Fall 2011

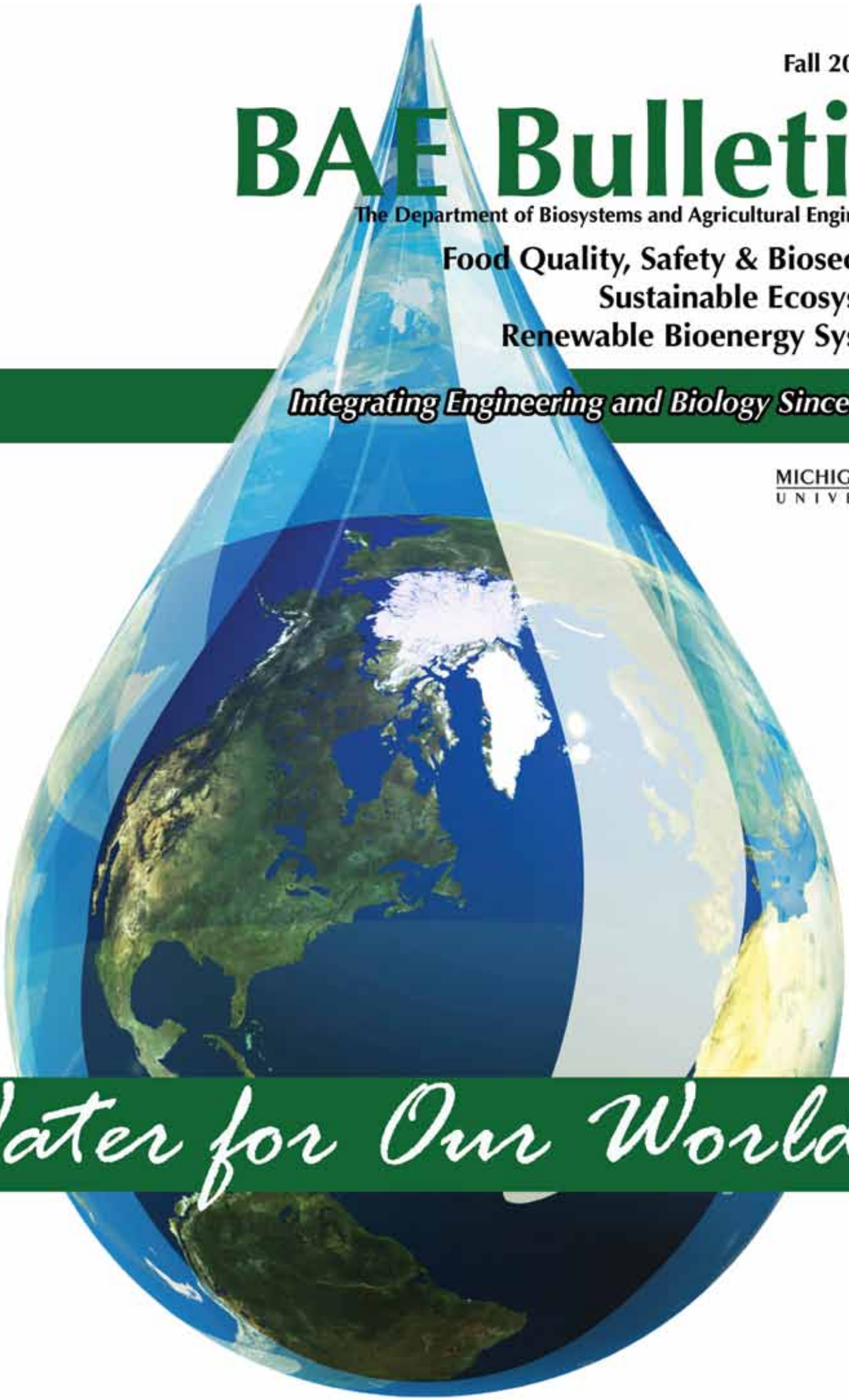
BAE Bulletin

The Department of Biosystems and Agricultural Engineering

Food Quality, Safety & Biosecurity
Sustainable Ecosystems
Renewable Bioenergy Systems

Integrating Engineering and Biology Since 1906

MICHIGAN STATE
UNIVERSITY



Water for Our World

From the Chair

BAE Bulletin

Since 1906, the Department of Biosystems and Agricultural Engineering has responded to the changing needs of society by integrating and applying principles of engineering and biology in a systems context. Today, biosystems engineers at MSU solve complex, rapidly-changing problems related to food quality and safety, ecosystems protection, homeland security and health protection, biomass utilization and renewable energy development.

Biosystems & Agricultural Engineering
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College of Agriculture and Natural Resources

College of Engineering

Dear alumni and friends:

Once again I am delighted to write to you with news of our department, faculty and students. Fall semester is now in full swing and we have settled in our day-to-day activities.

Dean Jeffrey Armstrong, who served our college of Agriculture and Natural Resources for nine years left in February to take the position of president at California Polytechnic at San Luis Obispo, CA. Dr. Doug Buhler has been appointed as the interim dean while we search for a permanent dean. Before being appointed in this position, Dr. Buhler served as the associate director of AgBioResearch (formerly known as Michigan Agricultural Experiment Research). He also has served as the chair of the MSU Crop and Soil Science department. He is a plant scientist and brings with him a wealth of academic and administrative experiences. More importantly he values teaching and is dedicated to providing students excellent learning experience.

To help with this transition in the college leadership, MSU Provost Kim Wilcox appointed a taskforce to develop recommendations to position the College to reassume a position of intellectual leadership on campus and to address questions related to shrinking resources from traditional sources, increasing reliance on competitive research funding, shrinking enrollment, and excessive administrative cost. I had the privilege of serving on this taskforce. The taskforce made several recommendations and suggested the following strategic platform to guide college teaching, research and Extension/outreach programs as well as future investments. These are:

- Food and Agricultural Systems
- Natural Resources and Ecological Systems
- Bioenergy and Bioproduct Systems

These strategic platforms are in alignment with our department's strategic directions: *food quality, safety and biosecurity; sustainable ecosystems, and bioenergy*. We look forward to working with the college to build on these platforms.

Enrollment in Biosystems Engineering degree program continues to grow and has exceeded 170 majors. To put it in perspective, this is a 100% increase over what it was five years ago. More importantly, BE graduates are getting jobs with highly competitive salaries. Our graduate student numbers are also increasing rapidly reflecting positively on our grant activities. In addition to receiving grants from agencies such as USDA and NSF, our faculty have been successful in receiving grants from the Department of State and Department of Defense.

We have been very active internationally this year. I was fortunate to lead a group of six faculty members and a graduate student to visit University of Costa Rica (UCR) in San Jose. The purpose of the visit was to build a relationship with the department of Agricultural Engineering and help them transform their curriculum into Biosystems Engineering. In that regard, this was a successful visit as they have changed their program to biosystems engineering and their department name to agricultural and biosystems engineering. We have two summer interns visiting us from Costa Rica and a Ph.D. student will join us in January. We have also received a major grant from the Department of State Western Hemisphere Affairs Division to increase access to clean energy in Latin America. We will be working with UCR (serving as a hub) and institutions in Nicaragua and Panama. Read more about it in the newsletter.

As experts predict, global population will increase to 9 billion by 2050. This is a 2 billion increase over the current population. How will we sustain 2 billion more lives on this planet? How will we grow enough food for everyone? Will we have enough water and energy to grow the food necessary to feed the world? Clearly, solutions to these problems will require taking a multidisciplinary systems approach to seeking sustainable solution to future challenges. Biosystems Engineering which integrates biology with engineering is well positioned to meet these challenges. Recent increases in our program clearly indicate that other also agree with this conclusion.

As always, I ask you to stay connected with us and if you plan to be in the area, please let us know and we will be happy to give a tour of the building and show you the exciting research our faculty are doing. GO GREEN!

With kind regards,

Ajit Srivastava

Table of Contents

BAE Bulletin

From The Chair 2

Faculty News

Interns from Zhejiang University 4
Lu Recognized by Penn State 4
New Faculty Member:Timothy Whitehead 4
Student Awards 5
Engineers Without Borders International Conference 5

Water for Our World

Fine-tuning Management Practices Helps to Minimize Risks to Water Quality, Maximize Profitability for Producers 6
Water, Climate and Bioenergy: Preparing for the Future 6
All Waste is Not Created Equal 7
Poplar Trees May Provide Solution to Food Processing Industry Waste Woes 8
Determining Risk to Fresh Food Safety of Using Treated Wastewater for Irrigation 8
Managing Phosphorus is Common Denominator in Sustaining Fresh Water Supply 9
Agriculture Has Opportunity To Show They Use Water Resources Wisely 9
Online Assessment Tool Allows Producers To Stay In Compliance With Regulations 10
System for the Treatment of Milking Center Wastewater 10
Biosensors for Early and Rapid Detection/Diagnosis 11

Food Safety Quality, Safety and Biosecurity

Evaluation and Development of Computer Tomography (CT) Imaging Technology For Internal Quality Evaluation of Fresh In-Shell Chestnut 12

Renewable Bioenergy Systems

MSU Trustees Approve Plan for New Source of Energy 13

Student News

MSU Team Nabs First Place For Innovative Microwavable Pie, Ice Cream Combo at National Competition 14
MSU Senior Team Wins First Place in National Competition 15
Senior Design Showcase 16-19

International Activities

New Partnership Between University of Costa Rica and MSU Formed 20
Anaerobic Digestion in Ghana 21
Alumni Awards/News 22-23
Michigan Chapter ASABE 24-25
Clean Water for the World: Aqua Clara International 26
BAE Gift and Order Form 27

Faculty News

Interns from Zhejiang University

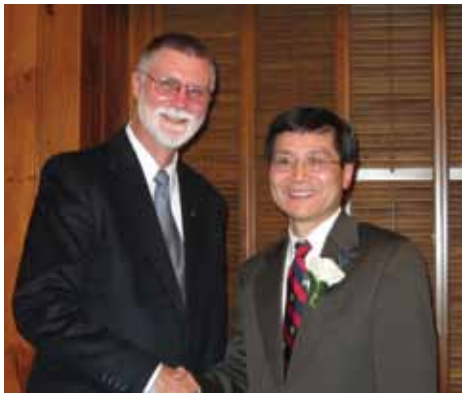
For the fourth consecutive year, the Department of Biosystems and Agricultural Engineering offered summer research internships for a group of undergraduate students from the College of Biosystems Engineering and Food Science at Zhejiang University (ZJU) in Hangzhou, China. Nine ZJU junior students stayed at MSU for four weeks, and conducted research projects related with post-harvesting, ecological system, neutracuetical production, and biological and thermal conversion of biofuels from renewable sources. In addition to the research activities, the students attended the weekly seminars of the U.S. history, culture, and society that were held by the College of Agriculture and Natural Resources. The students also toured Lake Michigan, and visited Henry Ford Museum and Greenfield Village during the weekends.

This internship is part of a special program (3+1+X) between Michigan State University (MSU) and Zhejiang University. The ZJU undergraduate students admitted in the 3+1+X program will study at their home institutes at ZJU for the first three years, and then come to MSU to take senior-level courses. After meeting ZJU's B.S. requirements, the students will be granted a bachelor degree by ZJU, and continue on their Master study at MSU. The summer internship provides an opportunity for the ZJU students to interact with MSU students and faculty, and gain research and social experiences before they start their senior year at MSU.

New Faculty Member: Timothy Whitehead

Timothy Whitehead has accepted a joint position with BAE and CHEMS. He received his Ph.D. at the University of Cailfornia-Berkeley in 2008 in Chemical Engineering. He just recently completed a post-doc at the University of Washington Biochemistry Dept. under David Baker. Dr. Whitehead is an expert on protein engineering and design and his interests are in the production of biofuels and chemicals from plant-derived biomass. Dr. Whitehead is a co-author on over a dozen peer-reviewed journal articles and two patent applications. Welcome aboard, Tim.

Lu Recognized by Penn State



Adjunct Professor Renfu Lu was selected to receive the 2011 Penn State College of Agricultural Sciences Outstanding Alumni Award. He is pictured above with Dr. Bruce McPheron, Dean of Penn State College of Agricultural Sciences, at the 2011 Outstanding Alumni Award Reception.

Jim and Susan Steffe(l) and Ajit and Barbara Srivastava (r), celebrate with Gene Ford and his family at the Alumni Awards Ceremony.

Engineers Without Borders International Conference

Dylan Comer
Biosystems Engineering, class of 2012


EWB-MSU in Louisville 1

Everyone in Engineers Without Borders (EWB) was excited when we found out the international conference was just around the corner in Louisville. This relatively close proximity, and the support of the college of engineering as well as BAE, and AES departments, allowed six of us to attend the conference. Three of these attendees, Alexa Jones, Kevin Koryto, and Kelsey Downey, and I are Biosystems Engineering students. Alex Voigt and Vanessa Stuart also represented EWB-MSU at this conference. This is the first time in EWB-MSU history anyone has attended. As a young chapter, we felt the information we would attain at this conference would likely be vital to the success of our next international project, however, at the time, I don't think we understood how vital it would be. I went into the conference expecting half of it to be lectures on the best practices for designing latrines or water filters, and the rest to be information on fundraising or chapter building. I was surprised when there was little to no technical information, after all, wasn't this an engineering conference? What I realized at this conference was that while most groups of engineers can design a working latrine or water filter, convincing a community to take ownership over a new latrine or filter can, at times, pose a monumental challenge. After all, if a community can not alter their cultural norms to properly use a latrine, or if they do not have the organization to maintain a water distribution system, that project is not sustainable. I believe that this improved understanding of what it takes for a project to truly be successful will drastically improve our chances of success on our next project. I am very excited for the composting latrine project we are currently applying for in El Salvador. This project will enable us to be more than a local engineering service organization, which we have been so far this year, and work towards the mission of EWB. That mission is to complete community driven sustainable projects which meet people's basic needs, as well as to train socially conscious engineers. On behalf of EWB-MSU I would like to thank the college of engineering, as well as BE, and AES departments for their support and funding.

Student Awards/ Scholarships

Undergraduate Scholarships 2011

F.W. Bakker-Arkema Endowed Scholarship
Alexa Jones

A.W. Farrall Scholarship
Lauren Deitz
Michael Huarng
Gretchen Suehr

Clarence & Thelma Hansen Scholarship
James Burns
Michael Herman
Nathan Jandernoa

Howard & Esther McColly Scholarship
Bridget Bednark
Jessica Emery
Matthew Gammans

George & Betty Merva Scholarship
Hanna Miller

DeBoer Family Scholarship/ Fellowship Fund
Lara Ejups
Miranda Sperry
Michael Zanotti

Fine-tuning Management Practices Helps to Minimize Risks to Water Quality, Maximize Profitability for Producers

"Society expects clean water and they expect the agricultural community to do everything they can to preserve water quality." – Tim Harrigan, MSU associate professor of Biosystems and Agricultural Engineering

Two research initiatives headed up by Tim Harrigan, MSU associate professor of Biosystems and Agricultural Engineering, and nearing completion are delving into the interdependent issues of water quality, on-farm application of waste products and public health.

One project was conducted at the Kellogg Biological Station in collaboration with Dr. Irene Xagoraraki from the MSU Department of Civil and Environmental Engineering. Working on the basis that soil can effectively filter and inactivate contaminants found in both manure and biosolids, the team evaluated the movement and survival of viral pathogens (adenoviruses and somatic phages) from treated biosolid waste on cropland. No pathogens were found in the test plot (sandy-loam soil seeded to a cover crop), but somatic phages were detected in surface water ponds created by heavy rainfall for at least two weeks after the application of biosolids. These findings will prove key when developing recommendations for spreading manure and biosolids on various soil types.

Dale Mutch, MSU Extension cover crops educator, and Natalie Rector, MSU Extension nutrient management educator, are working with Harrigan on the second project, which focuses on combining low-disturbance aeration tillage, liquid manure application and cover crop seeding together in one efficient operation to minimize erosion and maximize nutrient use. The process, slurry-seeding, was found to be more energy and time efficient as compared to using traditional tillage and seeding practices. It reduced machinery costs by 25 percent, fuel costs by 45 percent (more than 2 gallons per acre) and labor expenses by 50 percent (more than half an hour per acre). Additionally, no-till helps to reduce soil erosion and potential sediment and manure contaminant runoff to surface waters and, thus far, biomass yields of the cover crops sown have been equal to or greater than yields resulting from conventional seeding.

Funding partners for the recently completed biosolids research are the MSU Center for Water Sciences and the Water Environment Research Foundation. The USDA-NRCS (Conservation Innovation Grant) and Project GREEEN are funding partners on the slurry-enriched micro-site seeding project, which is nearing the end of year two of a three-year project.

Utilizing slurry-seeding is more energy and time efficient than using traditional tillage and seeding practices.

Water, Climate and Bioenergy: Preparing for the Future

Nejadhashemi

Amirpouyan (Pouyan) Nejadhashemi, MSU assistant professor of Biosystems and Agricultural Engineering and Crop and Soil Sciences, is looking towards the future with an eye to preserving the environment when it comes to climate change, growing bioenergy crops and preserving the integrity of aquatic ecosystems.

Climate change will undoubtedly affect future water quality and quantity and the best management practices (BMP) stewards use to protect it. Results of Nejadhashemi's climate change research determined that water quantity components, including runoff, base flow and yield, increased significantly under each future climate scenario studied. Secondly, management practice performance changed significantly under future climate scenarios at the field level, whereas they generally did not at the watershed level. This project was funded by the U.S. Geological Survey.

As the agriculture industry embraces its role in supplying the global demand for alternative fuel and energy sources, what cost will growing bioenergy crops have on the environment? One study traced the fate and transport of pesticides

All Waste is Not Created Equal

It quickly becomes obvious when talking with MSU assistant professor of Biosystems and Agricultural Engineering Wei Liao that agricultural residues are not wastes; their high nutrient content makes them a valuable source for producing bioenergy. The U.S. cattle population tops 100 million head – or in other words, a lot of manure is produced every year on farms and feedlots across the country just waiting for the right technology and systems to come along so that it can be cost-effectively repurposed into energy.

Recycling the millions of gallons of liquid animal wastes produced on farms and converting them into energy is a win-win: farmers may be able to achieve greater profitability by creating and using energy and fertilizer on-site and selling any excess energy for use in the community. Farmers will also succeed at further minimizing the operation's environmental footprint by being able to better manage the amount of nutrients returned to the land.

Liao is teaming up with colleagues to develop an integrated farm-based biorefining concept that utilizes a modified anaerobic digestion process to co-produce methane biogas and digested fiber; algae cultivation to reclaim water and accumulate algal biomass; and cellulosic ethanol production using digested fiber and algae biomass (Figure 1). The integrated system will reduce our reliance on fossil fuels and clean up water, while simultaneously maximizing the farmer's profitability and minimizing environmental impacts. Animal manure will be transformed from an environmental liability into a public and private asset.

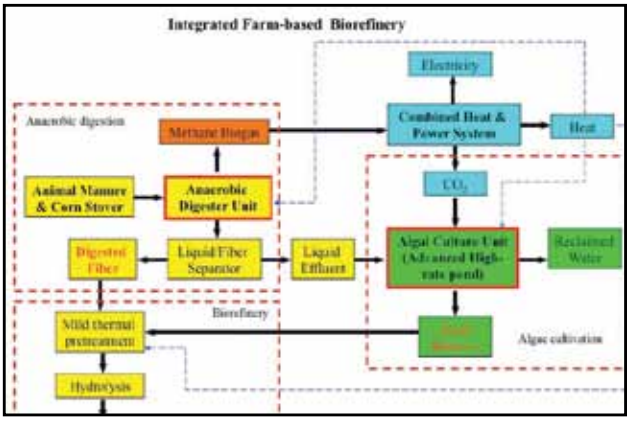


Figure 1. Integrated Farm-Based Biorefining

The goal of Dr. Liao's research is to scale-up the technology so that it's available to all sizes of animal operations. Next steps include identifying more value-added products that can be created from the process and determining if there are opportunities for developing pharmaceuticals.

Much of the study is being conducted on-campus at the MSU Dairy Teaching and Research Center. In addition to receiving funding support from AgBioResearch, the Michigan Public Service Commission has invested $1.6 million in the project.

MSU pilot-scale AD/Algae research facility

to evaluate the effects that producing bioenergy crops on a large-scale could have on aquatic and human health. Based on the study, rotations that incorporate perennial grass species, especially switchgrass and native grasses, appear to be the most suitable for implementing on a large-scale. Among all the crop rotations studied, continuous corn and corn and canola rotations resulted in the highest concentrations of glyphosate in basin-wide surveys, well above established toxicity levels for bluegill and humans. Another outcome from this project is the recommendation not to convert marginal land in areas with high nitrogen levels to bioenergy crop rotations. Multiple crops that were once thought to be detrimental to the environment actually showed potential to the contrary under certain scenarios, which will be important in managing watershed-scale land use. This research was funded by the Nature Conservancy.

Another Nejadhashemi-led project evaluated the impact water quality and quantity has on maintaining the integrity of aquatic ecosystems and its resident fish populations after human actions or influences have altered it from its natural state. Studies found that, over the long term, quantity has a greater influence on biotic integrity than does quality. Additionally, the state of water quality and quantity can explain 35 percent to 40 percent of the variability in fish populations. Results from this study will be used to help develop strategies for managing ecosystem water resources. This work was funded by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS).

Poplar Trees May Provide Solution to Food Processing Industry Waste Woes


Reinhold

Sustaining the fruit and vegetable food processing industry in Michigan is critical for the well-being of the state's economy: upwards of 1,200 facilities located in the state generate a reported annual gross income of nearly $497 million.

The work of one MSU Biosystems and Agricultural Engineering researcher, Dawn Reinhold, is attempting to find a solution to the industry's No. 1 challenge – developing a cost-effective and environmentally safe method for treating wastewater – while simultaneously helping to safeguard the health of the state's groundwater supply.

Food processors require a tremendous amount of water to process fruits and vegetables, but purchasing conventional systems for treating the resulting wastewater is often too expensive. Instead, many processors rely on land application to treat their wastewater. If too much wastewater is applied, this can deteriorate the soil and mobilize metals, potentially dispersing them to groundwater.

Poplar trees are a well-developed, low cost approach for removing contaminants from hazardous waste sites and could provide a cost-effective solution to conventional treatment technologies for food processors. Poplars have deep roots and extremely high transpiration rates (four times greater than corn, for example), and they can extract metals from the soil, take them up through their roots and transport them into their shoots. They can also withstand high concentrations of chelating agents and salt.

Results from this project may be used to develop a low-cost, environmentally-responsible system for treating food processing wastewater that will decrease the potential for metal contamination of groundwater.

Researchers are currently working with a food processor to establish a poplar field test site.

Additional funding for this project has been provided by Project GREEEN and the Michigan Department of Agriculture and Rural Development.


Young poplars will be planted to establish a field test site as the next step in Reinhold's research project.

Determining Risk to Fresh Food Safety of Using Treated Wastewater for Irrigation

Fresh water is a precious natural resource. It's also finite. Producers depend on natural water sources to irrigate a number of crops, but a growing scarcity of water is leading to restrictions on the amount of water agriculture can use and from what sources it can be drawn. An alternative is to use treated municipal wastewater to irrigate crops, but antibiotics and other pharmaceuticals present in this wastewater could accumulate in fresh food crops entering the consumer food chain.

To sustainably utilize treated wastewaters as an irrigation source, the role plants play in amassing antimicrobial residues and breaking them down must first be fully understand. Dawn Reinhold, MSU assistant professor of Biosystems and Agricultural Engineering, is heading a research project designed to characterize how much and what types of antimicrobials accumulate on fresh fruit and vegetable crops irrigated using treated municipal wastewater. The study will also determine how these findings compare to crops harvested from soils where biosolids have been applied. Findings from the various assessments will be synthesized according to the risk of exposure to antimicrobials to human health.

Repurposing treated municipal wastewaters for irrigation could also help remedy the negative impact it has on aquatic ecosystems when it's discharged directly into surface waters. By land-applying these waters instead, communities of soil microbes can slowly break down the antimicrobials. Findings indicate that soils have greater capacity to handle these wastes and break down the antimicrobials, whereas the capacity of aquatic ecosystems to assimilate antimicrobials without adverse effects is currently being exceeded.

The United States Department of Agriculture is funding this project.

Managing Phosphorus is Common Denominator in Sustaining Fresh Water Supply

It's estimated that 40 percent of the surface water in the United States is compromised, in large part, because of rising levels of phosphorus. Developing environmentally-sound and cost-effective practices for managing nutrient loads from land-applied livestock manure and treated wastewater is imperative for optimizing the short- and long-term health of streams, surface water, and groundwater reserves.

MSU associate professor of Biosystems and Agricultural Engineering Steven Safferman is working on two research projects to address this concern, one that concentrates on identifying media for removing phosphorus from onsite-generated wastewater and another that is focused on separating out phosphorus as part of the anaerobic digestion process.

In the first project, research proved the concept of using a novel media to remove phosphorus from onsite-generated wastewater (with a capacity exceeding all previously reported values). The next step is to develop a systematic, waste-specific design procedure, which should enable flexibility in terms of the wastewater quality, phosphorus regulatory limit, and length of time between replacing media. Many established modeling approaches exist, but further column and isotherm studies are needed to further develop the utility of the models. Success at the bench scale will then warrant field demonstrations, which can generate cost and design data and identify any unintended consequences.


Safferman

Implementing a well thought-out nutrient management plan is especially important when land-applying manure to those crops that have limiting phosphorus thresholds. Coupling an anaerobic digester with a tubular ultra-filtration membrane (membrane anaerobic digester) can potentially be part of that plan, which includes the added bonus of producing water that can be reused for certain farm functions. Recent research determined that phosphorus separation can indeed be achieved with this pairing process, resulting in bulk liquid concentrations that have drastically reduced levels of phosphorus. Findings also indicated that the simple and routine practice of cleaning the tubular membrane with hot water minimized clogging and upheld the durability of the membrane itself.

Funding support for these projects has been provided by MetaMateria Technologies, LLC, through a National Science Foundation Small Business Innovation Program grant, Great Lakes Regional Water Program, Michigan Onsite Wastewater Recycling Association, and the Anaerobic Digestion Research and Education Center, in addition to other organizations.

Agriculture Has Opportunity To Show They Use Water Resources Wisely

Agriculture is the largest consumptive user of water. With new water use legislation passed in the past decade, further scrutiny is being directed at efficiency and whether there could potentially be an adverse impact on water resources. Now more than ever it's critical that farmers can show that they're using water in the most efficient way possible to grow quality, high-yielding crops, while maintaining the integrity of the water sources.

Steve Miller, an MSU Extension outreach specialist in Biosystems and Agricultural Engineering, is working on a project with corn and soybeans that focuses on improving the uniformity of irrigation systems and the cost benefit of applying more water. Applying a uniform amount of water throughout the field results in not shorting one area of the field while overwatering another. This improves yields, is a more efficient use of water, and is important in applying a consistent amount of fertilizer and chemical when chemigation is used.

In addition to evaluating water usage patterns and practices in soybeans and corn, Miller is working with other MSU Extension staff members to determine the water demands of fruit trees and grapes under various growing conditions. Results of this work will lead to the development of scientifically-supported and sustainable recommendations for irrigation timing and water amounts for various crops.

Project GREEEN and MSU Extension are providing funding support for this work.

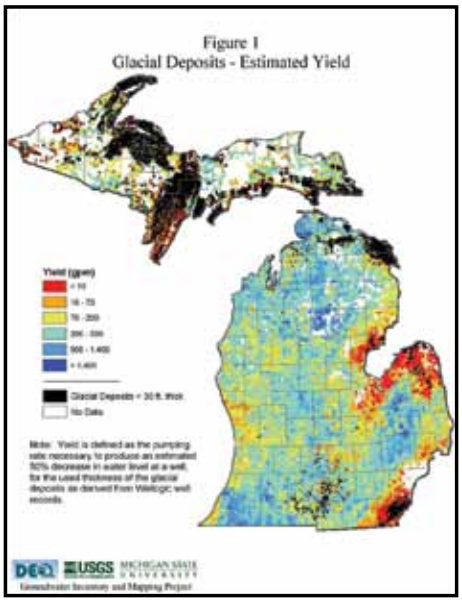
Online Assessment Tool Allows Producers to Stay in Compliance With Regulations

The Michigan Water Withdrawal Assessment Tool (WWAT) is an online screening tool that makes an initial assessment if the water source being tapped can accommodate high volume water withdrawal – defined by legislation as having a system capacity greater than 70 gallons per minute – without causing an adverse impact on the water source. The WWAT is available for anyone to use, and it builds on data mapping the location of groundwater and surface water resources throughout the state (called Groundwater Map, GWMAP), a huge project undertaken by a coalition of research partners almost a decade ago. The tool takes numerous factors into account and assesses how a large withdrawal of water will impact stream flow and fish ecosystems.

Steve Miller, an MSU Extension outreach specialist in Biosystems and Agricultural Engineering, who provided engineering support for GWMAP, is charged with educating producers and others about the water withdrawal assessment process, including the online tool. He's also helping with the process of identifying additional water resource data needs with a focus on southwestern Michigan.

If the proposed water withdrawal fails the WWAT assessment, a site-specific review must be completed by the Michigan Department of Environmental Quality (DEQ). Since a buffer is built into the WWAT, many times site-specific reviews still receive approval. By law, before a withdrawal take place, large volume water users that pass the WWAT assessment must register the planned withdrawal using the tool.

Geospatial water resources can be found by visiting www.gwmap.rsgis.msu.edu. To learn about identifying adverse water withdrawal impacts, visit www.miwwat.org.



This work was funded in partnership with a number of MSU staff members, the Michigan DEQ and the U.S. Geological Service.

System for the Treatment of Milking Center Wastewater

Treating wastewater from milking cows is one of the biggest challenges facing small dairy farms. Often this wastewater enters the environment untreated, resulting in potential health and environmental harm. One environmental complaint can result in dire consequences for the farm.

MSU associate professor of Biosystems and Agricultural Engineering Steven Safferman is examining cost effective technologies to treat wastewater from milking cows. Technologies include constructed vertical wetlands, Michigan Filter Mound, and onsite wastewater treatment technologies.

Safferman plans to develop a standard for farmers, including engineering specifications, for economical, effective wastewater treatment technologies that qualify for USDA Environmental Quality Incentives Program Funding.

This research is funded in part by: the Michigan Milk Producers Association, the Michigan Department of Environmental Quality, the Animal Agricultural Initiative, Clinton Conservation District, and USDA Conservation Innovation Grant.

Biosensors for Early and Rapid Detection/Diagnosis

Professor Evangelyn (Vangie) Alocilja has attracted nearly $5 million in research funding in the past five years to develop and investigate the use nano-sensors in food safety, biosecurity and health issues. Through the Nano-Biosensors Lab housed in the Department of Biosystems and Agricultural Engineering, Alocilja and her team work to save lives by diagnosing infectious diseases early, quickly, simply and inexpensively through point-of-care, field operable nanoparticle-based biosensors.


Alocilja

Current research projects include:

Proof-of-Concept Study For The Development of a Cell-Free GPCR-Based Biosensor For Rapid Non-Specific Detection of Chemical and Biological Toxic Agents

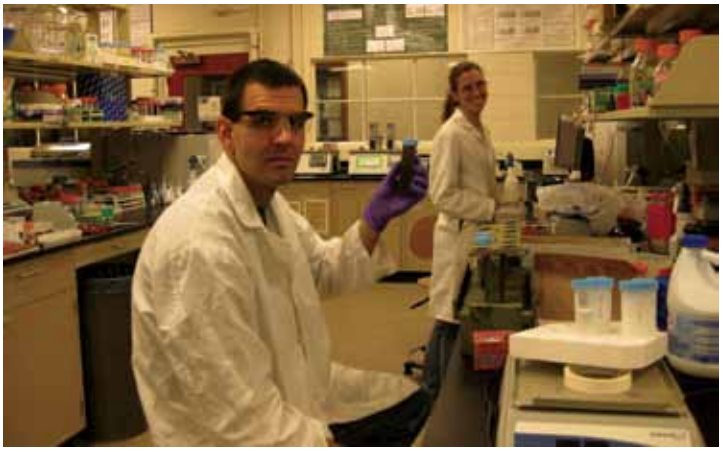
The objective of this project is to evaluate the potential of G-protein coupled receptors (GPCRs) as sensing elements in biosensor devices for rapid non-specific but highly sensitive detection (detect-to-warn) of toxicants in selected complex food matrices. Funding agency: Department of Homeland Security.

RET Site on Bio-Inspired Technology and Systems (BITS)

The RET Site on Bio-Inspired Technology and Systems (BITS) aims to establish a strong partnership between Michigan State University (hosting institution), NSF-supported Engineering Research Center for Wireless Integrated MicroSystems (WIMS) (co-hosting organization), school districts, and industry on advancing pre-college science and engineering education, by training a cadre of leaders of middle and high school teachers in the areas of Science, Technology, Engineering, and Mathematics (STEM). Funding agency: National Science Foundation.

Counterfeiting and Product Protection

The mission of the initiative is to develop the infrastructure and a set of marketable products to establish the Anti-Counterfeiting and Product Protection Program (A-CAPPP). Funding agency: Michigan State University Foundation.



Development of a Multiplex Bio-Barcode DNA Biosensor For Bacillus Anthracis Detection Without PCR Amplification, Phase I And Phase II

The long-term goal of this project is to develop a DNA-based detection device that will not require PCR amplification and still retain the PCR sensitivity. Funding agency: Department of Homeland.

Development Of Biologically Modified Electrically-Active Magnetic Nanoparticles (Nano-Beams) For Direct Capture and Concentration Of B. Anthracis Spores and Cells in Various Food Matrices (including validation)

This project will focus on the synthesis and novel application of biologically modified electrically-active magnetic nanoparticles (nano-BEAMs) for sample acquisition and pre-analytical processing to render representative samples of food products ready for rapid agent detection in multiple detection platforms. Funding agency: Department of Homeland Security.

Rapid and Quantitative Detection of Helicobacter pylori and E. coli O157 in Well Water Using a Nano-wired Biosensor and QPCR

This research will focus on the quantitative determination of the occurrence of key waterborne pathogens, and the development of a protocol for preparing and processing water samples for application of the proposed approach. Funding agency: US Environmental Protection Agency-STAR.

Department of Homeland Security (DHS) Career Development Grant (CDG) - Food Protection and Defense CDG Award.

Objective: To develop and train scientists on homeland security missions. Funding agency: Department of Homeland Security.

Target Characterization of Spectral Response to Antibody Displacement within Distributed Sensors

The objective of this effort is to deliver tactically relevant, distributed sensing data on waterborne pathogens of interest in real time (less than 18-hours) Funding agency: Department of Defense.

Evaluation and Development of Computer Tomography (CT) Imaging Technology For Internal Quality Evaluation of Fresh In-Shell Chestnut

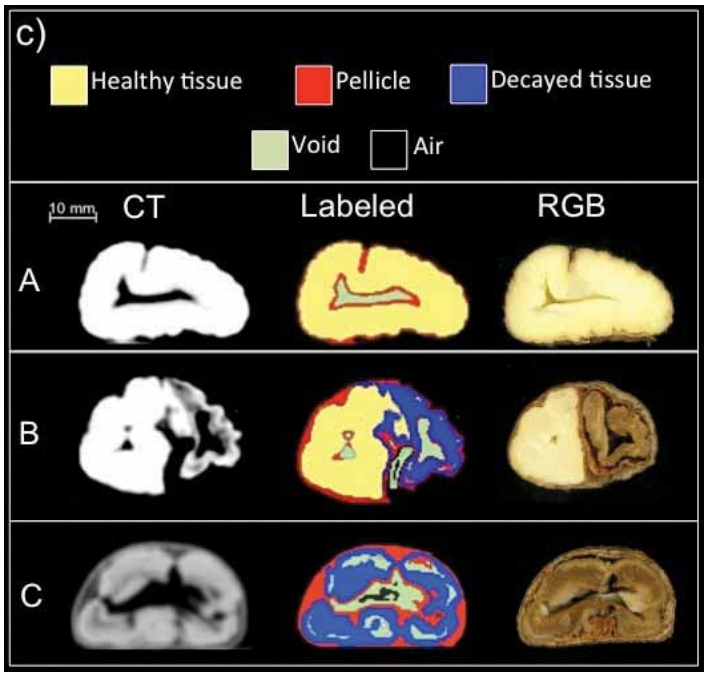

Guyer

Quality, and consistency of fresh fruits, vegetables, and nuts is of utmost importance for producers, packers, and processors, to remain competitive in the global marketplace. Considerable electronic technology exists and is commercially available for sorting fresh commodities. The majority of implemented systems detect surface characteristics, including color and defects. Some advanced technologies are now looking under the skin and into the commodity to detect internal issues and/or quality characteristics such as sugar content. While these most advanced systems are demonstrating success and effectiveness, there still exists a void in evaluating commodities with coverings that can not be penetrated by the light wavelengths common to commercially available systems and/or where more quantitative information may be desired.

The researchers plan to evaluate CT technology for its capability in detection and quantification of varying internal defects in fresh in-shell chestnuts; determine optimal CT-based parameters for the design of optimized dedicated systems for continuous on-line sorting technology; and extend the application beyond chestnuts to additional commodities. The researchers plan to collaborate with commercial CT technology development entities to develop and evaluation dedicated sorting systems.

The short term outcomes of this research will be to determine the potential for CT technology to detect and quantify commodity quality characteristics which are undetectable or measurable by current technology. Such has already been very successfully demonstrated with chestnuts, cucumbers, and cherries. The next outcome will be to determine/produce the CT design parameters for optimizing CT cost against quality detection. The final outcome or goal is to work with current CT development entities and further develop the potential for applying CT to food and agriculture utilizing the latest high-speed and continuous duty CT technology that is looking for such applications. The impact will be the ability to detect and quantify important quality characteristics of multiple commodities which current technology is not capable of accomplishing. Such capabilities will help producers and processors ensure quality and help direct product to the most appropriate and profitable markets.

Funding agencies: Project GREEEN (MSU), Rogers Reserve (MSU) along with collaboration with MSU Small Animal Clinic, and Plant Pathology.



BAE researchers are evaluating CT Technology for detection and quantification of internal defects in fresh in-shell chestnuts.

MSU Trustees Approve Plan for New Source of Energy

Reprinted from the State News

Kirk

Likely not to be hitting the fan — but powering it — a new waste-based energy source is drawing the attention of MSU officials to see if it can prove to be financially viable.

The MSU Board of Trustees has authorized a plan for a new anaerobic digester at the Dairy Cattle Teaching and Research Center on South Campus Farms, next to the current Anaerobic Digestion Research and Education Center.The preliminary cost estimate for the new facility is $3.5 million.

Anaerobic digestion is a process that converts waste products, such as animal manure and cafeteria waste, into renewable energy, said Steve Safferman, director of the Anaerobic Digestion Research and Education Center. Small organisms similar to bacteria break down the waste and turn it into methane gas that can be harnessed for energy — potentially reducing MSU's carbon footprint, he said.

The center currently is testing 100-liter waste systems in small-scale anaerobic digestion research and will have a 250,000 gallon system running by the summer to make sure MSU has accurate data before deciding to go ahead with the project, Safferman said.

Currently, anaerobic digesters tend to pay for themselves in about 10-15 years, Safferman said. The research team is working on ways to reduce that time and make the byproducts of the process more valuable, he said.

"We want to make sure it's a good investment," Safferman said. "(MSU) is not just interested in revenues, but in its carbon footprint."

The digester currently underway at the Dairy Cattle Teaching and Research Center is about 10 percent of the size of the full-scale proposed project, MSU Specialist Dana Kirk said. The team wants to run the facility for six months to a year before making final recommendations to the Board of Trustees.

Fred Poston, vice president for Finance and Operations, said the project would allow the university to reuse or recycle waste that currently is going into landfills or — in the case of manure — being applied to campus fields.

"Should we increase the number of research animals that we have, we would have a problem of getting rid of manure without causing environmental concerns," Poston said at the meeting. "It relieves pressure on those areas."

The new digester also has the potential to bring more outside research dollars to campus, MSU Trustee Brian Breslin said.

Biosystems Engineering senior Jason Smith has been working at the Anaerobic Digestion Research and Education Center for about two years. If the new facility is built, it will give students an opportunity to study what's on the horizon in renewable energy, he said.

Safferman said anaerobic digestion technology has been around for decades. Countries in Europe, such as Germany, use anaerobic digestion much more extensively than the U.S. because they can sell greenhouse gas credits for a substantial amount of money.

"The goal is to have something that solves environmental issues and can get you revenues," he said. "That's a win-win."

MSU Team Nabs First Place For Innovative Microwavable Pie, Ice Cream Combo at National Competition

ANR Communications

While it wasn't quite as easy as pie, a team of Michigan State University (MSU) students ranked first and were awarded $4000 for an innovative microwavable apple pie and ice cream combo at the National Product Development competition at the Institute of Food Technologists' (IFT) 2011 Annual Meeting and Food Expo.
The IFT meeting, held in New Orleans from June 11 to June 14, brings together thousands of food scientists, suppliers and marketers, showcasing innovation and information affecting consumers, growers, processors, regulators and researchers in food supply, management and delivery. It featured 900 exhibitors and more than 1,000 presentations from industry experts and members of academia.

MSU's Department of Food Science and Human Nutrition, in the College of Agriculture and Natural Resources, team of food science undergraduate and graduate students and one biosystems engineer, coached by Janice Harte, earned first place with "Minute Escape," an all-in-one dessert of frozen apple pie and custard ice cream that can be prepared in the microwave in only one minute. The competition was run by the IFT Student Association.

The food and package system was designed to heat the pie and filling while keeping the ice cream frozen, warming it just enough to allow it to soften and be easily removed from its enclosed cup, a technology for which MSU submitted a patent application. The single serving of apple pie had a rich apple cinnamon filling and a crunchy oatmeal streusel in a flaky crust and was joined by the creamy custard ice cream, designed to promote portion control in a delicious indulgence, according to Harte.

And although the end result was a product made for one, Harte, associate professor in the Department of Food Science and Human Nutrition, said the project was a true team effort.

Three students and two professors developed the concept and design. Sensing a quality idea, additional team members were recruited. The team then worked to further improve and develop the product, including processing, developing a food-safety plan, improving shelf life, and maximizing quality for the competition, Harte said.

"As a teacher and mentor, I was very impressed that the students were all able to rise to the top and show leadership," said Harte, who has been a team adviser since the nationwide competition's inception and has previously had first-place finishers in 2007 and 2008.

"Even though we are primarily food scientists, the fact that the students learned and mastered the marketing was very impressive; and they sought advice and learned from faculty, alums, previous MSU competition participants and even packaging graduate students throughout the project."

Of course, in the end all the innovation in the world doesn't matter if it doesn't survive the all-important taste test.

"The product is delicious," Harte said and the judges agreed with that sentiment.

Also competing for the top prize in the Product Development Competition were Cornell University, the Ohio State University, Pennsylvania State University, the University of Massachusetts and the University of Wisconsin.

The MSU team members were Hunter Gartner, whose name is on the patent; team leaders Rebecca Watts and Amanda Kaiser; and Natalie Duchene, Patrick Schafer, Amanda Geaslin, **Juliana Henriques (BE senior)** and Amanda Feighner.

The Institute of Food Technologists is a nonprofit scientific society with more than 18,000 members who are engaged in food science, food technology and related professions in industry, academia and government.

MSU Senior Team Wins First Place in National Competition

Michigan State University's (MSU) wetland team was selected as the first-place recipient for the 2011 Gunlogson Environmental Design Award, sponsored by the American Society of Agricultural and Biological Engineers.

Alyse Egner and Kevin Koryto, both May 2011 graduates, and Hanna Miller, a Dec. 2011 graduate, worked with the Michigan Department of Transportation (MDOT) staff to create an innovative and cost-efficient design for their senior project.

Over the last two centuries, three-quarters of Michigan's wetlands have been destroyed as a result of developing agriculture, industries and communities. MDOT is responsible for replacing or restoring wetlands that are harmed because of road construction. Egner, Koryto and Miller designed a model of a forested wetland for MDOT.

"It was part of our senior design project for biosystems engineering," said Miller. "MDOT needed a wetland to be designed for their mitigation purposes that was innovative and cost efficient. We did a lot of work with MDOT specialists, surveying on site analysis and characterization and took information to come up with a design that would minimize cost."

The group created a hydrologic modeling tool based on their design, which allows for site-specific design of forested wetlands. This proposed a two-cell design to reduce construction cost and the risk of failure. The last phase of design consisted of site selection, evaluation and development plans that included cross-sectional and plan views, an ecological establishment plan and an economic analysis.

Senior Design Team (l-r) Hanna Miller, Kevin Koryto and Alyse Egner.

Miller said classes at MSU helped prepare the group by teaching about the design process – going about taking information gathered on sites and the different parameters of weather and soil, and evaluating what exactly is needed in the end.

Faculty adviser Dr. Dawn Reinhold, assistant professor and AgBioResearch scientist; design instructors Dr. Steve Safferman, associate professor, AgBioResearch scientist and Extension specialist, and Steve Miller, Extension specialist; MDOT engineer Michael Pennington and industry advisers Michelle Crook and David Hamilton advised the group.

Graduate Awards

Outstanding BE Research Fellowship & Fitch H. Beach (3rd Place) Award
Edith Torres-Chavolla

Most Outstanding BE Graduate Student Fellowship & College of Engineering Most Outstanding BE Graduate Student
Sean Woznicki

Merle & Catherine Esmay Scholarship
Jade Wu-Haan

Bill & Rita Stout Scholarship
Ibrahim Greiby

Galen & Ann Brown Scholarship
Mark DeKleine
Irwin Donis-Gonzalez
Ahmed Rady

Senior Design Showcase

Bio-Fuel Source Optimization through Torrefaction

Team members: (Pictured l-r) Spencer Beatty, (Harbor Springs, MI) Ryan Black, (Battle Creek, MI), Ryan Rochelle, (Brighton, MI), Jason Smith, Pigeon, MI

Sponsor/Mentor: Chris Saffron, BAE

Academic Advisors: Christopher Saffron, MSU BAE

Michigan legislation calls for displacement of coal in power plants, requiring a percentage of energy be produced from renewable sources. Burning biomass is an option; however, biomass has a lower energy value than coal.

Torrefaction is a biomass pretreatment process which leaves 90% of the energy in 70% of the original mass. Additionally, producing torrefied biomass close to the point of collection concentrates the energy reducing shipping costs per unit amount of energy produced.

There is a lack of experimental systems to test the torrefaction of biomass feedstocks. The project objectives were to design, fabricate, and test a pilot-scale torrefaction reactor. A protocol to test and compare the energy content of the torrefied biomass, raw biomass, and coal using a streamlined life cycle analysis also was developed.

A screw conveyor reactor was selected. Biomass is introduced to the system through a feed hopper and then proceeds through the reactor where torrefaction occurs. Torrefied biomass falls into a collection tank where it is allowed to cool. Thermocouples are used to monitor temperature at various points within the system.

Urban Aquaculture Modeling and Feasibility

Team Members: (Pictured l-r) Qudus Ahmed, (Lansing, MI) Michael Holly, (St Clair Shores, MI), Blake Lougheed, (Rockford, MI) Andy Tran, (South Lyon, MI)

Sponsor/Mentor: Pingree Farms, Urban Ag. Initiatives of Detroit, Aquaculture Research Corp.

Academic Advisors: Yan "Susie" Liu, MSU BAE

Urban aquaculture can provide fresh seafood and jobs to local residents while showcasing the benefits of biologically sustainable solutions. The objective of this project was to develop a generic model that simulates an aquaculture system's design requirements. Capital and operational costs were estimated to determine the feasibility of an aquaculture farm. The team then performed a case study on a facility in Detroit to determine the validity of the model.

A computer model was developed using Microsoft Excel. The model is based on species commonly used for fish farming including trout, catfish, yellow perch, and tilapia. By incorporating species specific information and allowing users to modify system parameters, accurate results are obtained. Specifications for a facility's main components are determined including tank size, filtration rate, oxygen addition, water disinfection, and solids removal. Costs are estimated using up to date prices from manufacturers.

The model was tested to determine accuracy and ease of use for a site-specific case study. Results showed that the model is a useful tool for estimating the primary costs associated with developing a fish farm. A sensitivity analysis revealed that feed, fingerling, and energy prices have the greatest effect on cost.

Wastewater Treatment System Upgrade for a Small Cheese Producer

Team Members: (Pictured l-r) Megan Buhl, (West Bloomfield, MI) Shannon Henderson, (Harrison Twp., MI), Stepfanie Shaulis, (Engadine, MI)

Academic Advisors: Larry Stephens, Stephens Consulting

A small-scale cheese producer who uses milk from local Amish dairies plans to expand production and thus produce a greater amount of wastewater. To be proactive in accommodating the increase in wastewater, the company desires a new treatment system. Of great importance to the owner is to respect the Amish way of life and to maintain a less automated, more manual treatment system.

Wastewater can pose serious human health risks and contribute to environmental degradation. Effluent from food processors typically have a high organic content, as indicated by biological oxygen demand (BOD).

Based on factors such as cost, treatment effectiveness, maintenance, energy requirements, and land use, a lagoon with an open sand bed gallery was selected as the treatment system. A lagoon is a shallow constructed pond that treats waste by sedimentation and bacterial activity. An open sand bed gallery contains small particles with high surface area in contact with the wastewater where a biofilm is cultivated. To design the system, several techniques were used, including a topographical survey, soil testing, wastewater characterization, and mathematical models. The completed design will be approved by Larry Stephens, a professional engineer, and then constructed on site.Statistical testing of the pathogen reduction inside the filling chamber will be completed on site. Standard operating procedures will be established to assist operators in using the aseptic filler properly. Documentation of the project is recorded to help Nestle operate and maintain the aseptic filling chamber.

Best Management Practice Recommendation for Escherichia coli in the Red Cedar Watershed

Team members: (Pictured l-r) Jennifer Jury, (St. Johns, MI), Cody Kurzer, (Sebewaing, MI), Catherine Dudgeon, (Rochester Hills, MI)

Sponsor/Mentors: Jim Wilson, Ingham County Health Department

Academic Advisor: Pouyan Nejadhashemi, MSU BAE

Parts of the Red Cedar River do not meet water quality standards because of impairment with E. coli. The Ingham County Health Department requested a strategic plan that will restore the Red Cedar River to regulatory limits. This project determined point and non-point sources of excessive E. coli and developed a plan that will ultimately improve water quality.

Determining the cause of pollution in the Red Cedar requires accounting for sources in the entire Red Cedar watershed. The project used statistical analysis and watershed models to determine which areas likely contributed to high E. coli levels. This technique simulates hydrological processes and tracks the transport and die-off of bacteria throughout the watershed.

Best management practices, such as riparian buffers and rain gardens, are used to mitigate bacterial pollution before it reaches the river. These devices were entered into the watershed models to predict improvements to river water quality.

Senior Design Showcase

Escherichia coli Source Identification and Detection in Recreational Waters

Team: (Pictured l-r) Drew Coatney, (Clarkston, MI), Asmaa Abdel-Azim, (Niskayuna, NY), Bridget Bednark, (Onaway, MI)

Sponsor/Mentors: Jim Wilson, Ingham County Health Department

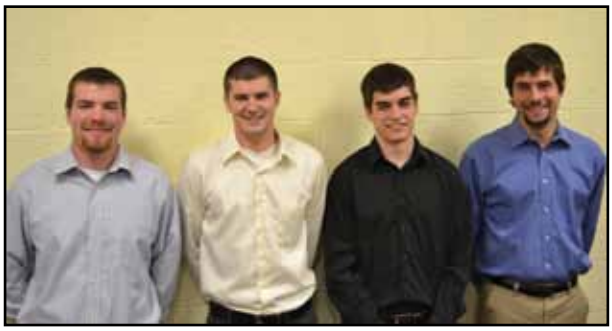
Academic Advisor: Evangelyn Alocilja, MSU BAE

Escherichia coli (E. coli) is a bacteria used to indicate the presence of fecal matter. Using the standard detection protocol, Ingham County Health Department reports that E. coli levels have exceeded the current Michigan Department of Environmental Quality safety limits of 300 colony forming units per 100 mL of sample within sections of the Red Cedar River.

The objective of this project is to develop a low cost protocol that can be used to find the likely sources of E. coli impairment so that preventative techniques (best management practices) can be instituted. Identifying the source of the impairment will require that a substantial number of samples be collected and analyzed but the standard, regulatory method is expensive and requires substantial resources, limiting the number of samples that can be collected and analyzed. With the data from the simplified method, a statistical analyses can be conducted to determine likely locations of the impairment.

Consequently, this project entailed developing a protocol with the following three components: 1) water filtration to remove debris and concentrate bacteria, 2) E. coli detection using an antibody-based biosensor, and 3) statistical analysis of the data to determine impacted regions of the Red Cedar River.

Sustainable Heat Systems: Investigating the Feasibility of Corn Drying using Biomass Combustion



Team: (Pictured l-r) Sam Prentice, (Novi, MI), Shaun Madsen, (Oxford, MI), Kyle Fischer, (Grosse Ile, MI), Nick Steo, (Rochester, NY)

Sponsor/Mentors: Larry Klope, Bioenergy Alternatives

Academic Advisor: Ajit Srivastava, MSU BAE; Phil Hill, MSU BAE

On-farm corn drying in the Midwest is primarily accomplished using propane as a heating fuel. The main objective of this project is implementing a biomass combustor to work in conjunction with a small-scale propane drying system (less than 60,000 bushels per season).

The project design is divided into four components: 1) biomass combustion, 2) heat transfer, 3) grain drying, and 4) emission filtration. Heat leaves the combustor at an average temperature of 1400°F and enters an indirect contact heat exchanger. Clean air warmed to a fixed grain drying temperature enters the dryer. After heat transfer is achieved through a heat exchanger, combustion gases pass through a cyclone separator system to remove particulate.

Economic analysis revealed a substantial capital investment and extended payback period for the duel fuel system. Corn is dried for 3-4 weeks after fall harvest and the drying season cannot be increased without causing a substantial decrease in the quality of the corn. However, two possible ways to reduce the payback period are: investigating off-season uses for the combustor and qualifying for government incentive programs. As propane prices increase this project becomes more attractive.

Developing Process Alternatives to Produce Consistent Meatless Burgers across Multiple Production Lines

Team: (Pictured l-r) Drew Selden, (DeWitt, MI), Ellen Bornhorst, (Houghton, MI), Cassie Giacobassi, (Litchfield, MI), James MacLellan, (Walled Lake, MI)

Sponsor/Mentors: Major Food Processor - Due to the proprietary nature of this industry the actual company and product names will remain anonymous.

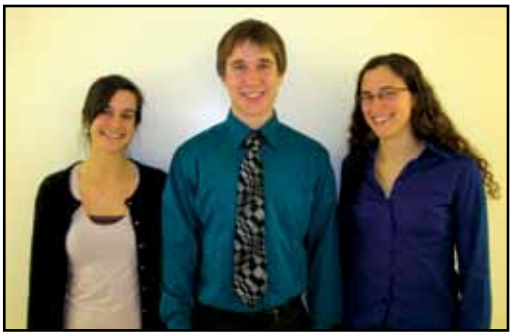
Academic Advisor: James Steffe, MSU BAE

According to a North American Consumer Goods Company, alternatives to meat products such as meatless, soy-based, burgers are gaining popularity. Currently, our sponsor's company utilizes a co-manufacturer for the production of meatless burgers on two processing lines. Line 2 produces burger batter with an acceptable quality while line 1 does not pass quality control standards for regularity. To utilize line 1, additional ingredients are required to give the wet batter a consistency comparable to the acceptable batter, resulting in $80,000 of additional costs each year. An alternative solution to achieve acceptable, consistent products from both lines utilizing the originally specified formulation is desirable. The objectives of this project were to characterize both production lines, identify potential causes for differences in product characteristics, and recommend process line modifications to enable the company to utilize the original meatless burger formula on both lines.

In order to accomplish these goals, the team visited the manufacturing plant to characterize both production lines. Pilot-scale mixing experiments were then performed at Michigan State University to determine the relationship between processing parameters and burger batter moisture content, water activity, and texture.

After determining relationships between processing parameters and batter characteristics, recommendations were proposed to improve the consistency of meatless burgers produced on line 1. A trial was conducted at the manufacturing plant to test the recommendations to produce meatless burgers that meet quality control standards.

Site Evaluation and Design Plan for a Created Forested Wetland



Team: (Pictured l-r) Alyse Egner, (Burton, MI), Kevin Koryto, (East Lansing, MI), Hanna Miller, (Midland, MI)

Sponsor/Mentors: Michael Pennington, Michigan Department of Transportation

Academic Advisor: Dawn Reinhold, MSU BAE

The Michigan Department of Transportation (MDOT) is deficit for wetland mitigation credits in the Maple River Watershed due to construction of the St. Johns Bypass on US 127. MDOT requested design plans for the creation of a forested wetland that is cost effective, innovative, and fits within the landscape.

Through ArcGIS mapping and field surveys, the construction site was characterized to determine hydrology, topography, and soil classification. In order to determine the hydrologic regime of the system a water balance Microsoft Excel model was developed to predict inundation period and daily water height. Site design was optimized to minimize excavation, maintain wildlife usage, and ensure vegetative establishment.

Results of the water balance indicate sufficient water for a forested wetland ecosystem. Stop-log control structures and an earthen berm constructed from on-site soil are utilized to facilitate the necessity for precise water depths. The design includes small areas of emergent and scrub-shrub wetland to promote ecological diversity.

AutoCAD design drawings depict plan, cross-sectional, and structural component views. Specifications are provided for construction of the site with details on required grading, vegetation planting, wildlife structures, and long-term monitoring.

New Partnership Between University of Costa Rica and MSU Formed

Ashley Thode, BE Graduate Student

Abundant plants, animals and climates compose Costa Rica—a nation with a welcoming and relaxed culture, but focused on technological improvement and environmental sustainability. In May, seven professors and one graduate student from the BAE department traveled to Costa Rica and visited the University of Costa Rica (UCR) and several research sites, experiencing the warm culture, while not taking too much time to relax.

The productive trip culminated in a new partnership between UCR and MSU focused on research, study abroad and collaboration. Students and professors in the Biosystems and Agricultural Engineering department at Michigan State will soon have the opportunity to increase their global engineering knowledge and experience. This partnership will add another option for students to engage in international activities during their time at MSU, complementing the existing program in Australia and partnership with China.

The seven professors, including Department Chair Ajit Srivastava, represented the diverse research areas and approaches that comprise the BAE department. The trip was a follow up visit, after Dr. Srivastava's trip in the fall promoting the benefits of transitioning from agricultural engineering to biosystems engineering. During the five months between the visits the UCR Department of Agricultural Engineering decided to officially change its name to the Department of Agricultural and Biosystems Engineering.

The group arrived in the capital city, San Jose, which is also the location of UCR's largest campus. The first three days were spent meeting with Ana Sittenfeld, the Provost in charge of research, the Department of Agronomy faculty and chair, and the Department of Agricultural and Biosystems Engineering faculty and chair.

Each of the professors presented on their research areas and the classes that they teach. The UCR professors made similar presentations, focused primarily on classes. The presentations exposed that little research focused on engineering is currently being conducted at UCR. Day one was devoted to introductions, Costa Rican culture, economics and education, and ecosystems engineering. Day two covered bioenergy and post harvest engineering. The morning of the third day focused on precision agriculture and information technology. The second half of the third day the group travelled to Earth University. The university is one of the premier undergraduate institutions in Central America. It focuses on sustainability and a liberal arts education. The campus features several green technologies,

BAE faculty and graduate student with Mr. Jose Francisco Aquilar, Director Ingenieria, Agricola, UCR (far right)

including an anaerobic digester. The first half of the trip provided the BAE faculty and student insight into education and research in Costa Rica, while highlighting potential areas of research.

A highlight of the one week stay were the field trips to various research sites and farms in Costa Rica taken during the second half of the trip. The group divided with one going to a hydroelectric site, small-scale biodigestor, and community tree nursery. Visiting with farmers and practicing engineers showed potential research areas and actual practices. Along major highways, the mountainous terrain is farmed along steep slopes with no support for the soil. The other group visited a research farm focused on fruit and vegetable production. The groups reconvened to discuss the sites seen and new ideas for the partnership.

The next day a large hydroelectric dam controlled by ICE (the Costa Rican energy company) was visited. Costa Rica has committed to become one of the first carbon neutral nations in 2021. However, additional knowledge and research are needed to meet the growing nation's energy needs sustainably. A wind farm, also operated by ICE, was visited in the afternoon. The final field trip was to a dam and UCR extension site. UCR, like MSU, operates many agricultural extension sites. The group was able to visit one location and speak with staff there. The importance of connecting research, classroom and applied field sites has already been recognized by the ABE department.

Having similar philosophies has enabled the partnership to develop naturally and quickly. Traveling to the vari-

Continued on page 21

Anaerobic Digestion in Ghana

In May, Dana Kirk traveled to Ghana to evaluate the potential application of anaerobic digestion technology to address sanitation and energy needs. The trip, arranged by Judy Gardi of the Lansing Regional Sister Cities Commission, involved site visits to several sanitation facilities and local food processors near Nsawam in the Akuapem South municipality as well as meetings with the Environmental Protection Agency, the Department of Agriculture and local government officials to discuss the prospect of creating an anaerobic digestion project.

Since 2000, the Akuapem South municipality population has grown by 40%. Currently, less than 30% of the population has access to a pit latrine and the number of latrines has not increased in the last 10 years. The Akuapem South sanitation engineer estimates there are more than 300,000 gallons of sewage annually in Nsawam. In addition, the municipality provides 65% of all the fruit that is exported from Ghana and within the vicinity of Nsawam there are 24 fruit processors generating more than 15,000 tonnes of organic waste. Similar to the sanitation and environmental concerns, the power supply in Ghana is tenuous at best. During the visit, power outages were a daily occurrence. Blue Skies, the largest fruit processor in Africa documented over 90 power outages during the first quarter of 2011.

Currently, with assistance from the Lansing Regional Sister Cities Commission and Blue Skies, a team of local engineers including Ted Loudon, Larry Stephens, Kurt Guter and Dana Kirk are evaluating a treatment system intended to treat septage and fruit waste. The proposed system would utilize anaerobic digestion, dry beds and treatment lagoons to stabilize and create value added products from approximately 15,000 gallons per day of human and fruit waste. The feasibility study should be completed this fall.

New Partnership between University of Costa Rica and MSU Formed (continued)

ous sites showed the MSU group the diverse ecosystems throughout the nation.

The one week concluded with an opportunity to enjoy the rainforest and abundant undeveloped nature, allowing for hikes, horseback riding, waterfall viewing, zip-lining and swimming. The faculty and student took time to relax and reflect on the trip, while enjoying the great tourism industry the nation offers.

The trip revealed that Costa Rica would provide an incredible research site for ecosystems, bioenergy and food engineering research. The newly gained knowledge could be directly reapplied to the large agricultural and growing technology fields. Costa Rica has the technology necessary to conduct the research, but has spent little time focused on research. The partnership is quickly developing with the first Costa Rican students traveling here this fall to complete a three month internship. Research proposals are already being developed and study abroad opportunities coordinated! Pura vida!

Costa Rican Students Maria Melissa Rojas Downing and Georgina Sanchez Salas.

Alumni Awards

BAE 2011 Distinguished Alumni Award
Dirk E. Maier

Dirk E. Maier is Professor and Head of the Department of Grain Science and Industry at Kansas State University where he is responsible for leading the department's teaching, research and outreach programs. He serves as the Director of K-State's International Grains Program which aims to educate foreign business leaders, industry professionals and government officials about U.S. grains and oilseeds through technical training and assistance programs in storage, handling, milling, marketing and processing. He also serves as the Director of the GEAPS-KSU Grain and Biorefinery Operations Distance Education Program which provides continuing education to grain industry professionals around the world. Dr. Maier is a registered professional engineer, and a member and officer of several academic, professional and scholarly societies. He has served on two EPA FIFRA Scientific Advisory Panels related to the assessment of genetically modified grains.

Prior to joining Kansas State University, he was Professor, Associate Head and Extension Agricultural Engineer at Purdue University (1991-2008), where he was the co-founder of the Purdue Grain Quality Team, key initiator and director of the Purdue Post-Harvest Education and Research Center, and director of the Purdue Grain Quality Laboratory. He received his B.S., M.S. and Ph.D. degrees in agricultural engineering from Michigan State University.

MSU College of Engineering BAE 2011 Distinguished Alumni Award
Eugene Ford

Eugene Ford is vice president of global technology management, R&D at Nestle Nutrition in Fremont, Mich. He has more than 25 years of experience in domestic and international product development, manufacturing, logistics, and sales within the consumer food industry. In addition to earning his BS ('83) and MS ('84) in agricultural engineering from MSU, Gene received an executive master of science in engineering degree in 1992 from the University of Pennsylvania.

After 22 years with the Campbell Soup Company, he went on to become director of product development for Ocean Spray Cranberries, Inc. In 2008 he moved into his current position with Nestle. In addition to product development and manufacturing support for Infant Nutrition, Meals and Drinks, his duties include capital plan development and management for the site, strategic direction of a 35,000 square-foot pilot plant, seamless commercialization of technology including developing and conducting training and intellectual property management. He also championed and launced an internship program in the department, working with key universities. Gene states that he has always enjoyed mentoring people and "making them shine."

He is currently a member of the Institute of Food Technologists. Gene and his wife, Debby, live in Grand Rapids.

BAE 2011 Outstanding Alumni Award
Paul E. Forton

Paul Forton graduated from MSU in December 2004 with a B.S. degree in Biosystems Engineering. During his time at MSU, he worked as a student assistant in the Fruit Pathology Department, a research assistant for Drs. Harrigan and Northcott, and was Assistant Site Manager for Ag Expo as well as a Teaching Fellow with Dr. Marks. In the fall of his junior year, Paul began working part-time at Spicer Group as a co-op in the drafting area for their St. Johns office.

Upon graduation, Paul was offered a full-time position at Spicer Group as a Design Engineer in the Water Resources area. He has since been promoted to Project Manager and oversees a variety of projects from conception to implementation. During his time at Spicer Group, he has utilized his watershed management skills on projects involving pond and wetland design, stream restorations, agricultural conservation practices, floodplain management, storm sewer system design, and soil erosion and sedimentation control projects. His experiences include managing a broad range of projects from designing small private ponds to serving as the construction administrator for an $18 million watershed restoration project. Over the course of his career, he has formed lasting relationships with both private and municipal clients across the state of Michigan completing work in over 55 townships in 22 different counties.

Paul received his Professional Engineer License and is also a Certified Professional in Erosion and Sediment Control.

CANR 2011 Outstanding Young Alumnus Award Tom Hefferan

Hefferan graduated from MSU in 2004 with a Bachelor of Science degree in biosystems engineering with an emphasis on food engineering. Hefferan's expertise in "Clean-in-Place" (CIP) technology for food processing systems helped him earn his current role in charge of all of Eli Lilly's CIP systems in the Puerto Rican production facilities. At Eli Lilly, Hefferan has been responsible for all technical aspects of nine fully automated recirculation CIP systems, supporting the fermentation/primary recovery and purification facilities.

At Eli Lilly he has led two Six Sigma projects, or data-driven strategies for eliminating defects from a process, at a certification level of "Green Belt" and brought about $1.5 million in annual savings. Both projects earned Lilly Six Sigma Project of the Year nominations. He led the mechanical and operational validation of facility CIP systems and was responsible for an optimization of CIP operations that resulted in a reduction of reliability issue-caused downtime by more than 50 percent.

Alumni Gold Breakfast

Members of the Alumni Gold Club met in June to celebrate 50 years or more of being a "Spartan." Those attending this year's breakfast were: BAE Chair Ajit Srivastava, John Koepele, (MSU 1959), Will Bergdolt (MSU 1961), and John Boldt (MSU 1961).

Pictured (l-r) John ('59) & Frances Koepele; Wil ('61) & Joan Bergdolt; John ('61) & Judy Boldt.

Passing....

Ernie Kidder

American Society of Agricultural and Biological Engineering (ASABE) Fellow Ernest Kidder (98) passed away February 23, 2011, in Petoskey, Michigan. At the time of his death, he was the ASABE member with the most years of membership at 75. He served in the Navy during World War II as a meteorologist and returned to his duties with the Soil Conservation Service in 1946. In September 1949, he accepted the appointment of associate professor of Agricultural Engineering at Michigan State University and served there until he retired as professor emeritus in 1979.

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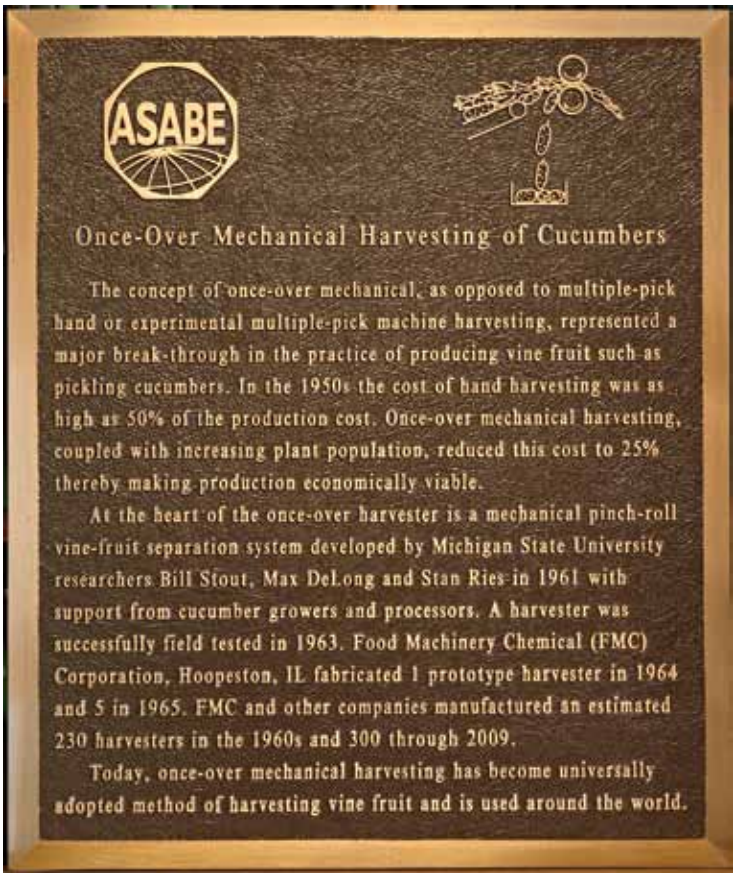
Cucumber Harvester Inventors Recognized for Innovation

It might surprise people to know that Michigan State University (MSU) played a role in getting those pickles into the jars in their refrigerators.

In the 1950s, the expense of hand-harvesting cucumbers was as much as 50 percent of the production cost. When the H.J. Heinz Company asked if MSU could come up with a solution, it was clear they were up to the challenge.

MSU scientists shunned the conventional methods of the '50s, which had focused on trying to develop a multi-pick machine. They wanted to develop a once-over cucumber harvester.



"Everybody laughed at us, but we convinced ourselves that the once-over cucumber picker could work," said Bill Stout, who at the time was an MSU professor in the Department of Biosystems and Agricultural Engineering.

Stout worked with then-graduate student and now professor Max DeLong and Stan Ries, professor in the Department of Horticulture, on a solution that would change not only the way cucumbers were harvested, but grown as well.

Ries thought that planting more cucumber plants per acre would help the harvester work more efficiently. "That was a radical thought, but we changed the way that cucumbers are grown and harvested," Stout said.

It was truly a landmark in American agriculture, said Ajit Srivastava, chairperson of the Department of Biosystems and Agricultural Engineering.

"The partnership between industry and academia in the 1960s resulted in the invention of a once-over cucumber harvester, now the predominant machine used in harvesting for pickle production," he said. "And, today, we enjoy the same types of partnerships with industry."

The American Society of Agricultural and Biological Engineers (ASABE) recognized the trio with a commemorative plaque. The plaque was unveiled on Thursday, April 21, in the second floor lobby of Farrall Hall at MSU.

"It is basically a testimonial that we are serving the land-grant mission of the university … that is taking the research and applying to the benefit of society," said Srivastava. The collaboration between companies and the college is thriving still today, he said.

Biosystems Engineering seniors complete capstone design projects putting problem-solving skills to the test of a real industry problem. An industry advisory board keeps the Department of Biosystems and Agricultural Engineering abreast of the latest industry's needs, and robust alumni relations keep the progress going.

"We look forward to the day, in another 50 years, when we are recognizing our current students following in the footsteps of Drs. Stout, Ries and DeLong," Srivastava said.

Biological Engineers (ASABE)

BAE Alumni and friends gather for the ASABE dedication in April. Pictured above: Bill Stout (orange sweater) visiting with Max Delong and his wife Marilyn. Top right: Bill Stout with the commerative plaque. Bottom right: Bill Stout and Stan Ries (in hat).

Urban Agriculture Summit

On October 28, 2010, the Michigan section of the American Society of Agricultural and Biological Engineers (ASABE) co-sponsored an Urban Agriculture Summit in Novi, Michigan with the Engineering Society of Detroit (ESD). The one-day summit, with 150 attendees focused on zoning and land use issues, farming concepts, agricultural farming systems including mechanization versus hands-on labor, environmental concerns, and financing opportunities, including how to start an urban farm. Dan Carmody, President of the Eastern Market Corporation, served as the keynote speaker and opened the summit with a discussion of a Healthy Metropolitan Food Hub supported by locally grown, urban food. Following the Summit, the Michigan ASABE section held its annual fall meeting. Tim Krause presided over the meeting attended by approximately 30 members.

Dana Kirk, MI ASABE Chair Elect (Left) and Darrin Drollinger ASABE Executive Director (Right) addressing the audience at the Urban Agricultural Summit. Photographs provided courtesy of the Engineering Society of Detroit.

Clean Water for the World: Aqua Clara International

Excerpts from the AquaClara website

Aqua Clara International (ACI) offers a robust mix of technology for simple, effective solutions. Their team of engineers has developed a variety of technology based solutions to worldwide water issues that are appropriate to a wide range of local contexts and needs. Their flagship product is the Aqua Clara Water Purifier, which produces safe, affordable drinking water for families worldwide. The principal ACI-supported sites for this purifier are located in Kenya and Nicaragua, while ACI also partners with many organizations to construct and install the purifiers in other countries.

In addition, ACI offers a wide range of solutions to address other water issues, whether they are found in surface water or well water, or are the result of special contaminants, such as arsenic and fluoride. By providing a source of clean, safe drinking water to those in need, they can prevent waterborne disease and circumvent the need to treat it. For those without access to doctors and antibiotics, this prevention is literally life saving.

The home base of ACI is located in the Michigan State University Bioeconomy Institute in Holland, Michigan. They are hosted by **Dr. Ted Loudon, Emeritus Professor of in the MSU Department of Biosystems and Agricultural Engineering.** Ted is actively engaged in Aqua Clara initiatives, particularly in Kenya, and is a valued member of our Science and Technology Council. Their space in this facility enables them to enjoy ongoing collaborative relationships with MSU research administrators and faculty.

Aqua Clara's basic research into new and inexpensive clean water technologies takes place here. Once initial testings are completed satisfactorily, they move new technologies to beta sites in the field, either in this country, or in countries where we have other installations. Final testing at our beta sites readies the technology for general use.

ACI exists to provide technologies for cleaning water that can be used by individuals and families who subsist on less than $2 per day. Their technologies require no electricity and have no moving parts and are constructed principally of local materials to keep costs low; are produced by local crafts people and/or local manufacturing units to create local jobs and businesses; and provide a value added component that distinguishes ACI's technologies.

There are generally two types of water available to individuals and families in developing countries: water that is brought to the home from streams, ponds, rivers, wells, or other similar surface water sources, or water that is processed by a municipal water system. Both types of water are generally contaminated and not suitable for human consumption without causing disease or sickness. Each type requires a specific technological intervention to ensure clean water is available.

There have been a wide variety of organizations working on clean water programs for some time now. Recently it has been noticed that one of the often overlooked elements was sustainability. That is, how long does a project continue to produce the desired result after outside input (financial or otherwise) moves on? Can a product be repaired by local craftspeople? Can it be constructed from local materials? Is it affordable? What are its upkeep costs? Does it need frequent maintenance? Does it require regular electricity or fuel?

ACI Technology was developed with these specific questions in mind. Likewise, they focus on training rather than on simply installing water purifiers because such a focus transfers know-how, thereby allowing for continued production and maintenance of ACI technologies once our resources refocus elsewhere. Their focus is on transferring technological know-how as rapidly as possible, as intelligently as needed, and in establishing an internally consistent, comprehensive data monitoring and evaluation system.

Different types of locally owned enterprises are supported. Some are for-profit businesses run by individuals. Others may be community run or administered by a local non-profit organization. Regardless, their main focus remains on empowering locals to work towards their community benefit in a sustainable fashion. We term these independently owned and operated enterprises into ACI Affiliate, whether for-profit or not.

To learn more about ACI visit their website at www.aquaclara.org.

Gift and Order Form

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