, and S. Gaguly. 2012. Relationship between land-use and water quality in spring-fed streams of the Ozark National Forest. Annual Meeting, Society of Freshwater Science, Louisville, KY

Henry, C. G., E. Vories, M. Anders, M. Reba, C. Wilson and S. Hirsh. 2012. Characterizing Irrigation Water Requirements for Rice Production from the Arkansas Rice Research Verification Program. Presented at the 2012 ASABE Annual International Meeting. July 29-August 1, Hilton Anatole, Dallas Texas. ASABE, St Joseph, MI

Brockman, L., R. Wang, J. Lum, L. Kelso, and **Y. Li**. 2012. Nanobead and aptamer based QCM biosensor for rapid detection of avian influenza virus. Presented at ASABE 2012 Annual International Meeting, July 29-August 1, 2012, Dallas, TX. ASABE Paper No. 121337670.

Fu, Y., C. Zou, Q. Xie, S. Yao and **Y. Li**, 2012. Sensitive aptasensing based on suppression of enzyme catalysis in polymeric bionanocomposites. Presented at BMES 2012 Annual Meeting, October 24-27, 2012, Atlanta, GA.

Kanayeva, D., I. Bekniyazov, A. Bekmurzayeva, M. Sypabekova, R. Wang, and **Y. Li**. 2012. Selection and characterization of ssDNA aptamers for detection of Mycobacterium tuberculosis. Presented at the 12th World Congress for Biosensors, May 16-18, 2012, Cancun, Mexico. Paper No. P3.60.

Li, M., W. Wang, and **Y. Li**. 2012. Inhibitory effect of chitosan and organic acids on the growth of Listeria monocytogenes in ready-to-eat shrimps during regrigerated storage. Presented at IAFP 2012 Annual Meeting, July 22-25, 2012, Providence, RI. Presentation No. 2494.

Li, M., W. Wang, W. Fang, and **Y. Li**. 2012. A quantitative risk assessment model for Listeria monocytogenes in ready-to-eat poultry products. Presented at SRA 2012 Annual Meeting, December 9-12, 2012, San Francisco, CA.

Li, Y., and M. Wang. 2012. Applications of biosensors in the internet of things: A review. Presented at ASABE 2012 Annual International Meeting, July 29-August 1, 2012, Dallas, TX. ASABE Paper No. 121338414.

Lu, H., L. Lin, R. Wang, **Y. Li**, and B. Scheuchenzuber. 2012. Development of H5 subtype-specific monoclonal antibodies (Mab) and Mab-based assays for rapid detection of H5 avian influenza. Presented at 8th International Symposium on Avian Influenza: Avian Influenza in Poultry and Wild Birds, April 1-4, 2012, Royal Holloway, UK.

Lum, J., R. Wang, B. Sirnivasan, B. Hargis, S. Tung, and **Y. Li**. 2012. Impedance aptasensor with microfluidic chips for rapid and specific detection of avain influenza H5 and H7 subtypes. Presented at ASABE 2012 Annual International Meeting, July 29-August 1, 2012, Dallas, TX. ASABE Paper No. 121337407.

Sun, X., Wang, R., X. Wang, and **Y. Li**. 2012. Magnetic nanobeads based impedance immunosensor with interdigitated microelectrode for detection of carbofuran. Presented at the 12th World Congress for Biosensors, May 16-18, 2012, Cancun, Mexico. Paper No. P1.173.

Sun, X., Q. Li, R. Wang, X. Wang, and **Y. Li.** 2012. Amperometric immunosensor based on gold nanoparticles and saturated thiourea for detection of carbofuran. Presented at ASABE 2012 Annual International Meeting, July 29-August 1, 2012, Dallas, TX.

PUBLICATIONS

Wang, R., Z.C. Callaway, **Y. Li**, Q. Hao, T. Huang, and H. Lu. 2012. Nanowire and nanoelectrode based biosensor for rapid screening of avian influenza virus. Presented at the 12th World Congress for Biosensors, May 16-18, 2012, Cancun, Mexico. Paper No. P2.170.

Wang, W., M. Li, and **Y. Li**. 2012. A predictive model for the decontamination effect of lactic acid and chitosan on Vibrio parahaeomolyticus in shrimps. Presented at IAFP 2012 Annual Meeting, July 22-25, 2012, Providence, RI. Presentation No. 2238.

Wang, W., M. Li, W. Fang, and **Y. Li**. 2012. A quantitative exposure assessment model of Vibrio parahaemolyticus in shrimps in China. Presented at SRA 2012 Annual Meeting, December 9-12, 2012, San Francisco, CA. Poster No. P.63.

Xu, H., H. Wang, H. Xu, Z. Aguilar, M. Kuang, M. Slavik, **Y. Li**, and A. Wang. 2012. Magnetic nanocrystals for bio-separation. Presented at 9th International Conference on Scientific and Clinical Applications of Magnetic Carriers, May 22-26, 2012, Minneapolis, MN. Poster #164.

Xu, X., Y. Ying and **Y. Li**. 2012. A simple, competitive biosensor for rapid detection of aflatoxin B1 based on aggregation of gold nanorods. Presented at IEEE Sensors 2012 Conference, October 28-31, 2012, Taipei, Taiwan. Paper No. 1817.

Xu, X.H., J. Zhou, Z. Nie, S. Yao and **Y. Li**, 2012. Aptametric peptide for one-step detection of protein kinase in cell lysate. Presented at BMES 2012 Annual Meeting, October 24-27, 2012, Atlanta, GA.

Xu, X.H., **Y. Li**, J. Zhou, Z. Nie, and S. Yao. 2012. Peptide inhibitor based QCM biosensor for rapidly detecting protein kinase activity. Presented at IEEE Sensors 2012 Conference, October 28-31, 2012, Taipei, Taiwan. Paper No. 1754.

Lum, J., R. Wang, B. Sirnisvasan, B. Hargis, S. Tung, and **Y. Li**. 2012. Impedance aptasensor with microfluidic chips for rapid and specific detection of avian influenza H7N2. Presented at ABI (Arkansas Bioscience Institute) 2012 Fall Research Symposium, October 23, 2012, Fayetteville, AR.

Lum, J., R. Wang, B. Sirnisvasan, B. Hargis, S. Tung, and **Y. Li**. 2012. Impedance aptasensor with microfluidic chips for rapid and specific detection of avian influenza H7N2. AAFP 2012 Annual Meeting, September 11-12, 2012, Fayetteville, AR. Won the 2nd place of AAFP 2012 Graduate Students Poster Competition.

Wang, R., H. Bai and **Y Li**. 2012. SPR aptasensor for rapid detection of avian influenza virus H5N1. Presented at ABI (Arkansas Bioscience Institute) 2012 Fall Research Symposium, October 23, 2012, Fayetteville, AR.

Liang, Y., G.T. Tabler, S.E Watkins and I. Berry. 2012. Field evaluation of controlled surface wetting system to cool broiler chickens. 2012 International Scientific Forum, Atlanta, GA, January 2012

Bautista, R., **Y. Liang**, T. A. Costello and W. Speer. 2012. Energy usage assessment of selected broiler houses in Arkansas. ASABE Annual meeting. St. Joseph, MI: ASABE July 2012

Liang, Y., J. Payne, C. Penn, S.E. Watkins, K.W. VanDevender, G.T. Tabler, J. Purswell 2012. Ammonia emissions from boiler houses using litter windrowing during downtime. ASABE Annual meeting St. Joseph, MI: ASABE. July 2012

Lei, M., **Y. Liang** and T. A. Costello. 2012. Heat production of windrow composting in the broiler houses. Annual meeting of ASABE. No. 12-1337899. St. Joseph, MI: ASABE, July 2012

Richardson, G. A., **G.S. Osborn**. Reducing Sediment Oxygen Demand in Eutrophic Lakes. Abstract submitted for presentation at 2013 ASABE Annual International Meeting, Kansas City, MO. In Review.

Richardson, G.A., **G.S. Osborn**. Reducing Sediment Oxygen Demand in Eutrophic Lakes. Abstract submitted for presentation at WEFTEC Annual International Meeting, Chicago, IL. In Review

Sadaka, Samy. Gasification of Raw and Torrefied Cotton Gin Wastes. Presentation to the ASABE annual meeting.

Sharara, Mahmoud and **Samy Sadaka**, Gasification of Algae biomass. Presentation to the ASABE annual meeting.

Sadaka, Samy, Gasification of animal manure. Presentation to the Canadian Society of Agricultural Engineers.

Saraswat, D. and N. Pai. 2012. Automated Approach for Streambank Delineation and Mapping. In 2012 Sea Grant and Land Grant National Water Conference, Portland, Oregon, May 21-25.

Other Creative Endeavors

Wilkerson, J, **C. Henry**, K. Hamms, L. Johnson and J. Heemsta. 2012. Modern Manure Management. Digital media. University of Nebraska Extension. 26 min. This educational product aired on NET1 and NET2 on October 11 and 14, 2012.

Patents

Kim, J.-W., R. Deaton, & V.P. Zharov, Near-infrared responsive carbon nanostructures. US patent No 8,313,773 (November 20, 2012).

Osborn, G. S., M. D. Matlock, S. S. Teltschik. UA Disclosure Ref. No. 04-24. System and Method for Dissolving Gases in Fluids and for Delivering of Dissolved Gases. U.S., Issued – 10/2/12, Patent No. 8,276,888.

Osborn, G. S., M. D. Matlock, S. S. Teltschik. UA Disclosure Ref. No. 04-24. System and Method for Dissolving Gases in Fluids and for Delivery of Dissolved Gases. Japan, Issued 11/9/12, Patent No. 5127702.

The University of Arkansas is committed to the policy of providing educational opportunities to all qualified students regardless of their economic or social status, and will not discriminate on the basis of handicaps, race, color, sex, or creed.

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