May/June 2014

RESOURCE

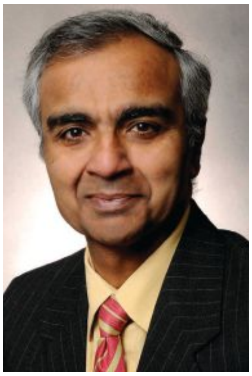
engineering and technology for a sustainable world

GIVING BACK

MAKING A DIFFERENCE

PUBLISHED BY AMERICAN SOCIETY OF AGRICULTURAL AND BIOLOGICAL ENGINEERS ASABE

The Future of Ag and Bio Engineering



The membership has spoken: The proposed reconfiguration of ASABE's technical divisions was approved by 88% of the voting members in the recent election. The Board of Trustees will now pursue this reconfiguration, along with development and execution of a strategic marketing plan. Communicating what ASABE offers will help us increase our membership and promote the value that we offer to the larger world. Watch for more developments on this effort in the coming months.

With the membership in mind, the MVP (Membership Value is Priority) agenda of my term is now being pursued through five task groups: the Agricultural and Biological Engineering P.E. Exam (led by Jay Harmon), Biological Engineering (led by Mark Riley), Global Challenges (led by Ajit Srivastava), Marketing ASABE (led by Leon Schumacher), and Students to Professionals (led by Naomi Bernstein). Each of these task groups is off to a good start and making progress.

We are also pursuing strategic partnerships with allied organizations. Serving as your president has allowed me to represent ASABE to our counterparts in Japan, Korea, China, and India. Professional organizations in these countries have a great desire to work more closely with ASABE. In February, we participated in the first-ever Global Forum for Innovations in Agriculture (GFIA) sponsored by the Abu Dhabi Food Control Authority (see Joel Cuello's article in this issue), which highlighted the grand challenges that we face in achieving sustainable food, water, and energy. Our profession is critically important to addressing these challenges.

That said, though, our profession is not yet achieving its potential, as measured by membership growth in our Society. We are working on this, and we will continue to work on it. There is also a need to address the role and scope of advocacy in ASABE, and the Board of Trustees will explore these topics in its next meeting at ASABE Headquarters. Our goal remains to provide compelling value to prospective members, so that they will join with us, their fellow ag and bio engineering professionals, to help the people of the world by addressing the grand challenges that we face. These challenges are very real, but I remain optimistic that the future will be a better place, both for ASABE and for the world.

Lalit R. Verma, P.E.
lverma@uark.edu

events calendar

ASABE CONFERENCES AND INTERNATIONAL MEETINGS

To receive more information about ASABE conferences and meetings, call ASABE at (800) 371-2723 or e-mail mtgs@asabe.org.

2014

July 12-13	**2014 Applications of Computer Image Analysis and Spectroscopy in Agriculture**. Montreal, Québec, Canada.
July 13-16	**ASABE and CSBE/SCGAB Annual International Meeting.** Montreal, Québec, Canada.

2015

July 26-29	**ASABE Annual International Meeting.** New Orleans, Louisiana, USA.

2016

July 17-20	**ASABE Annual International Meeting.** Orlando, Florida, USA.

ASABE ENDORSED EVENTS

2014

May 19-24	**DSSAT 2014.** Griffin Campus of The University of Georgia, Griffin, USA.
July 16-18	**4th International Symposium on Soil Water Measurement, Using Capacitance, Impedance, and Time Domain Transmission.** Macdonald Campus of McGill University, Ste-Anne-de-Bellevue, Québec, Canada.
Sept. 16-1	**CIGR 2014.** Beijing, China.
Nov. 1-7	**2014 21st Century Watershed Technology Conference and Workshop.** University of Waikato, Hamilton, New Zealand.

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Magazine Staff: Donna Hull, Publisher, hull@asabe.org; Sue Mitrovich, Managing Editor, mitro@asabe.org; Glenn Laing, Technical Editor, laing@asabe.org; Melissa Miller, Professional Opportunities and Production Editor, miller@asabe.org; Sandy Rutter, Professional Listings, rutter@asabe.org; Darrin Drollinger, ASABE Executive Director, drollinger@asabe.org.

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American Society of Agricultural and Biological Engineers
2950 Niles Road
St. Joseph, MI 49085-9659, USA
269.429.0300, fax 269.429.3852
hq@asabe.org, www.asabe.org

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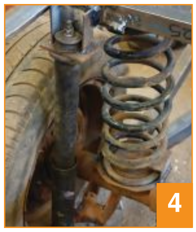
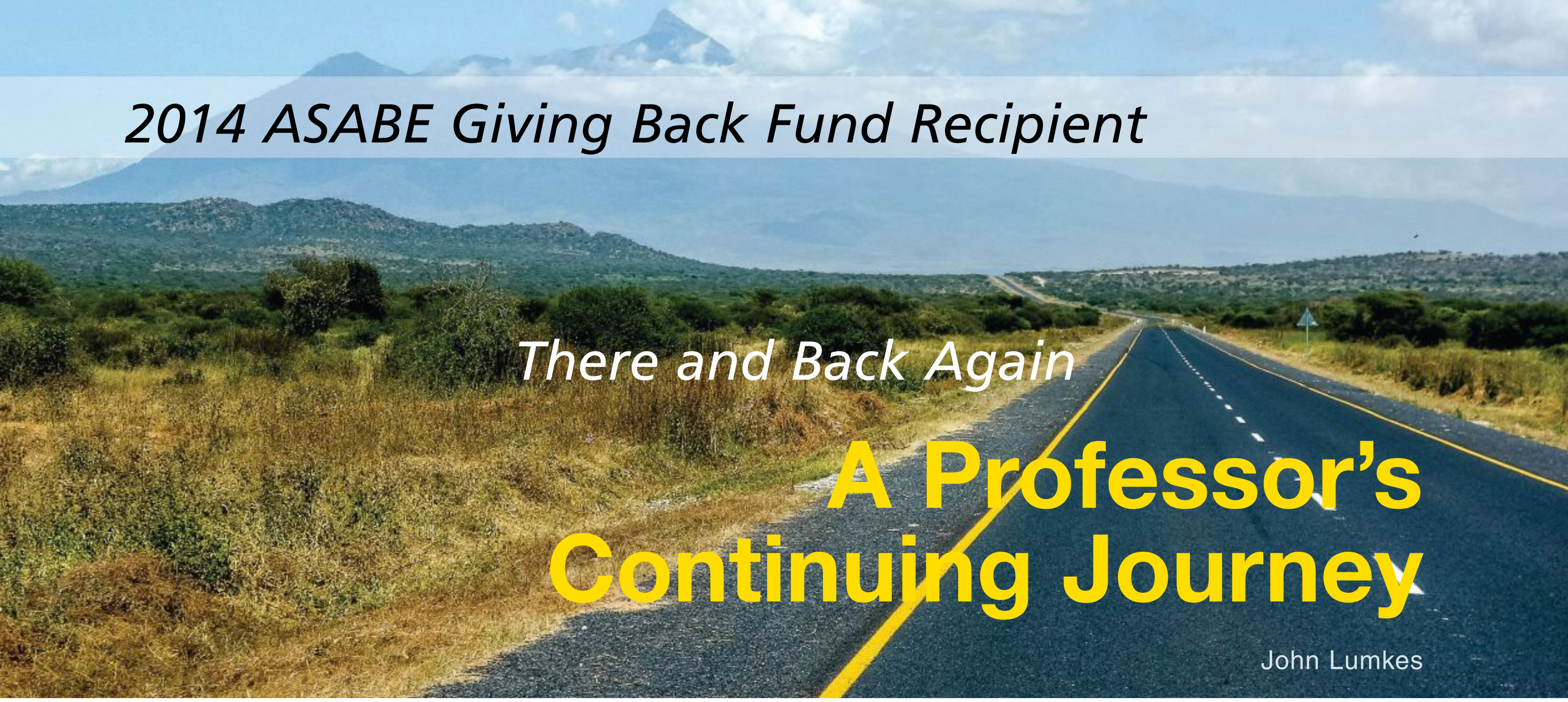
FEATURES



UPDATE

DEPARTMENTS



2014 ASABE Giving Back Fund Recipient

There and Back Again

A Professor's Continuing Journey

John Lumkes

As you might have guessed from the title—if you're a fan of J.R.R. Tolkien—my use of the phrase "There and back again" refers to the subtitle of *The Hobbit*, Tolkien's 1937 literary classic that has seen renewed interest due to the hugely successful movies based on his books about Middle Earth. So be forewarned, this might not be your typical *Resource* magazine article!

Long before the movies came out, I was a fan of Tolkien's books, and I made my kids read them, too. Actually, they didn't have a choice: I read *The Hobbit* and *The Lord of the Rings* to them, chapter by chapter, at bedtime when they were little. That's a fond memory for us now.

So what do Tolkien's books have to do with this article, the ASABE Giving Back Fund, my work with partners in Africa, and my activities as a professor?

Well, if you'll indulge me, actually quite a lot. As I was struggling with writing an outline to tell my story, I kept remembering various quotations from Tolkien. In a moment of inspiration (okay, some desperate moments due to lack of inspiration), I decided to arrange my outline by following a series of those quotations. Here begins the journey.

Gandalf checks his email behind the scenes on the movie set of "The Hobbit." ***Photo by Miraclefish, courtesy of imgur.com.***

> "It's a dangerous business, Frodo, going out your door. You step onto the road, and if you don't keep your feet, there's no knowing where you might be swept off to."
>
> *The Fellowship of the Ring*

Having recently been awarded a grant from the new ASABE Giving Back Fund, I was asked to write an article about my activities in Africa, in particular about the partnership in Cameroon that formed the basis for my team's video submission for the Giving Back Fund. The preceding quotation, in which Frodo's uncle Bilbo warns him about leaving home, mirrors my own experience during my first trip to Cameroon, which had unintended, but very positive, consequences. I didn't find gold in a dragon's lair, but I found real treasures of a different kind. You can read more about my first few trips in the May/June 2012 issue of *Resource*. Since then, we have built multiple vehicles with our partners in Cameroon, learned a lot about building hydroelectric turbines, and added projects in Tanzania and Kenya related to water and energy—all projects for which agricultural and biological engineers are ideally qualified.

As a result, I have a three-fold purpose for this article:

- To highlight some amazing opportunities for our profession, particularly for current students as we prepare them to be future leaders.
- To show that even in the midst of incredible challenges, there is hope, energy, and a unique vitality in Africa.
- And to remind you that stepping onto the road, although dangerous to your perceptions about a faraway place and about working internationally with students, can lead to new opportunities.

Yes, Africa has political and economic struggles, food production is often dependent on small-holder subsistence-level farmers, and women provide the majority of the agricul-

Matthew Lumkes and co-laborer do maintenance on the 2012 PUP.

David Wilson paints the new PUP's rear frame.

tural labor. But Africa also has resources that can help feed the world's growing population, it has significant opportunities for engaging in new markets, and it is filled with diversity and energy.

"You certainly usually find something, if you look, but it is not always quite the something you were after."
The Hobbit

How true this was for me. In our various professional positions, we are often encouraged to provide personal growth plans by answering questions like "Where do you want to be in five years?" If anyone had asked me that back in 2009, before my first invitation from Vincent Kitio, founder of the African Centre for Renewable Energy and Sustainable Technologies (ACREST, www.acrest.org), to visit him in Cameroon, not one sentence in my five-year plan would have included Africa, or things like maize grinders, water pumps, appropriate technologies, and slow sand filters.

The team in Cameroon with a newly constructed 2013 PUP. ***Author John Lumkes, front row, far right.***

ACREST and the 2013 Purdue team

Five years later, we have built multiple vehicles in Cameroon—we renamed our original Basic Utility Vehicle (BUV) the Practical Utility Platform (PUP) to reflect the multiple labor-saving tasks that it's designed to accomplish. We have tested the PUP with a variety of implements like maize grinders and water pumps, and we have received requests from other countries in Africa to start similar partnerships. After my first trip, back in 2009, I returned home with a notebook full of ideas, and I'm still adding to it! This year, we started a multi-grain thresher project and an electric driveline option for the PUP using batteries and an electric motor to replace the engine. The goal is to use off-peak surplus electricity from the hydroelectric project to charge the PUP for local use. This will promote renewable energy in Africa, demonstrate electric vehicle technology to the many groups that visit ACREST (politicians, schools, and other NGOs), and provide valuable on-the-ground data for future electric vehicle efforts.

"Well, you can go on looking forward," said Gandalf. "There may be many unexpected feasts ahead of you."
The Fellowship of the Ring

To say that I am excited about future opportunities is an understatement. In fact, the opportunities are often overwhelming, and I struggle to balance the high levels of student interest, possibilities for new projects, and the normal demands of being a working college professor. Blessed with an incredibly supportive family, I also need to make time for being a father and husband, and serving those around me. Occasionally, these different roles blend beautifully. Last year, my son and I worked side by side in Cameroon, Kenya, and Tanzania. With the projects continuing in Cameroon, new projects in Kenya and Tanzania, and more on the horizon, it has been an "unexpected feast" indeed.

High-density housing in Kibera, Kenya.

"All have their worth and each contributes to the worth of the others."

The Silmarillion

About halfway through our 2013 trip, I told the students, "Every time I come here I am more humbled by how much I continue to learn, even after multiple trips." Before their first visit, students often have the preconception that they will simply show our African partners how to do everything. They quickly learn that formal education is just one way to learn (and it certainly comes with privileges), but skills like resourcefulness, problem-solving, and the ability to fix things are not guaranteed, nor even likely, from formal education alone. It is hugely rewarding to see our Purdue team sharing ideas with our African partners, learning from each other, and in the end coming up, jointly, with a plan to solve the problem. The distinct cultural and educational backgrounds add value and perspective. When those differences are respected and embraced, everybody learns, and everybody wins.

"Where there's life there's hope."

The Hobbit

In 2013, we added projects in East Africa. After finishing the vehicle build in Cameroon, a few students, my son, and I flew to Kenya to meet a second group of students. This team was working on an earthen dam for water collection combined with a water filtration system for a small village in Tanzania. The students chose this project as their capstone design project in agricultural engineering. Knowing that they couldn't visit the village after graduation unless they raised their own funds, they wrote grants and were successful in raising enough money to cover their travel expenses. Flying into Nairobi made sense because it was more economical, and it provided us with an opportunity to visit the East African Farmer Innovation Fair and our colleagues at UN-Habitat.

Octopizzo, a Kenyan rapper, gave a tour of Kibera.

The year before, I had met Octopizzo, a Kenyan rap artist from Kibera (http://octopizzo.com). Kibera is the largest slum in Africa, with about one million people, and it's a difficult place to comprehend. Octopizzo offers a walking tour of the slum—as opposed to a "drive by and look out the windows" tour. It doesn't take long to realize that life is difficult for the people of Kibera. Water, sanitation, and energy are daily struggles. But there are also numerous NGOs, schools, and many ongoing projects, such as those presented by our UN colleagues.

In *The Hobbit*, the dwarves and Bilbo are trapped in the Lonely Mountain for many days. The dwarves despair—"This is the end," they say, "We shall die here"—to which Bilbo responds, "While there's life there's hope!" This hopeful attitude is also evident in Kibera, and throughout Africa. Even in the most difficult places, people refuse to give up. They find solutions to problems, and they are incredibly resourceful. In the heart of Kibera, children were laughing on their way to school; shopkeepers were buying, selling, and bartering on every street; craftsmen were making all sorts of tools and goods; and there was music from people like Octopizzo. Ultimately, our students must ask themselves how they would respond if they lived in such circumstances. And now, given their education and skills, what can they do for the world, for a country, or for a village? In confronting these questions, they discover that there are abundant opportunities to contribute to the grand challenges of our time.

"Don't adventures ever have an end? I suppose not. Someone else always has to carry on the story."

The Fellowship of the Ring

I think we all agree that the grand challenges will not be solved in our lifetime. And I expect that as we find solutions, we will also find new challenges (probably caused in part by our new solutions). Who will carry on? Science and engineering will continue to play a key role, and I am especially excited about the opportunities for agricultural and biological engineering. But how do we recruit and mentor future leaders in this profession? Getting students involved as undergraduates, or even as high school students, in projects like I have described is a great place to start. I have worked with high school teachers through the NSF Research Experience for Teachers program, and I involve them in my research during the summer. The pre-engineering teacher at a local high school and a group of his students traveled with us to Cameroon in 2012 and to Tanzania in 2013. Many of the high school students who have traveled with us are now pursuing careers in engineering. I also keep in contact with the project's many alumni who have chosen to continue in internationally focused careers, some through industries like John Deere, Cummins, and other companies with an international footprint, and others as graduate students.

Meanwhile, our activities continue to expand. In 2012, I made my first visit to East Africa and met with various institutions and community-based organizations. As a result of the contacts we made during that visit, in 2013 a graduate student did her research on fluoride removal in a region north of Arusha, Tanzania, in partnership with the Nelson Mandela African Institute of Science and Technology (NM-AIST, www.nm-aist.ac.tz) and Oikos (www.oikoseastafrica.org), a Tanzanian NGO that promotes the protection of biodiversity and sustainable use of natural resources as tools to fight poverty.

This year, I have two graduate students working in East Africa—one in Kenya doing research on urban energy through an internship with UN-Habitat, and another in Tanzania working with NM-AIST on a constructed wetland project. These two students were undergraduates in ABE at Purdue. Through opportunities as undergrads, they became excited about international work in the grand challenges and decided to pursue graduate degrees. Another graduate student who started working with me on the PUP project in 2011 as a sophomore in ABE is now in the first year of his MS program, working on a multi-grain thresher, and planning a trip to Cameroon. These examples are not about my accomplishments—they show that encouraging our students to get involved internationally has a significant influence on their later career choices, and thus on the relevance of our profession to the world.

"True education is a kind of never ending story—a matter of continual beginnings, of habitual fresh starts, of persistent newness."

J.R.R. Tolkien to his students

One thing I love about my job is the never-ending opportunity to learn, and getting involved internationally has been a large part of this. I don't know what I'll be doing five years from now, and I never could have guessed what the last five years have held for me. Students continue to arrive each year; we work with them, mentor them, challenge them; and then they graduate. Each year brings new lessons, opportunities, friendships, and setbacks that we all learn from.

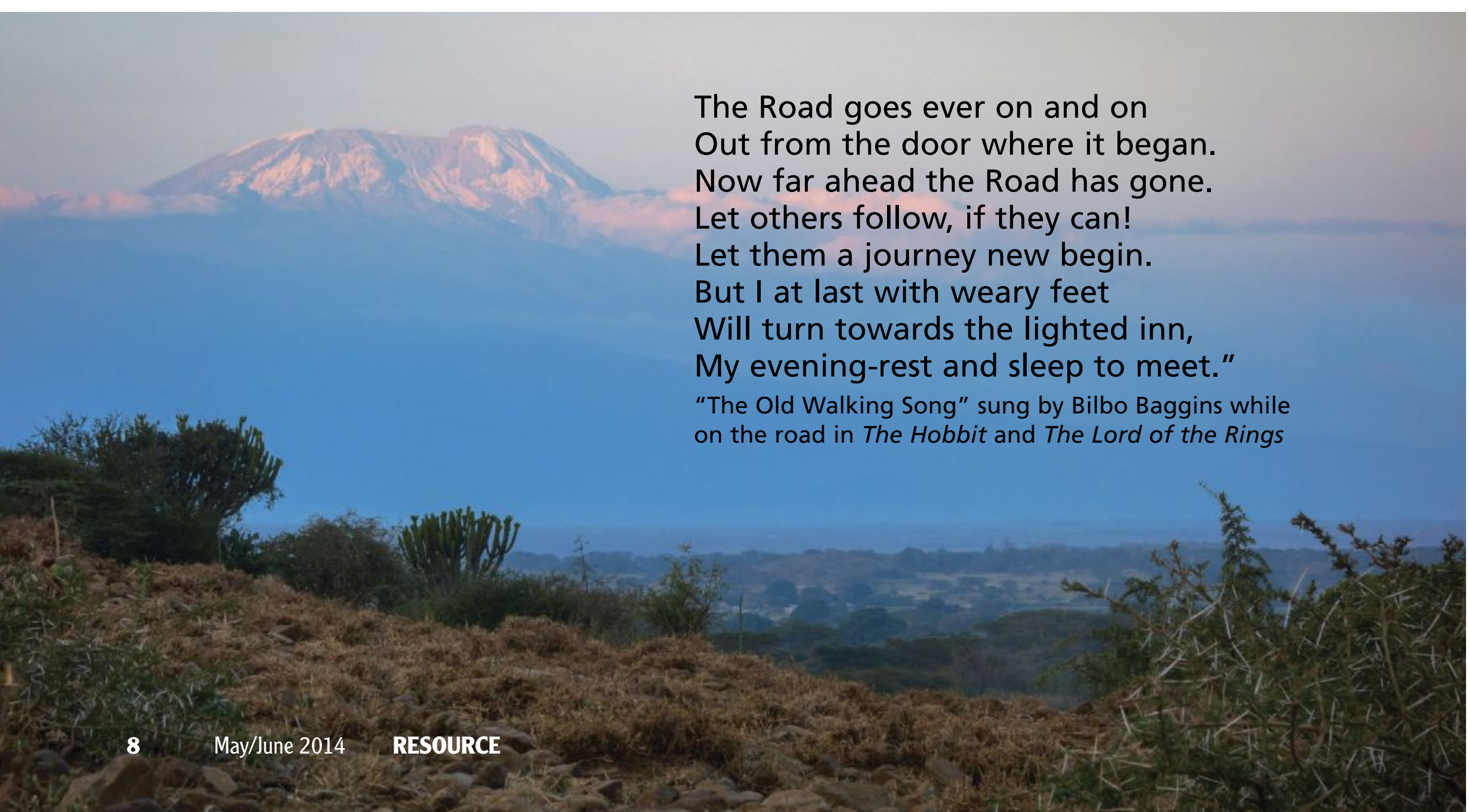
"It's the job that's never started as takes longest to finish."

The Lord of the Rings

Okay, this is supposed to be the grand conclusion, the big motivational finale. Instead, all I have to say is get involved where you can, when you can. For me, getting started has led to one opportunity after another. Working with the students, with our partners across the globe, with my colleagues at Purdue, and with many of you has been incredibly rewarding. For every student I work with, every country I visit, every project I work on, every friendship I make, there seems to another waiting to get started. Whether you are a faculty member, current student, newly employed, or looking for a job, there is a place for you to get involved. Just be careful—you don't know where that first step out your door might lead!

ASABE Member John Lumkes, P.E., Associate Professor, Department of Agricultural and Biological Engineering, Purdue University, West Lafayette, Ind., USA, lumkes@purdue.edu.

For more information about the ASABE Giving Back Fund, visit www.asabe.org/awards-landmarks/giving-back-fund.aspx.



The Road goes ever on and on
Out from the door where it began.
Now far ahead the Road has gone.
Let others follow, if they can!
Let them a journey new begin.
But I at last with weary feet
Will turn towards the lighted inn,
My evening-rest and sleep to meet."

"The Old Walking Song" sung by Bilbo Baggins while on the road in *The Hobbit* and *The Lord of the Rings*

Highlights from

The Global Forum for Innovations in Agriculture

Joel L. Cuello

In our interconnected world, with its increasing population and increasing prosperity, the global demand for all types of resources—food, water, land, energy, etc.—is creating scarcity in resource-limited areas. Resource scarcity is most severe in arid and semi-arid regions, which are home to 2.3 billion people, about a third of the global population. Arid and semi-arid regions are located in about 100 countries and cover as much as 40% of the Earth's land surface. In recent years, the production of food and other goods and services in these resource-scarce regions has suffered a sharp decline due to severe shortages of water and arable land, exacerbated by soil degradation, desertification, climate change, and other confounding factors.

ASABE members in Abu Dhabi (left to right): Joel Cuello, GFIA Steering Committee Member; Darrin Drollinger, ASABE Executive Director; Sreekala Bajwa, North Dakota State University, Agricultural and Biosystems Engineering Department Chair; and Lalit Verma, ASABE President.

It was thus both appropriate and timely that a desert city—Abu Dhabi in the United Arab Emirates—recently hosted the largest and most diverse collection to date of innovations in agriculture and food security. The first-ever Global Forum for Innovations in Agriculture (GFIA), sponsored by the Abu Dhabi Food Control Authority, featured 150 of the world's top innovations in the field and attracted over 3,200 participants from 62 countries, including the ministers for agriculture and natural resources from many African and Middle Eastern nations together with leaders of international research centers and non-governmental organizations. The University of Arizona, my academic home, served as the Knowledge Partner for the GFIA, while the Bill and Melinda Gates Foundation served as the Global Development Partner.

The 150 top innovations all showed great potential as effective solutions to the challenges of agriculture and food security. These impressive innovations also demonstrated that the design of sustainable solutions requires peer-based collaboration that pulls together knowledge and expertise from diverse disciplines and disparate sources. In fact, designing innovations for agriculture and food security has gone "wiki"—and this peer-to-peer cooperation was vividly displayed at the 2014 GFIA. Here are four noteworthy innovations from the top 150, along with profiles of the wiki-engineers and wiki-scientists who are developing them.

A Sahara Forest Project installation. ***Photo courtesy of the Sahara Forest Project.***

The Sahara Forest Project: Sustainable Integrated Food Production

The Sahara Forest Project (SFP) is an integrated technology solution that addresses the question of how to feed a growing population without incurring a large negative environmental impact through energy consumption, CO_2 emissions, water scarcity, desertification, and deforestation. It is an "innovative solution designed to utilize what we have enough of to produce what we need more of, using deserts, saltwater, and CO_2 to produce food, water, and clean energy," said Joakim Hauge, CEO of the SFP.

"With nature as an inspiration, the SFP has designed a system in which the waste product from one technology is used as a resource for another. With three core components—saltwater-cooled greenhouses, concentrated solar power, and technologies for establishing outside vegetation in arid environments, we enable restorative growth—defined as revegetation and creation of green jobs—through profitable production of food, fresh water, biofuels, and electricity," Hauge commented.

Web-Based Crop Environmental Monitoring

Grove OS is a web-connected hardware and software technology for installation in controlled-environment farms, such as greenhouses and hydroponic growing operations, that gives growers the data and insights they need to make more profitable decisions by optimizing crop growth and significantly reducing the risks of crop loss due to pathogen outbreak. Grove OS is among the first web-connected monitoring and control systems for indoor crop production, which allows

Virginia L. Corless, Science and Development Manager for the Sahara Forest Project, earned a BS in physics from MIT and a PhD in astronomy from the University of Cambridge. She conducted her postdoctoral study at the Excellence Cluster for Fundamental Physics: Origins and Structure of the Universe in Munich, Germany, and then worked for the U.S. Senate Committee on Energy and Natural Resources through a Science and Technology Policy Fellowship from the American Association for the Advancement of Science (AAAS). As the SFP's first Science and Development Manager, Corless manages scientific R&D programs, such as those at the SFP's pilot facility in Qatar, that focus on leveraging technical concepts to meet sustainable development needs.

"Physics is a great foundation for anything," Corless said, "And although the subject matter of my work at the Sahara Forest Project is far removed from the galaxy clusters that I used to study, the analytical techniques and rigor I learned in my field serve me well daily. So, too, do the teaching skills I developed, and the international experience I gained working with collaborators all over the world. I see my current work as a fantastic opportunity to combine my expertise in the scientific process and community with my other interests in cross-disciplinary and cross-boundary solutions, clean tech deployment, and sustainable development."

Jamie Byron *(left)* and Gabe Blanchet *(right)* became best friends after meeting during their first week as undergraduates at MIT. Having worked on an experimental farm and being concerned with the uncertainty of global food production, Byron built an aquaponic garden in the fraternity room he shared with Blanchet during their senior year. After months of eating fresh kale, lettuce, and tomatoes harvested right from their own room, they started Grove OS on a mission to "enable local, healthy food for every person on Earth." Michael H. Corbin *(middle)*, U.S. Ambassador to the United Arab Emirates, visits with them at the GFIA.

automatic implementation of optimal growth conditions using various control loops augmented by machine learning algorithms.

Accordion Photobioreactor for Scalable Algae Production

The Accordion photobioreactor (PBR), patented by The University of Arizona and exclusively licensed to Biopharmia AS, is an innovative scalable algae PBR technology that provides optimal liquid mixing and light incidence together with the benefits of using low-cost plastic materials. With the high market demand for algae biomass for a wide array of applications, including nutraceuticals (e.g., omega-3 fatty acids), animal feeds, proteins and vitamins, biofuels, cosmetics, and other high-value products, the advantages of the Accordion PBR include its modular design, ease of scale up, adjustable control of mixing and light incidence, significantly reduced risk of culture contamination, ease of maintenance, and ease of harvesting, among others.

Scalable Production of Insect-Derived Nutrients

Protix Biosystems BV, based in The Netherlands, has developed a scalable and controllable system for mass production of protein-rich insects to produce high-grade insect-derived nutrients. Their products include protein and hydrolyzed protein meals, chitin-rich products, and insect-derived oils and fats for applications in aquaculture, livestock, pet food, and other markets. In partnership with their customers, they create functional value based on feed conversion, health, stamina, anti-microbial, and other beneficial effects in feeds.

Kees Aarts, Founder of Protix Biosystems BV, is an aerospace engineer with a degree in physics from Delft University of Technology in The Netherlands. With a passion for scuba-diving, Aarts returned from a vacation five years ago frustrated by how the world's oceans are being mistreated by overfishing. Without an in-depth knowledge of entomology, he knew that "insects are the largest living biomass on the planet, representing the biggest protein source, yet the least utilized protein source that we know of." Although the concept of using insect-derived nutrients is not new, it was the focus that Aarts brought to developing scalable and controllable technologies that are now enabling his company to create its current collection of innovative insect-based products.

ASABE Member Joel L. Cuello, Professor, Department of Agricultural and Biosystems Engineering, The University of Arizona, Tucson, USA, cuelloj@email.arizona.edu.

Cuello and his team at the University of Arizona designed a suite of photobioreactors that have improved liquid mixing and light incidence while using low-cost plastic materials, resulting in the proprietary zigzag or wave design of the Accordion PBR. Co-Inventors (left to right): Cody Lee Brown, Master's candidate; author Cuello; Sara Kuwahara and Takanori Hoshino, postdoctoral researchers.

STRIPS:
Science-Based Trials of Row Crops Integrated with Prairie Strips

Matt Helmers

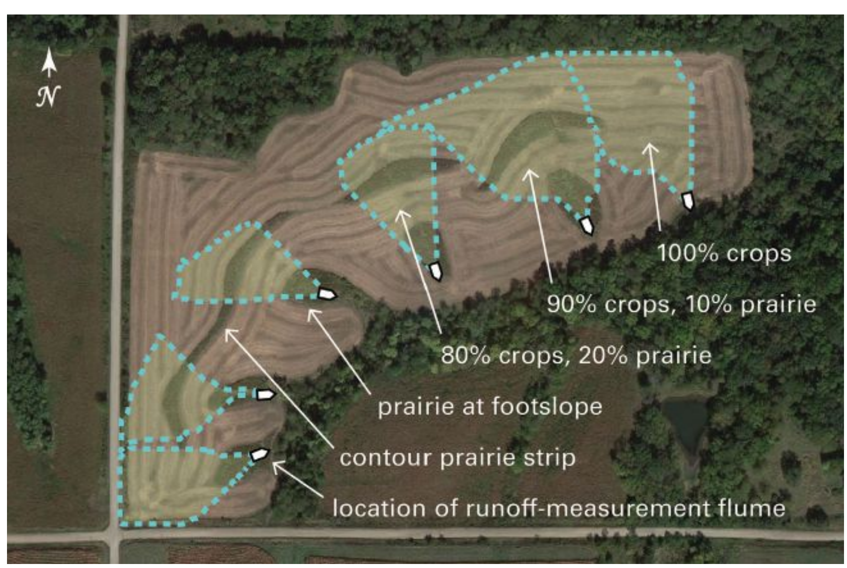
Growing demand for agricultural products to supply food, feed, fiber, and fuel comes at a time of intensified pressure by the public as well as by local and federal government agencies to reduce the impacts of agricultural production on water quality and biodiversity. Midwest land under heavy agricultural production has been identified as a major contributor to nitrogen and phosphorus losses to downstream water systems and to hypoxia in the Gulf of Mexico.

To address these challenges, a team of research scientists, educators, and extension specialists has implemented a demonstration and evaluation project called the Science-based Trials of Row-crops Integrated with Prairie Strips—or STRIPS. The team is specifically interested in how the water quality and biodiversity of watersheds committed to a corn-soybean rotation can be improved through the targeted incorporation of native prairie vegetation. The researchers determined that strategically placed prairie strips can offer a number of benefits to the watershed, including reduced soil erosion, slower gully formation, reduced surface runoff from watersheds, reduced nutrient and sediment losses, and protection of waterways from agricultural runoff.

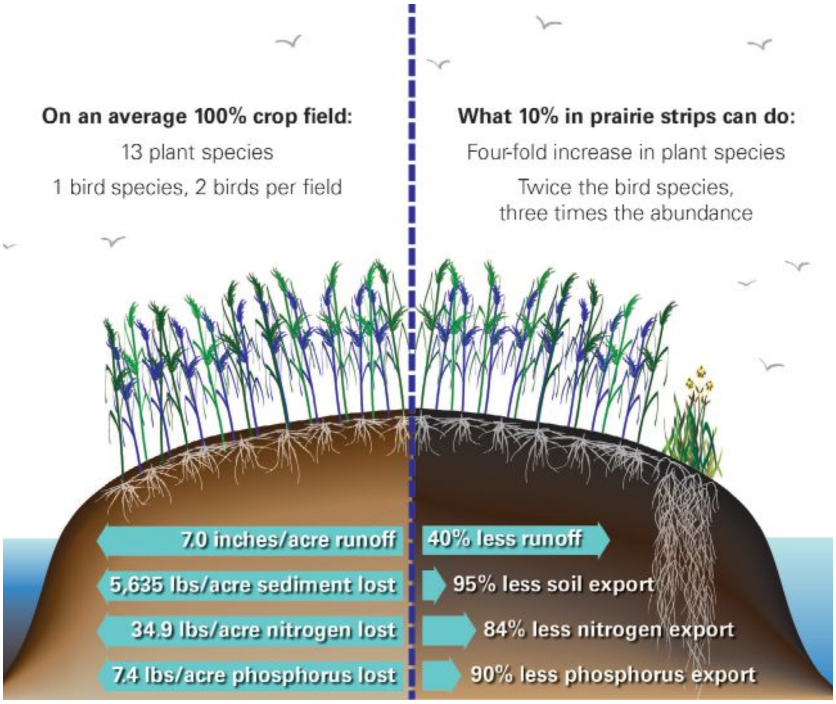
The project treatments were established in 2007 by an interdisciplinary team from Iowa State University, the University of New Hampshire, the USDA-ARS National Laboratory for Agriculture and the Environment, the U.S. Forest Service Northern Research Station, the Leopold Center for Sustainable Agriculture, and the Neal Smith National Wildlife Refuge (NSNWR) in the Walnut Creek watershed in Jasper County in central Iowa. Using twelve small watersheds, the group's first objective was to quantify the influence of different proportions and landscape configurations of annual and perennial plantings on nutrient, carbon, and water storage and losses, along with biodiversity impacts. Their second objective was to promote greater understanding among diverse groups that environmental stewardship may be compatible with viable cash crop production.

The research

To test their hypothesis, the team set up twelve small watersheds on portions of the NSNWR that were waiting for restoration to native tall-grass prairie landscapes and in the meantime were being leased to farmers for crop production in a corn-soybean rotation. The size of the watersheds ranged from 0.4 to 3.2 ha (1 to 8 acres) with average slopes of 6% to 10%. The total land planted to prairie vegetation was 0%, 10%, or 20% of the field. To measure sediment, water, nitrogen, and phosphorus movement off the fields, a fiberglass



An experimental field with different combinations of crops and prairie vegetation.



This infographic explains the benefits of STRIPS.

flume was installed at the bottom of each watershed. Researchers also took regular counts of bird and insect populations in and around the prairie strips to discern biodiversity benefits of the native prairie strips.

The results

According to results recently published by the Leopold Center of Sustainable Agriculture and Iowa State University, the impact of relatively small prairie strips is significant. Between 2007 and 2012, the STRIPS team determined that, with the addition of only 10% prairie, sediment export was reduced by 95%, total phosphorus export was reduced by 90%, and total nitrogen export was reduced by almost 85%. The team also documented substantial gains in biodiversity, creating important habitat for pollinating insects, wildlife, and songbirds. On average, 51 plant species were found in areas surveyed within the prairie strips, as compared to 13 species within the row-crop areas.

This native plant diversity provides habitat that fosters conservation of native communities—not only of plants, but also birds and beneficial insects, such as pollinators and natural enemies of crop pests. In particular, the prairie strips supported several species of insect predators beneficial to corn and soybeans as well as a diverse community of pollinators (70 species of native bees along with the European honey bee). The researchers found consistently greater numbers of birds in the areas that incorporated prairie strips, including some species in greatest need of conservation. The STRIPS team calculated that the average annual cost of treating a farm field with prairie strips ranges from $24 to $35 per treated acre.

The next steps

Based on these significant findings, combined with an increasingly urgent demand to address nutrient and sediment losses to waterways for production agriculture in Iowa, the team has expanded the demonstration project. In 2013, they began establishing a network of demonstration sites run by private landowners across the five soil regions of Iowa. By continuing to collect data on sediment retention, soil quality, nitrate-nitrogen in groundwater, and biodiversity at these new sites, the team is striving to broaden the applicability of their findings. These sites will also provide further opportunity for landowners and operators to see firsthand the economic potential of prairie strips in their own agricultural operations. Field days at the sites and other extension outreach activities are planned.

Work on the prairie strips project is being supported or has been supported by the U.S. Fish and Wildlife Service Neal Smith National Wildlife Refuge, the USDA Agricultural Research Service, the U.S. Forest Service Northern Research Station, the National Science Foundation, the USDA SARE and AFRI programs,, the Leopold Center for Sustainable Agriculture, the Iowa Department of Agriculture and Land Stewardship, Trees Forever, Iowa State University, The Walton Family Foundation, and The McKnight Foundation. Visit the STRIPS website at: www.prairiestrips.org.

ASABE Member Matt Helmers, Associate Professor, Department of Agricultural and Biosystems Engineering, Iowa State University, Ames, USA, mhelmers@iastate.edu.

For Further Reading

Zhou, X., M. J. Helmers, H. Asbjornsen, R. Kolka, M. Tomer, and R. Cruse. 2014. Nutrient removal by prairie filter strips in agricultural landscape. *J. of Soil and Water Conservation* 69(1): 54-64.

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The Path Toward Sustainable Agriculture

Marty Matlock, P.E.

Editor's note: This article is the second in a four-part series on biological and agricultural engineers in sustainable agriculture. The previous article discussed the role of biological and agricultural engineers. Subsequent articles will discuss the food and agricultural industry's leadership in sustainable agriculture, and the challenges and opportunities of global agriculture.

Eighty years ago, the economic outlook for the United States was bleak. The government was broke, unemployment was at record levels, and there was no clear end to the economic depression that mired the nation. A crisis of another sort was forming in the heartland of the country. On May 12, 1934, a huge dust storm swept across the southern Great Plains. Hugh Bennett, director of the Department of Interior's Soil Erosion Service, described the storm this way:

"This particular dust storm blotted out the sun over the nation's capital, drove grit between the teeth of New Yorkers, and scattered dust on the decks of ships 200 miles out to sea. I suspect that when people along the seaboard of the eastern United States began to taste fresh soil from the plains 2,000 miles away, many of them realized for the first time that somewhere something had gone wrong with the land. It seems to take something like a disaster to awaken people who have been accustomed to great national prosperity, such as ours, to the presence of a national menace. Although we were slowly coming to realize that soil erosion was a major national problem, even before that great dust storm, it took that storm to awaken the nation as a whole to some realization of the menace of erosion."

The crisis we now call the Dust Bowl that was playing out on the plains was preventable. Prior to this ecological disaster, there had been significant reluctance across federal agencies and within academic institutions to recognize that soil erosion was a serious concern. The Bureau of Soils had issued Bulletin 55 in 1909, wherein the chief of the Bureau, Professor Milton Whitney, proclaimed: "The soil is the one indestructible, immutable asset that the nation possesses. It is the one resource that cannot be exhausted; that cannot be used up."

Bennett worked for Whitney at that time and was sounding the warning of the impacts of soil erosion on U.S. agricultural productivity. Whitney instructed Bennett to stop talking about loss of soil as a national threat. But Bennett recognized that soil erosion from unsustainable agricultural practices was creating a catastrophic threat; he persisted in sounding the warning a full generation before the collapse of the Great Plains agro-ecosystem. Bennett toiled his entire career to overcome what he considered to be arrogance and selective blindness to facts in order to move a nation to action.

Where we came from

March 21, 1935, was a blustery day in Washington, D.C., when the Senate Subcommittee on Agriculture continued hearings on proposed legislation to create a soil conservation agency. Bennett was scheduled to testify that morning on the need for a consolidated agency within the USDA to focus on soil and natural resources conservation. There was significant opposition to this proposal; the Department of Interior did not want to lose control over the soil erosion program (even though funding for the program was slated to end in another year), and many congressional leaders did not want to create yet another government program that would cost money. Bennett's testimony covered, in meticulous detail, his recent survey of soil conditions across the nation. Senators started to fidget and yawn openly. Through his network of staff across the U.S., Bennett had been tracking yet another dust storm that was heading east. His testimony went on for hours, until

The Lincoln Memorial on March 21, 1935, as a dust storm blocks the sun. ***(114G-c-6001a, National Archives and Records Administration, College Park, Maryland).***

the daylight in the room suddenly dimmed. Here's the scene as described by Bennett's biographer:

"Presently one of the senators remarked—off the record—'It is getting dark. Perhaps a rainstorm is brewing.' Another ventured, 'Maybe it's dust.' 'I think you are correct,' Bennett agreed. 'Senator, it does look like dust.' The group gathered at a window. The dust storm for which Hugh Bennett had been waiting rolled in like a vast steel-town pall, thick and repulsive. The skies took on a copper color. The sun went into hiding. The air became heavy with grit. Government's most spectacular showman had laid the stage well. All day, step by step, he had built his drama, paced it slowly, risked possible failure with his interminable reports, while he prayed for Nature to hurry up a proper denouement. For once, Nature cooperated generously."

During this time of national economic crisis, the 74th Congress unanimously passed Public Law 46: The Soil Conservation Act. This was the world's first soil conservation act. President Roosevelt signed it into law on April 27, 1935. It had taken Hugh Bennett 25 years and some spectacularly well-timed testimony before Congress to move the machinery of government to action, even though the data supporting that action were overwhelming. The USDA Soil Conservation Service (SCS) was created.

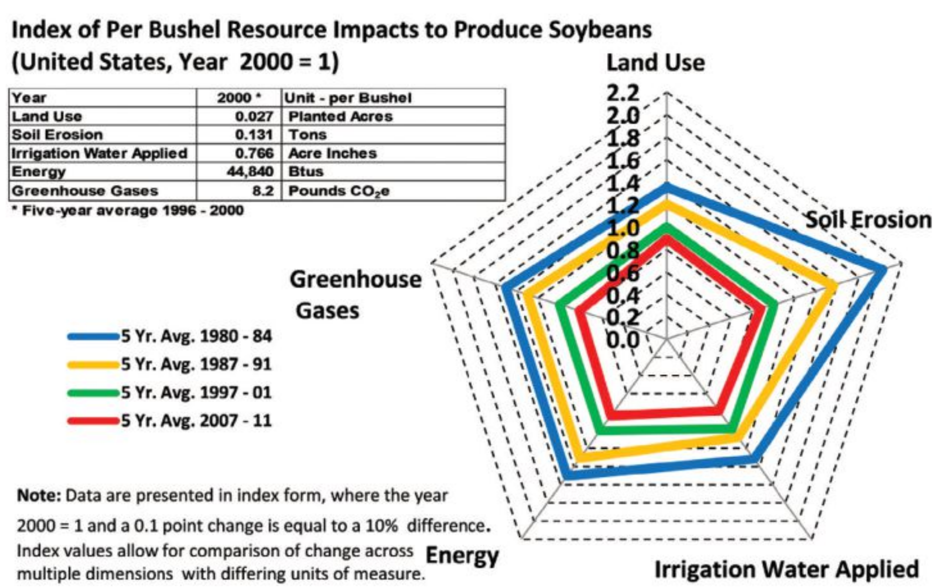
What we have accomplished

In the nearly 80 years since the formation of this agency, the U.S. Great Plains have been transformed from an ecological wasteland to the most efficient, effective, and productive agricultural landscape on Earth. The SCS has evolved to become the Natural Resource Conservation Service (NRCS). Conservation districts have been established to provide local farmer governance and expertise in every county in every state, and the Cooperative Extension Service has become the world's most effective instrument for agricultural innovation and stewardship. U.S. production yield and efficiency for corn and soybeans have become the highest in the world. In 2014, the United States is projected to produce almost 37% of the world's corn on 20% of global planted acres and 31% of the world's soybeans on 27% of global planted acres.

Field to Market: The Alliance for Sustainable Agriculture, a multistakeholder collaboration of representatives from across the U.S. agricultural supply chain, was organized in 2007 to develop a comprehensive strategy for sustainability in U.S. agriculture. Members include grower organizations and corporate partners such as the United Soybean Board, National Corn Growers Association, Cotton Incorporated, Syngenta, Monsanto, John Deere, Bunge Corporation, Cargill, General Mills, Kellogg Company, McDonalds, and Wal-Mart. The University of Arkansas, North Carolina State University, and the University of Wisconsin also participate, along with The Nature Conservancy, Environmental Defense Fund, World Wildlife Fund, NRCS, and USEPA. I serve on the executive committee for Field to Market. Over the past seven years, we have worked to develop first-tier key performance indicators (KPIs) for row crop agriculture. The goal is to identify and benchmark KPIs across all three domains of sustainability: environmental, social, and economic. We began with environmental KPIs based on the four criteria defined by Field to Market as the minimum criteria for KPIs: science driven, outcomes based, technology neutral, and transparent.

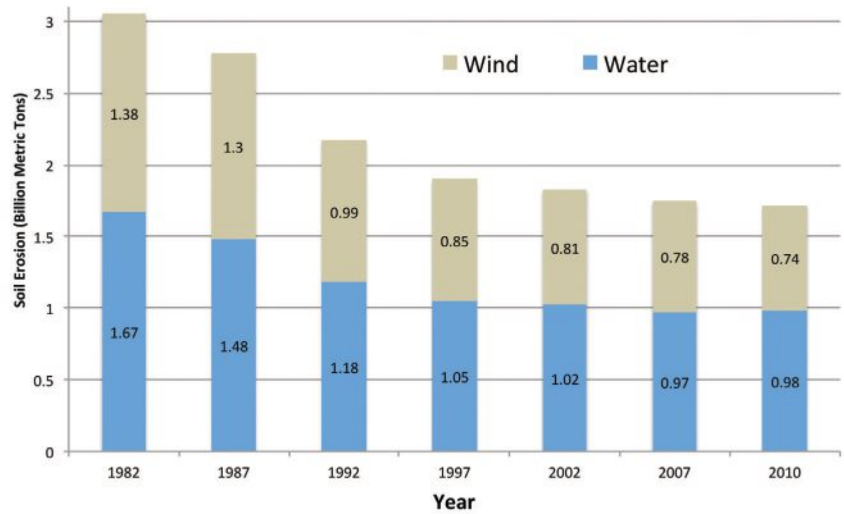
The five first-tier environmental KPIs for sustainable agriculture developed by Field to Market were soil erosion, energy use, greenhouse gas emissions, water use, and land use. The Field to Market team analyzed metrics over the past 30 years (1980-2011) for each environmental KPI at the national level for the major U.S. crops: corn, soybeans, cotton, wheat, potatoes, and rice. During that period, yield per planted acre increased for all these crops. The most dramatic increases were for corn (+64%), potatoes (+58%), soybeans (+55%), and rice (+53%). Moderate increases were achieved for cotton (+43%) and wheat (+25%).

Reduction of soil erosion has been a major sustainability success in U.S. agriculture. On a unit of production basis (tons of soil lost per ton of crops produced), soil erosion decreased over the past 30 years for all six crops: corn (-67%), cotton (-68%), soybeans (-66%), potatoes (-60%), rice (-34%), and wheat (-47%). Similar efficiency improvements were achieved across the other four KPIs.



Field prints for U.S. soybeans, 1980-2011.

We evaluated the five KPIs using five-year averages, benchmarked to 1997-2001 data. The diagram on the previous page shows the resulting index of resource impacts per bushel for U.S. soybean production. The index decreased for every five-year period for each of the five KPIs, with the biggest decrease for soil erosion. Similar reductions for U.S. corn and cotton represent one of the great success stories in agriculture. These improvements are the results of research and innovations in plant genetics, tillage practices, smart implements, and constant effort by producers to increase efficiency through technology and reduce impacts through conservation practices.



Estimated total U.S. soil erosion from water and wind, 1982-2010. ***Modified from the USDA.***

Where we are going

Despite the improvements that U.S. agricultural producers have made across the first-tier environmental KPIs, we still have a number of challenges ahead. Soil erosion is a fundamental metric for soil health. Soil loss across U.S. agricultural lands decreased in total mass by 41% in the past 30 years, but the amount of soil eroding each year is still too high. The NRCS National Resources Inventory estimated that 1.72 billion metric tons of soil were lost in 2010 due to water and wind erosion. Unfortunately, the trend of soil loss reduction has flattened; erosion in 2010 was essentially unimproved from 2007. Soil erosion is not an inevitable cost of agricultural production, but it is an insidious and pernicious threat to U.S. productivity. Production practices that result in soil erosion damage the aquatic ecosystems of downstream neighbors and reduce the fertility of the land for future generations. Production practices that result in soil erosion are unsustainable and must eventually be replaced with more responsible practices. Reducing soil erosion is a primary priority for sustainable agriculture.

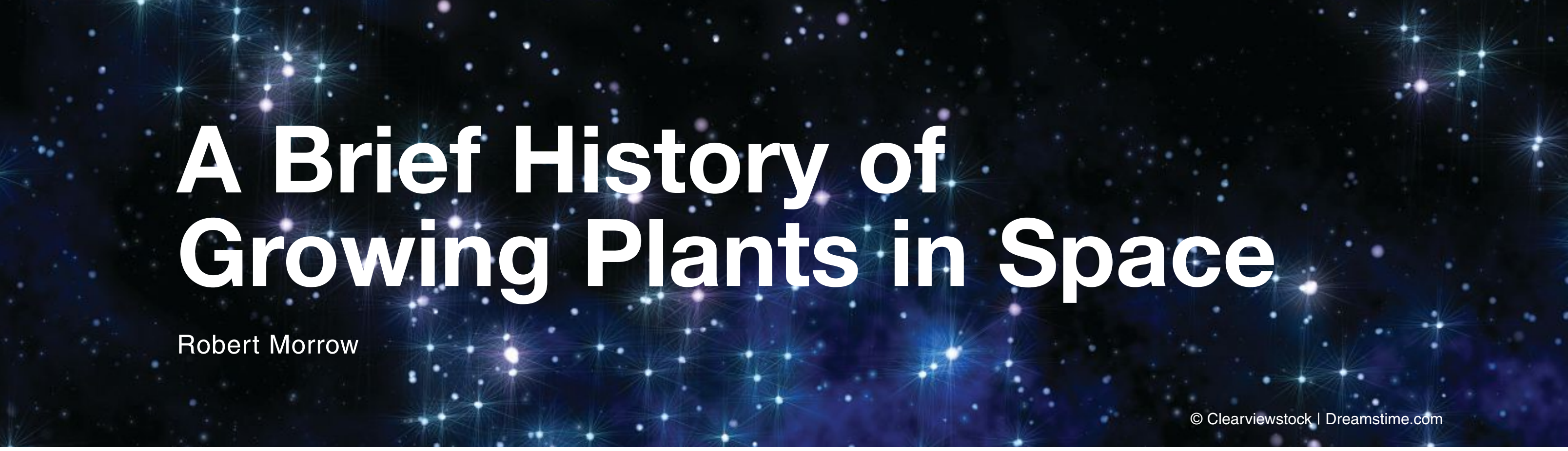
Hugh Bennett had to struggle for two decades to change the way the U.S. agricultural community addressed the threat of soil erosion, and he was only successful after erosion drove the system to collapse. The reluctance to acknowledge threats and to recognize change, as illustrated by Bennett's difficulty in creating the SCS, is a common characteristic of human organizations. We all construct simplified models of how the world works. These models define how we respond to information and challenges. We do not easily change our models, even in the face of overwhelming data that challenges their effectiveness. Our minds are not adapted to a world in which change is constant and the rate of change is accelerating. We have to create a more complete framework for viewing data and trends. Sustainability provides this context.

Our challenge going forward is to identify trends like U.S. soil erosion with a new model that considers the consequences of these processes for the prosperity of current producers, for the next generation of farmers, and for the coming generations of consumers. Additional metrics such as soil organic carbon, which is one of the most important and effective metrics for soil health, after erosion rates, should be managed so that there is no net loss and preferably a net gain over time. Soil organic carbon increases soil fertility by enhancing the tertiary structure, water infiltration and storage capacity, microbial diversity, nutrient cycling capacity, and overall root health. Soil organic carbon appears to be on the rise in some soils in the United States, as conservation tillage becomes standard practice in corn, soybeans, and cotton.

The five first-tier KPIs identified by Field to Market are only the beginning. Water quality, biodiversity, as well as social and economic KPIs are being developed to enhance our ability to understand and improve agricultural sustainability. We have an additional 2.5 billion people coming to dinner in the next 40 years, and they will be more prosperous than any population in human history; they will eat a lot of food. The priorities for biological and agricultural engineers should be identifying technologies and innovations that shift the critical KPIs toward more sustainable trajectories. We must focus our efforts to drive up efficiency, drive down impacts, reduce risks, and share knowledge in new ways.

The work that Hugh Bennett started at the beginning of the 20th century is even more important today. We have to see the world more completely, understand the impacts of change more clearly, and drive innovations more effectively if we are to avoid another ecological catastrophe caused by our blind arrogance.

ASABE Member Marty Matlock, P.E., Executive Director, Office for Sustainability, and Professor, Department of Biological and Agricultural Engineering, University of Arkansas, Fayetteville, USA; mmatlock@uark.edu.



A Brief History of Growing Plants in Space

Robert Morrow

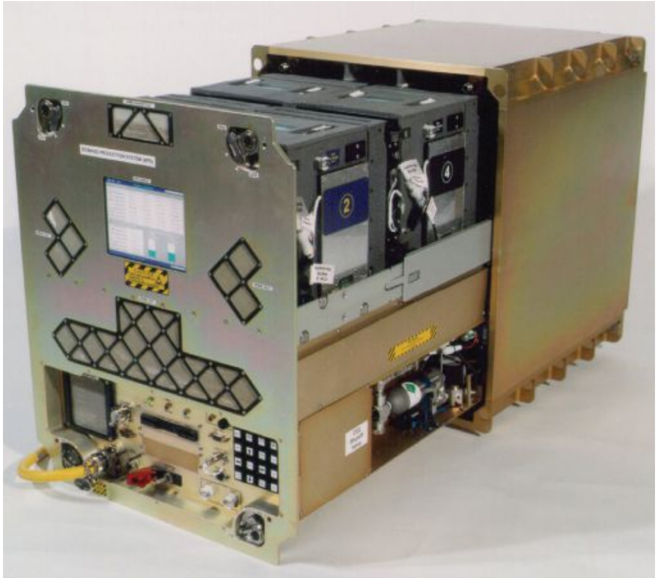
Agricultural and biological engineering extends beyond terrestrial farming and plant research. Since the advent of the space age, there has been a desire to provide capabilities for plant growth in the unique environment of space, both to use reduced gravity as a new variable to elucidate plant physiological processes and to develop the foundation of plant-based regenerative life support systems mimicking the Earth's biosphere. In space, plants are subject to elevated levels of ionizing radiation and reduced gravity, both of which may affect plant response. Reduced gravity also affects the behavior of the fluids and gases necessary for plant growth and development. Over the years, hardware systems engineered to grow plants in microgravity have evolved to provide improved control of the root and shoot environment to enable long-duration testing, to support good plant growth, and to minimize confounding factors that can mask responses caused by the space environment.

The first successful in-orbit plant experiments were flown on Biosatellite II, a free-flying platform that was placed in orbit for three days in 1967 and returned to Earth by parachute. Since then, most plant growth systems have been engineered to grow plants in manned vehicles and are generally a single or double "middeck locker equivalent," a middeck locker equivalent being about 50 × 43 × 25 cm (20 × 17 × 10 in.). The precursor to modern space plant growth systems was the NASA Plant Growth Unit, which first flew on the STS-3 space shuttle mission in 1982.

Examples of plant growth units that have been used aboard the space shuttle or the International Space Station since that time include the Astroculture system, the Advanced Astroculture system, the Biomass Production System, the Plant Generic Bioprocessing Apparatus, the Advanced Biological Research System, and the European Modular Cultivation System. These systems were developed to conduct research primarily with seedlings or small species such as dwarf Brassica and Arabidopsis. A "quad middeck locker" sized plant research system, called the Plant Habitat, is currently in development for a 2016 flight and will be the largest in-orbit plant growth system to date. The Plant Habitat is designed to accommodate small to medium-sized plants or dwarf versions of larger plants and is being developed as a permanent in-orbit research facility.

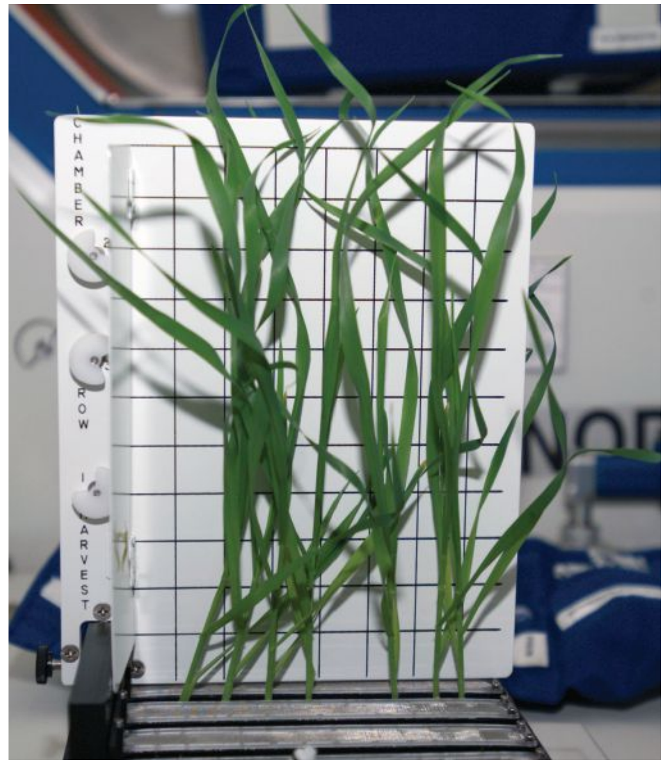
Over time, from simple to complex

The evolution of plant growth systems from the inception of spaceflight to the space station era has been from simple, short-duration systems to more complex units with advanced environmental controls capable of supporting long-duration testing. These systems are the precursors of large-scale plant growing systems that may eventually support the long-term exploration of space. Diverging from these highly controlled research systems are the "space gardens" that began with the Svet plant growth unit on the Mir space station, followed later by the Lada unit on the International Space Station (ISS). Another space garden is the deployable vegetable production system (Veggie) that will launch to the ISS in 2014 with the goal of supplementing the ISS crew's diet with fresh vegetables. These space garden systems represent the transition from ground testing of plant-based life support to actual in-orbit demonstrations of plants that provide food as well as atmospheric and water revitalization.



The Biomass Production System with four independently controlled plant growth chambers flown aboard the ISS from April 8 to June 19, 2002. Photosynthesis and transpiration rates were measured in orbit, multiple daily images were collected to document growth and development, and over 300 wheat seedlings and Brassica plants were collected for analysis.

Astronaut Peggy Whitson holding the Advanced Astroculture soybean plant growth experiment in the Destiny laboratory on the ISS.



Dwarf wheat seedlings being harvested aboard the ISS. Each row of plants was photographed, cut, and then frozen for later analysis in ground-based laboratories.

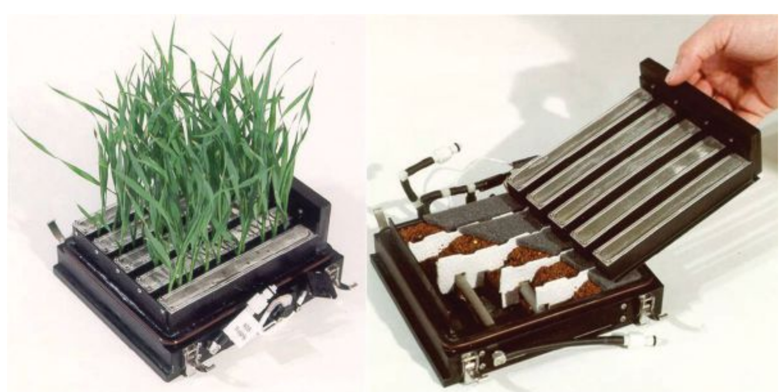
The success of space-based plant growth systems relies heavily on collaboration between plant scientists and engineers to develop technologies that overcome the constraints imposed by the space environment, including reduced gravity and restrictive limitations on power, mass, volume, and crew time. The capabilities provided by the most advanced plant growth chambers include control of light level, quality, and timing; control of root zone moisture and nutrients; and control of shoot zone temperature, humidity, and atmospheric composition (primarily carbon dioxide level).

Light level

Lighting systems for space-based plant growth initially used fluorescent lamps, which required compromises due to safety issues such as high voltages, glass envelopes, and the presence of mercury, a hazardous contaminant in a space vehicle. Fluorescent technology has since been replaced by LED-based lighting. LED systems eliminate the hazards of gas discharge lamps and provide more functionality and higher efficiency. The development of LEDs for space-based photosynthetic lighting has provided much of the technological base for transitioning to LED lighting for horticultural applications, providing yet another example of how space technologies can be spun-off for terrestrial applications.

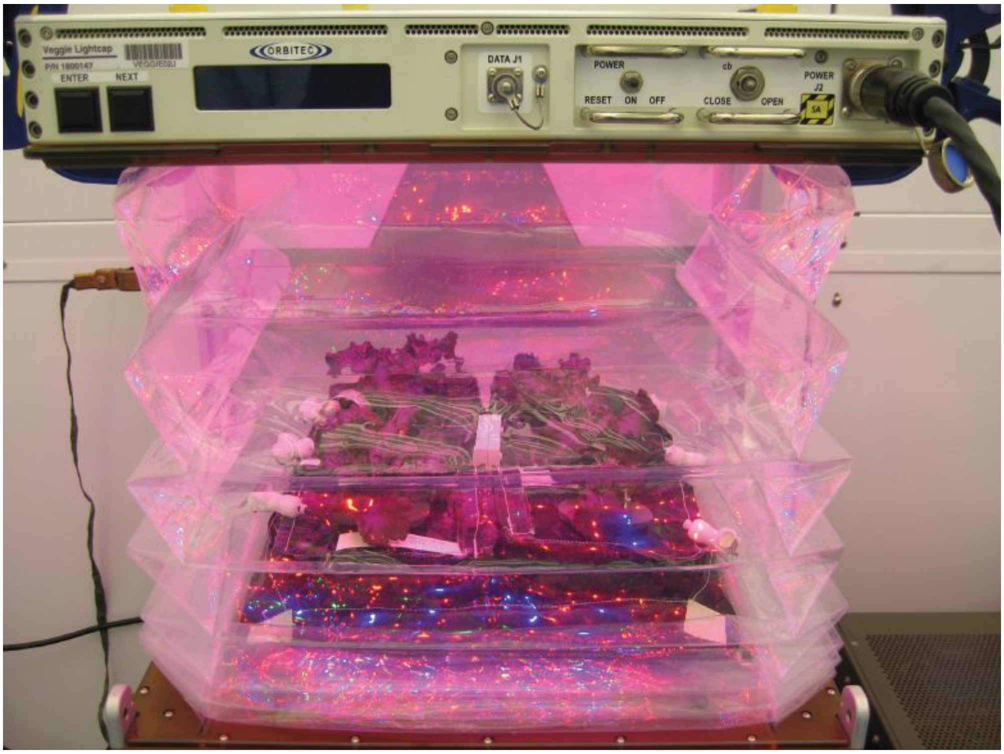
Water, always a necessity

The need to deliver water to plants in a weightless environment while providing sufficient aeration of the root zone is a particular challenge. Early systems using sponges or gels were not adequate for long-term plant growth. To counter the lack of gravity, root modules have been designed to use capillary force. The plants are rooted in a particulate medium into which water is transferred using porous tubes that provide a capillary interface between the fluid reservoir and the root zone. These systems maintain precise control of root zone moisture while providing aeration and containment of water. Thin-film hydroponic and aeroponic systems could also function in reduced gravity, but they have not been used to date.



The root module for plant growth used on the ISS. Right view shows the capillary-based watering system developed for use in microgravity. This system, with minor modifications, has flown as part of several plant research payloads.

To conserve water, most plant systems condense the water transpired by the plants and recycle it to the root zone. Current humidity control systems use a porous interface that is chilled to the desired dew point, allowing water to be condensed and drawn through the interface and into a reservoir. Temperature control is provided using thermoelectric elements that can both heat or cool.



The Veggie plant growth system undergoes testing in preparation for spring of 2014 launch to the ISS. The goal of this system is to eventually supplement the crew's diet with fresh vegetables.

CO_2, too

The gaseous composition of the atmosphere is generally controlled by adding CO_2 or using absorbents to remove CO_2. Excess O_2 is generally vented to the crew cabin, and contaminants such as ethylene are removed using absorbents or catalysis systems. The lack of buoyancy in space requires the use of forced convection to mix gases so that the boundary layer around the plants does not become depleted of CO_2. Again, there must be compromises in hardware design, as the use of fans to overcome the lack of convective mixing imparts forces on the plants that can mimic gravity effects and thereby confound the research results.

Finally, plant growth systems in space use extensive sensor and imaging technologies to track plant development, which is particularly valuable in an environment where the ability to make manual measurements or to retrieve specimen samples for later analysis may be quite limited.

Plant growth technology has advanced significantly since the first space-based plant growth systems. Agricultural and biological engineering will continue to play a crucial role in meeting the needs of future space missions by developing more efficient growing methods, improving our understanding of the ecology of closed systems, and even bioengineering plants to perform more effectively in the space environment.

ASABE Member Robert Morrow, Bioproducts and Bioproduction Systems Lead, Orbital Technologies Corporation (ORBITEC), Madison, Wis., USA, morrow@orbitec.com.

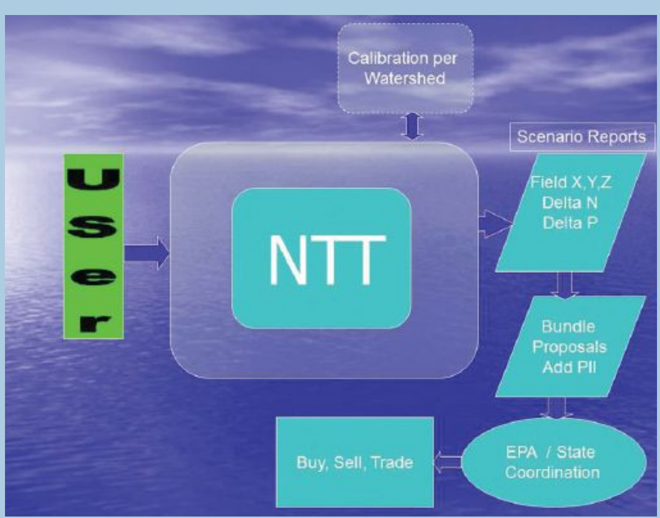
AGRICULTURAL AND BIOLOGICAL ENGINEERING WILL CONTINUE TO PLAY A CRUCIAL ROLE IN MEETING THE NEEDS OF FUTURE SPACE MISSIONS.

The Nutrient Tracking Tool

A historical perspective and a look to the future

Harbans Lal

The Nutrient Tracking Tool (NTT) is a user-friendly web-based application that evaluates changes in nitrogen, phosphorus, and sediment levels, as well as crop yields, under different crop management and conservation practices. In a single run, NTT simulates two scenarios (the baseline and an alternative) to estimate and compare their effects on nutrient and sediment loads and crop yields. These results can be used as a science-based calculation of nutrient credits for water quality trading markets as well as to aid in conservation benefit analysis and resource planning by USDA-NRCS field staff. The user enters the baseline and alternative management and conservation practices for an area of interest (AOI) along with its spatial and non-spatial attributes defined by a geo-spatial navigation interface. The AOI centroid and its extent are used to interface with national databases managed by the USDA-NRCS and other federal agencies to collect soil, climate, and management information to generate input files for the simulation model. The NTT then processes this information and produces reports that can be viewed and printed by the user.



Integration of the NTT with site-specific and user-supplied information to generate marketable water quality credits.

Presently, most NTT users are external to the NRCS and engaged in water quality trading. Thus, the next generation of the NTT is being designed to meet their requirements. When the NTT is integrated within the conservation desktop (CD), to be developed within the Conservation Delivery Streamlining Initiative (CDSI) program, the NTT could also be used by NRCS field staff for evaluating alternative conservation practices for resource planning needs.

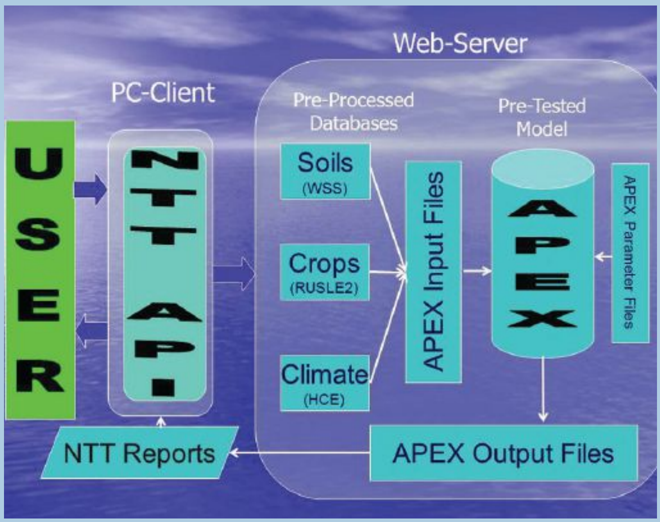
Historical prospective

The first prototype of the NTT, known as the Nitrogen Trading Tool, was developed in collaboration with the USDA-ARS Natural Resources Research Center and hosted on its server at Ft. Collins, Colorado. This version used the Nitrate Leaching and Economic Analysis Program (NLEAP, www.ars.usda.gov/Services/docs.htm?docid=20339), a field-scale model that assesses the potential nitrate leaching associated with agricultural practices. The NLEAP-based version of the NTT only addressed the vertical movement of nitrogen, with little consideration of surface runoff. It also did not simulate phosphorus dynamics and crop yields as affected by different management practices. Similar to nitrogen, phosphorus pollutes national waters and is of great interest to the water quality trading community. Furthermore, variations in crop yields could help producers decide if participating in water quality markets would be financially beneficial under different management scenarios.

To further enhance the NTT and address the NLEAP's limitations, the second generation of the NTT was developed in collaboration with the Texas Institute for Applied Environmental Research (TIAER) at Tarleton State University in Stephenville, Texas. Initially known as the Nutrient Trading Tool, this updated version of the NTT was integrated with the APEX simulation model, which was developed at the Texas A&M AgriLife Research Center in Temple, Texas (http://epicapex.tamu.edu/). This version of the NTT improved the evaluation of nutrient and sediment behavior under various management practices.

The APEX model evaluates various land management strategies by considering sustainability, erosion (wind, sheet, and channel), economics, water supply and quality, soil quality, plant competition, weather, and pests. It has components for routing water, sediment, nutrients, and pesticides across complex landscapes and channel systems to the watershed outlet, as well as groundwater and reservoir components. The integration of APEX into the NTT enhanced the NTT's capabilities for estimating phosphorus, nitrogen, and sediment losses, along with changes in yield under different management scenarios.

The NTT predicts changes in edge-of-field nutrient losses. It primarily tracks how nutrients move in and off the field, rather than generating tradable credits that can be sold or listed for sale in environmental markets. The NTT edge-of-field results need to be bundled with personal information and further adjusted by location-specific factors, such as uncertainty factors and trading ratios, to define tradable credits. Thus, the name of the NTT was further changed from Nutrient Trading Tool to Nutrient Tracking Tool to reflect its real function and capabilities. This version of the NTT is hosted on the TIAER server (http://nn.tarleton.edu/NTT/).



The current configuration of the NTT.

Components of the NTT

The NTT consists of the following components and processes:

- A user-interface including a GIS that allows the user to delineate an area of interest (AOI) and select and/or enter information related to that location.
- A set of databases that contain information including soils, climate, crops, management, and conservation practices needed to run the simulation model.
- A mechanism that processes the user-supplied/selected information along with site-specific information from different databases to generate input files to a linked simulation model such as APEX or NLEAP.
- A model, such as APEX or NLEAP, that simulates the baseline and alternative scenarios with the site-specific resource and crop management information using the generated input data files.
- Processing of the model outputs to generate and present reports to the user.

All of these components and processes are important successful implementation of the NTT. However, the development team at the USDA-NRCS West National Technology Support Center (WNTSC) has primarily concentrated on the following components and processes:

- A user interface that is intuitive and easy to use for selecting and entering information.
- Design and implementation of databases with mechanisms to efficiently store, access, and process soil, climate, and crop data.
- Transformation of the user input and database information into a format that can be used by the simulation model.
- Making simulation calls to the model and running it for the baseline and alternative scenarios.
- Analysis of model outputs for producing and presenting reports that can be easily understood by the user.

When combined with other site-specific information, the NTT reports provide a foundation for generating the water quality credits that can be traded in environmental markets. It is important that the model linked to the NTT interface, such as NLEAP or APEX, is well parameterized and calibrated for the region. As the developer of the NTT interface and associated databases, we have relied on the authors of the models and the research community engaged in testing and validating these models for these services. We recognize the magnitude of this task for a tool like the NTT, with its national scope. Thus, we have proposed a "professional validation" process in which the NTT outputs are checked, verified, and blessed by regional experts for their validity and appropriateness for generating water quality credits for regional environmental markets.

Current configuration of the NTT

To date, all versions of the NTT have been implemented as web applications. In these implementations, all components of the NTT, including the user interface, the simulation model (NLEAP or APEX), and the databases and programming code, are hosted on a single server. The data on soils, climate, and crop management are downloaded from their original locations and duplicated on the NTT server, after preprocessing if necessary.

In the current NTT configuration, hosted on the TIAER website, the user interacts with the NTT through a web browser on a PC. The NTT application programming interface (API) within the web browser connects to the NTT web server, which hosts the NTT components, including the

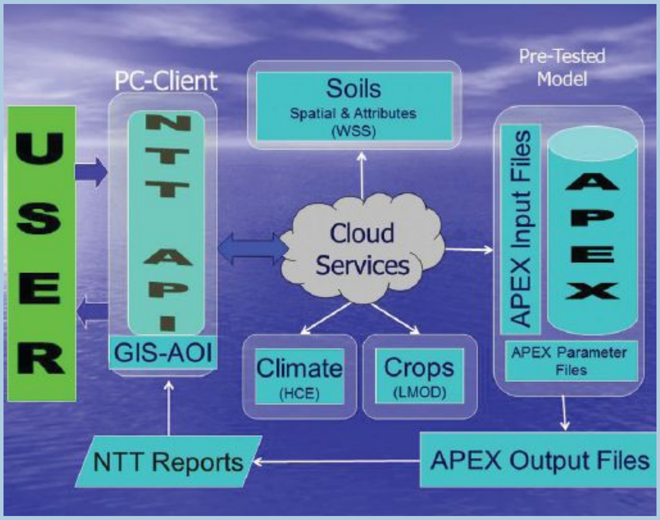
APEX model, the databases, and the programming code. Based on user input, the NTT API interacts with the NTT web server to access different databases (soils, crops, and climate) and generate the APEX input files. The NTT API then runs the APEX model, linking the input files with the APEX parameter files that are also stored on the web server. The APEX simulations produce a set of output files, which are then processed to produce NTT reports. These reports are displayed to the user for viewing and printing.

This configuration requires significant time and resources to process information from the national databases, which are duplicated on the NTT hosting server. In addition, the national databases change at their original locations, requiring regular updates of the in-house NTT data. This data transition process can lead to significant potential for error if not handled with a high level of quality control and quality assurance. It can also result in discrepancies between the data at the national sites and the data stored on the NTT website, leading to erroneous simulation results.

The next generation of the NTT

The next generation of the NTT is being designed to reduce or eliminate these data processing limitations. This new version of the NTT is being developed in collaboration with the NRCS Information Technology Center and the Soil Science and Resource Assessment Division of the Texas A&M AgriLife Research Center in Temple, Texas, using recent computer technologies. These technologies include cloud computing, web services, distributed corporate databases, and an enhanced integrated geo-spatial navigation system.

All components of the next-generation NTT are being restructured using web services to access corporate databases and models running in a distributed cloud environment. This allows accessing the soils, climate, and crop management data from the original databases, thereby eliminating the need to duplicate the databases on the NTT hosting server. Several of the data-provisioning techniques, such as data mining and processing for the APEX model being developed for the NTT, will also be applicable to other models planned for the CDSI framework. This new configuration is in alignment with the NRCS streamlining effort and will enable seamless integration of the NTT into the CDSI desktop computing environment.



The new configuration of the NTT using modern technologies, such as cloud computing, web services, distributed corporate databases, and integrated geo-spatial navigation.

Similar to the current version, the user of the next-generation NTT will interact with the NTT API through a web browser. However, the new API will be greatly enhanced with improved menus that simplify the data entry and editing process as compared to the previous version. The enhanced API will also have an integrated GIS that will allow the user to delineate the area of interest (AOI). Based on the AOI, the system will automatically access the national databases for soil, weather, and crop information specific to the delineated site. These databases include the NRCS Web Soils Survey (WSS) for soils, the NRCS High-Resolution Climate Extractor (HCE) for weather, and a Land Management Operations Database (LMOD), which is under development by the NRCS, for crops and associated operation schedules.

The GIS interface of the NTT API will provide the centroid of the AOI along with the acreage of different parcels with individual soil map units. The centroid of the AOI is used to access historical weather data, such as daily rainfall and minimum/maximum temperatures, from the HCE database using the web services. The AOI centroid will also be used to identify the crop management zone (CMZ) for the AOI and to extract the most dominant cropping systems and associated operations for each crop. The information on soil properties and crop operations will be presented to the user for editing, if desired, a selected set of parameters. This will allow the user to customize the data for a specific location while maintaining the overall integrity of the corporate databases.

The historical climate data along with the customized crop operation and soil parameters will be transformed into APEX input data files. These files, along with APEX parameter files, will be used to run the APEX model in the cloud using the web services. The resulting output files will be processed to produce the NTT reports, which will be presented to the user for viewing or printing, similar to earlier NTT implementations.

The distributed environment for storing and accessing the databases and for running the APEX model in the cloud using web services, coupled with improved system integration, is expected to reduce the run-time requirement for the NTT and enable multiple users to access the NTT simultaneously.

Comparison of the current NTT and the next-generation NTT.

Item	Current NTT	Next-Generation NTT
Hosting server	TIAER (http://nn.tarleton.edu/NTT/)	USDA-NRCS
APEX version	CustomizedVersion 0604	Version 0806 or higher
NTT operation and maintenance	Changes and maintenance of NTT components, including the simulation model, databases, or program code, can result in disruptions of service and require re-building of the servers.	Web services can be modified independently to accommodate changes in the simulation model and data structures with minimum effect on other components.
Soil, weather, and crop databases	Downloaded from corporate data sources, pre-processed and stored on the NTT server along with the APEX model.	Accessed directly from the corporate data servers using web services and processed on the fly.
Area of interest (AOI) selection	Cut-and-paste from the Web Soil Survey (WSS) interface.	A GIS interface for the AOI is an integral part of the next-generation NTT.
System configuration	The APEX model, associated input files, and other data files are stored on a single server, leading to slower processing speed.	A distributed data structure leads to improved processing time and allows simultaneous access processing for multiple users.
System expansion	To meet increased system demand, additional servers with duplicate databases would be required.	Cloud-based service implementation offers the ability to expand the capacity as demand increases.
NTT input data consistency	User selection of state, county, climate, crop, soils, etc., individually from different menu systems increases the possibility of inconsistency among these data.	Accessing and processing of crop, soil, and weather information based on the user-defined AOI eliminates the possibility of mismatch of these data elements .
Crop management and operation data	Generated independently of the CMZ (crop management zone) operational file.	Accessed from the CMZ within the user-defined AOI and converted to the APEX input files.

More work still needs to be done

Several of the components of the next-generation NTT, such as the improved user interface for selecting and entering data, the web services for accessing the national databases, and the programming code for transforming the user-supplied and database information into APEX input file format, have been developed and are available for testing. However, a considerable amount of work still needs to be done to complete the initial prototype and subsequently the production version of the next-generation NTT. Some of these tasks include:

- Further improvements of the user interface, with editing capabilities that let users customize the data accessed from the national databases specifically for their location.
- A GIS interface that lets users modify the AOI with multiple non-contiguous fields and provide their spatial and non-spatial attributes. These include the AOI centroid, the area of each field and of the mapping units within them, and the soil characteristics of all mapping units.
- Integration of the most recent version of the APEX model that has been parameterized and calibrated for the U.S. geographic regions where the next-generation NTT is planned to be introduced and that has the capability to generate the NTT reports.
- Integration of the different components of the next-generation NTT into a functioning prototype and then testing it for proper functioning.

Thanks to our partners and collaborators

Our team will continue to rely on the developers of the simulation models and other experts for the accuracy and usefulness of the NTT. In the first prototype of the NTT (known as the Nitrogen Trading Tool) using NLEAP, we collaborated with Dr. Jorge Delgado and Dr. Marv Shaffer at the USDA-ARS Natural Resources Research Center in Fort Collins, Colorado. For the current versions of the NTT (the Nutrient Trading Tool and the Nutrient Tracking Tool) using APEX, we collaborated with Dr. Ali Saleh at the Texas Institute for Applied Environmental Research (TIAER) at Tarleton State University in Stephenville, Texas. For the next generation of the NTT, we are collaborating with Dr. M. Lee Norfleet at the Soil Science and Resource Assessment Division of the Texas A&M AgriLife Research Center in Temple, Texas. Thanks to their efforts, as well as the comments we have received from NTT users, the next-generation NTT will provide many new benefits in comparison to its current and past implementations.

ASABE Member Harbans Lal, Environmental Engineer, USDA-NRCS West National Technology Support Center, Portland, Ore., USA, harbans.lal@por.usda.gov.

Lie Tang ***(right)*** **talks with Ken Blackledge about how the robot will be designed to aid organic farmers. Blackledge owns and operates Black Cat Acres in Nevada, Iowa.** ***Photo by Bob Elbert, courtesy of Iowa State University.***

Robotic weeding leads to big labor savings

In Brief: **ASABE member Lie Tang**'s research in robotics offers a glimpse into the future of organic agriculture. Tang, an associate professor in Iowa State University's Department of Agricultural and Biosystems Engineering, is developing robotic technologies for intra-row weeding of vegetable crops. He hopes that by perfecting this technology, he can design an automated robot to reduce the labor and chemical inputs on small to mid-sized operations for farmers who are looking for environmentally friendly weeding alternatives.

After talking with Iowa vegetable growers with small to mid-size farms, Tang recognized a hole in current weeding approaches that robotics could fill. "Weeding has been a long-standing problem for many years because there is no silver bullet. There are just too many variables. And for organic farmers, their options are very limited. Their options are either chemical, laborious, or expensive," says Tang. "My robot design offers the producer a more effective and sustainable alternative."

For organic farmer Ken Blackledge, owner of Black Cat Acres in Nevada, Iowa, the battle with weeds occupies much of his time and energy. "If a robot could weed a diverse crop and be cost-effective I would be interested," says Blackledge. "Management of weeds is one of the biggest challenges that I face. Weeding takes away from crop development, time needed to market, and other more productive activities.

A key part of the weeding robot is the sensing system used to distinguish productive plants from weeds. The robot will monitor and adjust its real-time location in reference to the plants, rows, and landscape based on three-dimensional data. "There are other, larger weeding robots on the market," says Tang. "But they are designed for much larger operations and require high-accuracy GPS systems. Few farmers in Iowa can afford that type of equipment. Our robot will take pictures with three-dimensional sensors to provide more robust information than a conventional camera."

Time of flight data from the sensors will be used to calculate distances and give a picture of what types of plants are growing in the row. If weeds are found, actuators on the robot will disturb the soil around the crop and within the row, removing the weeds mechanically without disturbing the crop. The small robot will also be designed to travel over the planting rows without disturbing the crops. By getting as close as possible to the plants, the robot will be able to remove weeds autonomously without the use of herbicides or plastic sheeting.

Kathleen Delate, a professor of horticulture and co-principal investigator, has been enthusiastic about the potential that the project holds for organic farmers. She says that not only does the robot offer an alternative to herbicides, it also considers the importance of soil structure. “Robotic weeding technology offers promising options for producers by reducing the labor required to manage weeds and by avoiding the soil compaction that can occur with tillage. Organic producers are especially interested in this technology because herbicides are disallowed in organic production. With the increasing problem of herbicide resistance, more and more producers will be looking for alternatives,” says Delate.

Tang’s research group originally built a larger, more cumbersome robot that served as inspiration for a smaller and more aesthetic design. “With the new generation of the robot, we are integrating sensing and controls together to fine-tune the robot’s capabilities,” said **ASABE member Brian Steward**, professor of agricultural and biosystems engineering and co-principal investigator. “This technology is potentially transformative.”

Automation and sensor technologies are developing rapidly. The result is that precision agriculture is quickly being adopted, transforming the farming industry. In order for these technologies to run properly and be maintained, the next generation of agricultural engineers is being trained to embrace robotics. “My sons are participating in FIRST robotics competitions,” says Steward. “Students are learning to design robots as children. As these young people move forward in their education, our society’s aptitude with robotics will increase. If we are going to adopt robots in agriculture, we will need people who can build and repair them. And now that’s happening.”

As his project moves forward, Tang recognizes that there will be obstacles, including economic feasibility. However, he’s proud of the attention that his peers have given his work, which marks one of the first times that field robotics has been included in an organic agriculture related grant. Tang’s project began with two competitive grants from The Leopold Center for Sustainable Agriculture’s Marketing and Food System Initiative.

For more information, contact Dana Woolley, Communications Specialist II, dwoolley@iastate.edu.

New technique makes “biogasoline” from plant waste

In Brief: A plant-based gasoline replacement would open up a much bigger market for renewable fuels.

Gasoline-like fuels can be made from cellulosic materials such as farm and forestry waste using a new process invented by chemists at the University of California, Davis. The process could open up new markets for plant-based fuels, beyond existing diesel substitutes.

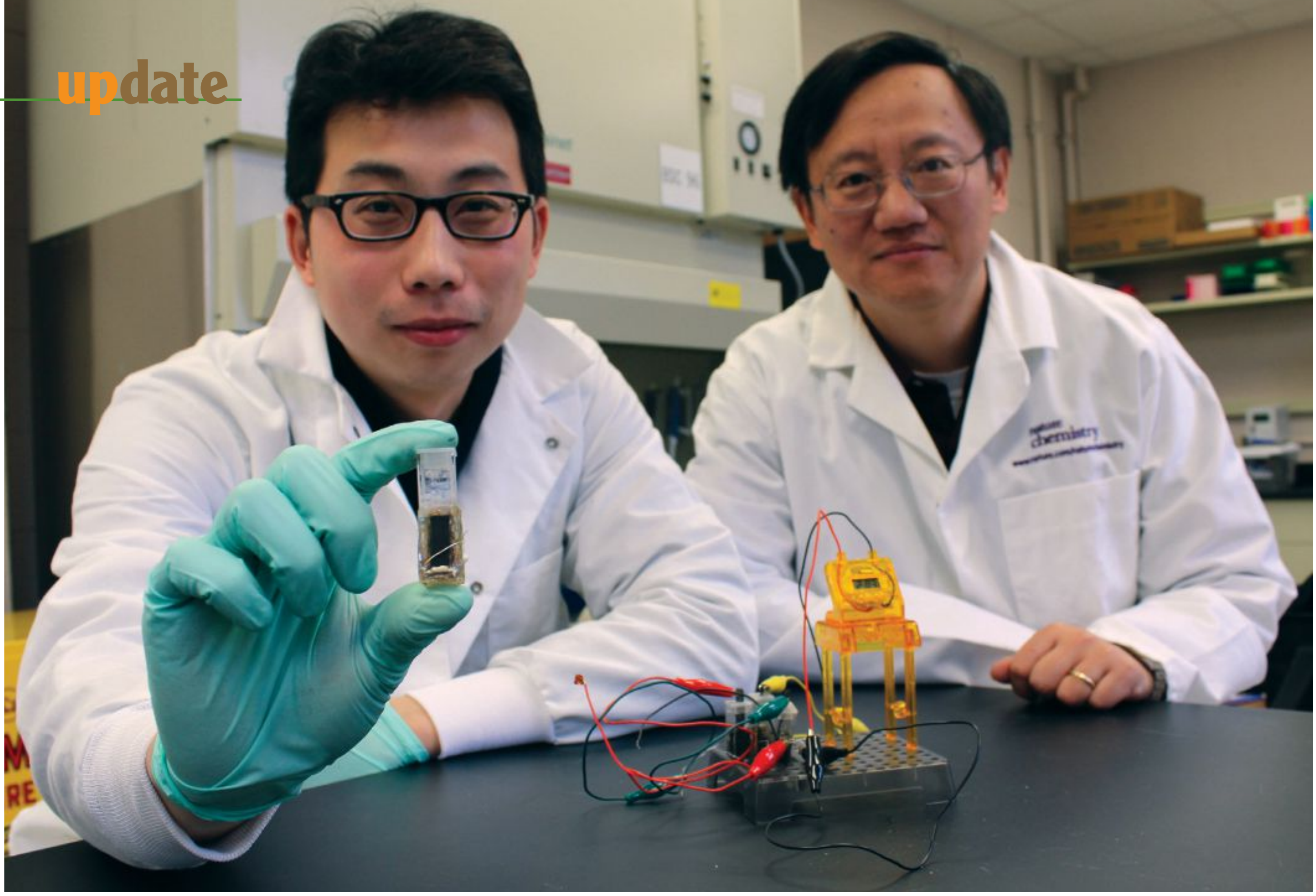
Traditional diesel fuel is made up of long, straight chains of carbon atoms, while the molecules that make up gasoline are shorter and branched. This means that gasoline and diesel evaporate at different temperatures and pressures, as reflected in the different designs of diesel and gasoline engines. “What’s exciting is that there are lots of processes to make linear hydrocarbons, but until now nobody has been able to make branched hydrocarbons with volatility in the gasoline range,” said Mark Mascal, professor of chemistry at UC Davis.

Biodiesel, refined from plant-based oils, is already commercially available to run modified diesel engines. A plant-based gasoline replacement would open up a much bigger market for renewable fuels.

The feedstock for the new process is levulinic acid, which can be produced by chemical processing of materials such as straw, corn stalks, or even municipal green waste. It’s a cheap and practical starting point that can be produced from raw biomass with high yield, Mascal said.

“Essentially it could be any cellulosic material,” Mascal said. Because the process does not rely on fermentation, the cellulose does not have to be converted to sugars first. UC Davis has filed provisional patents on the process.

For more information, contact Mark Mascal, mjmascal@ucdavis.edu, or Andy Fell, UC Davis News Service, ahfell@ucdavis.edu.



Y. H. Percival Zhang *(right)* and Zhiguang Zhu show off their new battery. ***Photo courtesy of Virginia Tech College of Agriculture and Life Sciences.***

Environmentally friendly, energy-dense battery runs on sugar

In Brief: A Virginia Tech research team has developed a battery that runs on sugar and has an unmatched energy density, a development that could replace conventional chemical batteries with power cells that are cheaper, refillable, and biodegradable.

While other sugar-based batteries have been developed, **ASABE member Y. H. Percival Zhang**, associate professor of biological systems engineering in Virginia Tech's College of Agriculture and Life Sciences and College of Engineering, said his team's battery has an energy density an order of magnitude higher than others, allowing it to run longer before needing to be refueled.

The new battery is also biodegradable, which is important. In the United States alone, billions of toxic batteries are thrown away every year, posing a threat to both the environment and human health, according to the U.S. Environmental Protection Agency. Zhang's development could help keep thousands of tons of batteries from ending up in landfills.

"Sugar is a perfect energy storage compound in nature," Zhang said. "So it's only logical that we try to harness this natural power in an environmentally friendly way to produce a battery." In as soon as three years, Zhang's new battery could be powering some of the cell phones, tablets, video games, and myriad other electronic gadgets in our energy-hungry world.

Zhang's previous research involved mixing enzymes together in combinations not found in nature. He has published articles on creating edible starch from non-food plants and developed a new way to extract hydrogen in an economical and environmentally friendly way that can be used to power vehicles. In this newest development, Zhang and his colleagues constructed a synthetic enzymatic pathway that strips all charge potentials from sugar to generate electricity in an enzymatic fuel cell. Low-cost biocatalyst enzymes are used as catalysts instead of costly platinum, which is typically used in conventional batteries.

Like all fuel cells, the sugar battery combines fuel (in this case, maltodextrin, a polysaccharide made from partial hydrolysis of starch) with air to generate electricity, with water as the main byproduct. "We are releasing all electron charges stored in the sugar solution slowly, step by step, by using an enzyme cascade," Zhang said.

The fuel sugar solution is neither explosive nor flammable, which is an important difference from hydrogen fuel cells and direct methanol fuel cells, and it has a higher energy storage density. The enzymes and fuels used to build the device are biodegradable. The battery is also refillable, and sugar can be added to it much like filling a printer cartridge with ink.

For more information, contact Zeke Barlow, zekebarlow@vt.edu.

Technique allows more frequent and detailed water quality monitoring

In Brief: Researchers at North Carolina (NC) State University have developed a new technique that uses existing technology to help researchers and natural resource managers collect significantly more information on water quality to better inform policy decisions.

"Right now, incomplete or infrequent water quality data can give people an inaccurate picture of what's happening, and making decisions based on inaccurate data can be risky," says **ASABE member François Birgand**, an assistant professor of biological and agricultural engineering at NC State and co-author of a paper describing the work. "Our approach will help people get more detailed data more often, giving them the whole story and allowing them to make informed decisions."

In addition to its utility for natural resource managers, the technique will allow researchers to develop more sophisticated models that address water quality questions. For example, the researchers at NC State are using data they collected with the new technique to determine the extent to which fertilizer runoff contributes to water pollution in specific water bodies and the role of wetlands in mitigating the effect of the runoff.

The researchers used UV-Vis spectrometers, which measure the ultraviolet and visible wavelengths of the light absorbed by water, to collect water quality data. The upside to these devices is that they can collect data as often as every 15 seconds, and over long periods of time. This is far more frequent than is possible with conventional water sampling and laboratory analysis techniques. The downside is that they are designed to monitor only a handful of key water quality parameters: nitrates, dissolved organic carbon, and turbidity.

The NC State research team developed a technique that uses a suite of algorithms to significantly expand the amount of information that can be retrieved from the spectroscopic data collected by the UV-Vis devices. Specifically, the new technique allows researchers to get information on the levels of organic nitrogen, phosphates, total phosphorus, and salinity of the water. This additional water quality data can offer insights into a host of questions, including questions about nutrient pollution.

The researchers tested the new technique in a restored brackish marsh that experiences approximately 70 cm (28 in.) of tidal variation, along with salinity that can vary from freshwater to saltwater within minutes when the tide turns. "We found that the results obtained with our automated technique were comparable to the results we obtained by testing water samples in the lab," Birgand says. "So we gain a lot in terms of monitoring frequency, without sacrificing accuracy."

For more information, contact Matt Shipman, matt_shipman@ncsu.edu, or François Birgand, francois_birgand@ncsu.edu.

Researchers have developed a new technique for collecting more (and more accurate) water quality data. The technique was tested in this brackish marsh. ***Photo by François Birgand.***

ASABE member receives $1 million to develop milk cooler

In Brief: Keeping milk safe and healthy to drink is a challenge in areas without electricity. **ASABE member William Kisaalita** received $1 million to continue working on a milk cooler designed to help dairy farmers, particularly those in sub-Saharan Africa, who lack access to refrigeration.

William Kisaalita *(right)* works with Ryan Brush, an undergraduate student, on the milk cooler used in his refrigeration project in Uganda.

The milk cooler developed by Kisaalita, professor of biological and mechanical engineering in the University of Georgia's College of Engineering, uses the principle of evaporative cooling to quickly chill milk to a safe holding temperature. "It's the same phenomenon that occurs when you jump into a swimming pool and then you come out on a windy day," said Kisaalita. "If there's water on your skin, you will feel cold. This same principle is applied in chilling the milk."

Kisaalita recently received $1 million from the U.S. Agency for International Development in partnership with the Swedish Government, Duke Energy Corporation, the German Government, and the Overseas Private Investment Corporation. Kisaalita's was one of 12 international projects selected from 475 applications to share $13 million in funding through USAID's Powering Agriculture: An Energy Grand Challenge for Development. The prizes were awarded to projects that integrate clean energy technology into the agriculture sectors of developing countries. "Powering Agriculture demonstrates how we can harness ingenuity and entrepreneurship to generate and scale real solutions in our fight to end extreme poverty," said USAID administrator Rajiv Shah. "These winning ideas prove that we can change the landscape of what is possible."

In the milk cooler developed by Kisaalita, the evaporative cooling process is powered by biogas. The biogas is produced through the collection of cow manure, which is an abundant resource on dairy farms. The milk cooler design includes a container of milk that is surrounded by water. A vacuum pump depressurizes the container, and zeolite, an adsorbing silicate, captures the evaporating water, causing the temperature inside the cooler to drop. The milk is thereby chilled and keeps fresh overnight, allowing farmers to sell the milk the next day. Currently, dairy farmers in developing regions may lose as much as 50% of their daily milk due to inadequate cooling.

Working with farmers in rural Uganda, Kisaalita will refine the design of his cooler and then work with local manufacturers to bring the cooler to the local farmers. "The social, economic, and environmental benefits of this project are interrelated and will have a rippling effect," said Kisaalita "The milk coolers will benefit dairy farmers by decreasing milk spoilage and increasing production and profits. The biogas, which will also be used for lighting and cooking, will save income that otherwise would be spent on kerosene and will replace the use of charcoal and wood for cooking, which is shrinking in availability as Uganda's forests are depleted. In addition, extracting biogas from cow manure mitigates the greenhouse gas emissions from fermenting cow dung. Finally, there are health benefits from cooking with biogas, because smoke from woody biomass causes respiratory problems in children."

A native of Uganda, Kisaalita received his PhD in chemical engineering from the University of British Columbia in Vancouver and BS in mechanical engineering from Makerere University in Kampala, Uganda. He joined the UGA faculty in 1991, and he has been involved in various research activities and international service-learning projects that have engaged undergraduate students in addressing real-world problems in developing solutions. Along with his teaching and research responsibilities, Kisaalita has served as associate director of UGA's Center for Undergraduate Research Opportunities, and he is a faculty mentor for students in the Peach State Louis Stokes Alliance for Minority Participation.

For more information, contact William Kisaalita, williamk@engr.uga.edu, or Mickey Montevideo, Public Relations Coordinator, mickeym@uga.edu.

FACULTY POSITION AT COLLEGE OF MECHANICAL AND ELECTRONIC ENGINEERING (CMEE), NORTHWEST A&F UNIVERSITY

Northwest A&F University (NWAFU) is a national key university directly under jurisdiction of Ministry of Education of China and supported by its "Project 985" and "Project 211". The University is located in Yangling, Shaanxi, 80 km west of Xi'an, a historic city of China. Yangling is the location of the state-level Agricultural Hi-tech Industries Demonstration Zone.

POSITION: Associate or Full Professor of Agricultural & Biological Engineering

RESPONSIBILITIES: The CMEE is currently seeking applications for 5-6 full-time positions at the Associate or Full Professor level in the area of intelligent agricultural equipment and technology, agricultural information and computer application technology, vehicle design and engineering, and mechanical design theory. The successful candidate is expected to establish a nationally or internationally recognized applied research program that supports development of agricultural engineering disciplines in China. The individual will engage industry, along with local, province, national government or non-government agencies. It is expected that the individual will develop a successful externally-funded and well-documented applied research and teaching program.

SALARY AND COMPENSATION (IN RMB): For distinguished full professors, start-up fund is 3-5M, salary is >100-600K, with settling-in allowance of 300K, providing an apartment of 150-180 m^2, and arrangements of spouse's job, depending on qualification and experiences. For associate professors, start-up fund is about 0.3-1M with competitive salary, settling-in allowance of 50-100K, providing an apartment of 140 m^2, and possible arrangements of spouse's job. Both apartment properties will be owned by individuals after working for 10 years.

CLOSING DATE FOR APPLICATIONS: Review of applications will begin May 1, 2014 and continue until the positions are filled.

APPLICATION MATERIALS: Letter of interest, resume, official academic transcripts, five representative papers, and three reference letters. Applications should be submitted electronically to Mrs. Xiaoying Chen at rencaike@nwsuaf.edu.cn.

CONTACT: Dr. Shaojin Wang, Associate Dean, Search Committee Member, email: shaojinwang@nwsuaf.edu.cn.

AGRICULTURAL SYSTEMS MODELER ASSISTANT PROFESSOR, MICHIGAN STATE UNIVERSITY

Agricultural Systems Modeler Assistant Professor, fixed term: Michigan State University seeks an outstanding individual for a position 60% in the Department of Plant, Soil and Microbial Sciences (PSMS) and 40% in the Department of Biosystems and Agricultural Engineering (BAE). Funding for the position is available for five years. Following an initial three-year appointment, the position will be renewed annually based on satisfactory performance. The position is expected to develop an outstanding, grant-supported research program addressing complex agricultural systems in an international context. Experience with widely used models such as DSSAT or EPIC, agent-based models or advanced statistical methods would be a plus. Applicants must have a doctorate in an agricultural sciences or modeling field, and show evidence of excellence in research and a demonstrated ability to obtain grant funding.

Qualified individuals should submit a letter of application, a statement of research interests, curriculum vita, and names and contact information for three references to: Prof. Sieg Snapp, Search Committee Chair, 517-282-5644, snapp@msu.edu. Applications for this position should be submitted online at https://jobs.msu.edu (posting #9290), by May 15, 2014.

MSU is an affirmative-action, equal-opportunity employer. MSU is committed to achieving excellence through a diverse workforce and inclusive culture that encourages all people to reach their full potential. The University actively encourages applications and/or nominations of women, persons of color, veterans and persons with disabilities.

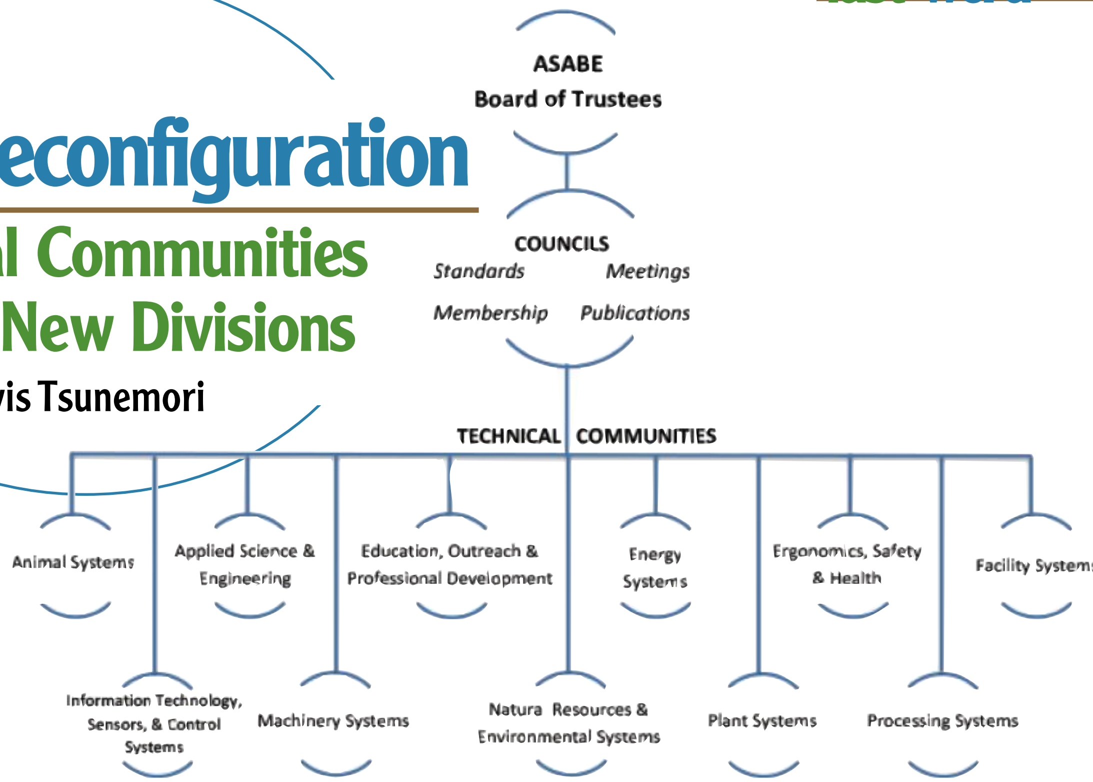
Resource is published six times per year: January/ February, March/April/, May/June, July/August, September/October, and November/December. The deadline for ad copy to be received at ASABE is four weeks before the issue's publishing date.

For more details on this service, contact Melissa Miller, ASABE Professional Opportunities, 2950 Niles Road, St. Joseph, MI 49085-9659, USA; 269-932-7017, fax 269-429-3852, miller@asabe.org, or visit www.asabe.org/resource/persads.html.

ASABE Reconfiguration

Technical Communities Are the New Divisions

Travis Tsunemori



If you voted in the latest Society election or attended a recent Annual International Meeting (AIM), you have probably heard the buzz about reconfiguring the Society's technical committees and updating our "look and feel" for marketing and outreach. If you haven't heard yet, then here's a brief overview: the previous system of technical divisions has been reconfigured into a new system of technical communities (see the accompanying diagram).

As part of this reconfiguration, committee members are carefully restructuring ASABE's many technical committees to better reflect biological and agricultural engineers' engagement within the Society. Some existing committees will remain the same, and some will move to a technical community that is more closely aligned with their work. A few committees have determined that they will disband or combine with another committee of similar scope and membership.

To help guide this process, ASABE staff has created a one-to-one mapping document that lists every committee and where it could land. If you would like a copy of this document, let me know. And keep in mind that this is no "one and done" exercise. It's intended to be a dynamic process. If you don't see your home in the new structure, then let me or other ASABE staff know, and we can develop one together.

As we move forward with the reconfiguration, look for these upcoming milestones:

All ASABE members will soon receive (if you haven't already) a postcard that illustrates the overall structure of the technical communities.

Committee leaders will receive communications from headquarters about the specific impact of the reconfiguration on their committees.

All committee members will receive a later communication from headquarters with final details of where their committees will fit in the new structure.

The 2014 AIM will be conducted under the old structure, both for committee meetings and for technical session sponsorships. This will help ease the transition to the new structure.

The 2015 AIM and Call for Papers will reflect the new structure. A huge benefit of this will be a significant reduction in overlapping sessions with similar themes.

A question that has come up recently is, "Why did biological engineering go away?" The answer is, "It didn't." The Society has embraced the fact that biological engineering is a significant part of all the technical communities. The BE committees have been placed into the technical communities that best match their scope and purpose. Other divisional committees have been similarly placed. For example, the FPE committees that deal mostly with processing for energy are now in the Energy Systems technical community.

ASABE staff and leadership believe that the reconfiguration will better reflect what ASABE members actually do, and it will help the Society grow and continue to thrive. As I mentioned above, the new structure is dynamic, and it will be adjusted as areas of duplication and missing needs are identified. It's not done yet, but so far we're off to a very good start.

ASABE Member Travis Tsunemori, Staff Engineer, ASABE, St. Joseph, Mich., USA, travist@asabe.org.

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GUIDE TO CONSULTANTS 2014

This *Guide to Consultants* is presented as a service to people interested in agricultural/ biological engineering assistance. This listing is not an offer or advertisement to provide engineering services in any state or jurisdiction where the professional engineer or professional engineering firm is not registered/licensed. All information was provided by the listed consultant. The American Society of Agricultural and Biological Engineers (ASABE) assumes no responsibility for the validity of the qualifications listed or the consulting services performed.

Listings for both registered professional engineers and consultants who are not registered engineers are included. In the United States the registration/licensing of professional engineers is vested in the states/territories. Administration of the relevant laws governing the practice of engineering is assigned to engineering boards. The primary role of these regulatory boards is to protect the life, health, property, and welfare of the public and to ensure that unqualified individuals do not practice engineering. Many other countries also have laws and regulations pertaining to the practice of engineering. When selecting a consultant, it is recommended that any jurisdictional registration/ licensing requirements be identified for specific services.

In the following listings, the date after the specialty description is the professional engineer's initial registration date. The state(s) or country in which the consultant is registered follows the date. The consultant's availability is given on the next line, including geographic area of service.

Indication of registration in a single state does not imply that a professional engineer cannot be registered in other states. Most state engineering registration laws and rules are patterned after guidelines prepared by the National Council of Examiners for Engineering and Surveying, P.O. Box 1686, Clemson, SC 29633, USA. Most states have laws that permit a professional engineer to become registered in other states, either temporarily or permanently, without re-examination. Consideration of the consultant should be on the basis of the consultant's qualifications and not on where registered, because many consultants can obtain registration in other states or jurisdictions.

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Suite 100
Peoria, IL 61604, USA
309-693-7615
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Consulting, evaluation, planning, and design services for livestock and poultry production facilities including expansion, site development, feasibility studies, renovation, ventilation and heating, environmental monitoring, product development, field research, manure handling/ storage/treatment, permitting, nutrient management, odor assessments, equipment/material specifications and earthwork quantities. Expert witness testimony. Experience includes horses, swine, dairy, turkeys, broilers, and beef cattle facilities.

Initial date of registration 1998; IL, IN, AR, WI
Available full-time; Domestic and International

John A. George, P.E.

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AEA provides experienced (40 years), leading edge services to US and International Clients on production and research livestock and poultry facilities and associated environmental systems, permitting, crop production, and renewable energy systems to maximize efficiency, profitability, and environmental compliance. Primary services include complete facility design, environmental permitting, and construction management.

Initial date of registration 1974; KS, AL, AR, CO, GA, IL, IN, IA, MO, MI, MT, NE, NM, NY, NC, OH, OK, OR, PA, SD, TX, WA, WI, WY
Available full-time; Domestic and International

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Initial date of registration 1993; SK (Canada)
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816-223-5927
rich.wjob@sbcglobal.net

Managing the product design and development process; product safety evaluation process; standards application and compliance.

Initial date of registration 1985; WI
Available part-time; Domestic and International

Larry R. Johnson, P.E.

Oakwood Engineering LLC
W7975 Oakwood Lane
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920-650-3371
ljohnsonwi@gmail.com

Consulting services for agricultural and construction equipment. Services include product safety program development, safety evaluation of equipment and product documentation, and expert witness litigation support. Litigation experience in personal injury, product performance, contracts, trade dress, patent and trademark issues. Over 30 years experience in operations and engineering management.

Initial date of registration 1974; MI, WI
Available part-time; Domestic and International

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Initial date of registration 2007; MO, IL
Available full-time; Domestic and International

Joseph G. "Jake" Martin III, P.E.

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jake@dairydesign.com
www.dairydesign.com

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Initial date of registration 1984; LA,GA, FL, KS, AZ, IA, VA, TX, KY, 0H, SC, NC, TN
Available full-time; Domestic and International

Frank C. Mercurio, P.E.

KLA Environmental Services, Inc.
1303 Yucca Street
Scott City, KS 67871
785-823-0097
fmercurio@klaenviro.com
www.klaenviro.com

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Initial date of registration: 1985; KS, CO, OK
Available full time; Domestic

Brad Meyer, P.E.

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Provider of engineering, design, prototype build, and testing for various industries. Work done in agricultural and construction equipment, food processing, specialty machines, test machines, weld fixtures and tooling for prototypes and manufacturing, CMM measurement, and data acquisition. Experience in all phases of a project: concept, design, FEA, build, testing, product verification. Pro/E, AutoCAD, Inventor, SolidWorks.

Initial date of registration 2007: IA
Available full-time; Domestic and International

James M. Miller, Ph.D., P.E.

J.M. Miller Engineering, Inc.
2392 Fuller Court
Ann Arbor, MI 48105, USA
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miller@millerengineering.com
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Initial date of registration; ID 1999, OH 1968
Available full-time; Domestic

Registered Engineers

David A. Olheiser, P.E.

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Initial date of registration 1978; MN, all states except AK and HI
Available full-time; Domestic and International

Jason E. Olmstead, P.E.

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www.mstutz.com

Consulting, evaluation, planning, and design services for livestock and poultry production facilities including expansion, site development, feasibility studies, renovation, ventilation and heating, environmental monitoring, product development, construction observation, manure handling/storage/treatment, permitting, nutrient management, equipment/material specifications and earthwork quantities. NRCS project experience. Experience includes beef, dairy, swine, horses, and poultry facilities.

Initial date of registration 2010; IL, IA, MO, WV, HI, AZ
Available full-time; Domestic and International

Jonathan C. Popp, P.E.

Popp Engineering, Inc.
2710 Ford Street
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jpopp@poppengineeringinc.com
www.poppengineeringinc.com

Professional engineering and project management services are provided to the seed and related agricultural industries. These services encompass renovation and new construction, specializing in air systems, dust control, and seed drying systems. All phases of projects from problem analysis and design to equipment procurement and construction management are provided to clients.

Initial date of registration 1993; IA, IL, MO, NE
Available full-time; Domestic

Brian L. Roy, P.E.

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211 West Warren Avenue
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RoyBL@royalconsulting.com
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Initial date of registration 1992; FL, PA, NY, NC, TX, LA
Available full-time; Domestic and International

Timothy R. Royer, P.E.

Timber Tech Engineering, Inc.
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Consulting engineering and design services for timber frame and light wood constructed buildings. Design of manure containment structures and agricultural engineering. Concrete, masonry, and steel design. Also, building code review and computer aided drafting services.

Initial date of registration 1989; PA, CT, DE, FL, GA, IN, IA, KY, MA, MI, MN, MO, MS, MD, NJ, NY, NC, OH, SC, TN, UT, VA, WI, WV, WY
Available full-time; Domestic

Fred B. Semke, P.E.

Semke Forensic
154 Hughes Lane
St. Charles, MO 63301, USA
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Initial date of registration 1998; MO, IL, AR, KY, KS, OK, IA, AL
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Ralph Shirley, P.E.

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Phone: 507-331-1500
Fax: 507-331-1501
Cell: 507-951-4589
russ.stammer@is-grp.com
www.is-grp.com

Consulting engineering services for agricultural waste handling and storage, manure and nutrient management, food processing waste and wastewater treatment, egg production wastewater treatment, odor control, biofiltration, planning, design, construction observation, construction management, permitting, site design, drainage, stream stabilization, spray irrigation design, and structure design. NRCS project experience and TSP.

Initial date of registration 1985: IA, MN, NE, WI
Available full-time; Domestic and International

Jerry L. Wille, P.E.

President, Curry-Wille & Associates,
Consulting Engineers, P.C.
425 S. 2nd Street / PO Box 1732
Ames, IA 50010, USA
515-232-9078
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Consultation on agricultural experiment stations, commercial and private facilities housing livestock and poultry or storing grain and seed. Services include designs, plans, and specifications for the general, structural, mechanical, and electrical portions of the projects, including site development, utilities, and waste handling.

Initial date of registration 1977; IA, OK, IL, KS, OH, ID, CO, MO, MN, MS, WI, NC, KY, NE, PA, SD, IN, MI, NJ, AR, MD, TN, AL, GA, VA
Available full-time; Domestic and International

Nellie J. Brown MS., C.I.H.

Director of Workplace Health & Safety Programs
Certified Mold Assessor
Lead Programs Manager
Cornell University, ILR School
237 Main Street, Suite 1200
Buffalo, NY 14203-2702, USA
716-852-4191 ext.111
Fax: 716-852-3802
njb7@cornell.edu

Nellie Brown is a certified industrial hygienist, providing health and safety training and technical assistance. She developed a process failure and hazard assessment protocol for anaerobic digesters used for processing manure and generating electricity on dairy farms. Nellie serves on an ASABE committee developing a standard on manure pit ventilation.

Available part-time

Gary M. Hyde, Ph.D.

G.M. Hyde Consulting
750 SE Pheasant Run
Pullman, WA 99163-6414, USA
Cell: 509-336-9143 (preferred)
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Agricultural Engineering Associates

John A. George, PE
johng@agengineering.com

1000 Promontory Drive
PO Box 4
Uniontown, KS 66779

www.agengineering.com
Phone: 800-499-5893
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Because of their broad educational background, consulting agricultural engineers are a source of information on a wide variety of topics and can provide help with diverse technical problems. The design and management services agricultural engineers provide can be invaluable to small businesses without their own engineering departments, to agricultural producers and similar enterprises, and to large businesses or governmental agencies that want to supplement their in-house engineering departments. Consultants also can provide service to lending institutions, law firms, local units of government and planning boards, or to individuals that need expert witnesses or technical analysis.

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- Food and Food Processing
- Forestry
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- Power and Machinery
- Safety
- Soil and Water Resources
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Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

I. using their knowledge and skill for the enhancement of human welfare;
II. being honest and impartial, and serving with fidelity the public, their employers and clients;
III. striving to increase the competence and prestige of the engineering profession; and
IV. supporting the professional and technical societies of their disciplines.

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1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
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3. Engineers shall issue public statements only in an objective and truthful manner.
4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
5. Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
6. Engineers shall act in such a manner as to uphold and enhance the honor, integrity and dignity of the profession.
7. Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of those engineers under their supervision.

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