

FALL/WINTER 2014

THE

magazine

UNIVERSITY OF KENTUCKY

COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT



The Environment Issue

Rainy Days and Outcomes pg. 12

Are we still paying the price for the acid rain of the 70s and 80s? A 20-year study by UKAg researchers looks for the answer.

Reviving the Dead Zone pg. 16

Kentucky is a large contributor to a serious problem in the Gulf of Mexico. UKAg specialists and farmers are changing that.

.....from the dean

Solutions *through* Science

When the college name changed in 2013, the words “environment” and “food” were included to make it clear these two topics are important parts of our programs. This issue of the magazine focuses a lot on our work to create solutions for the natural environment.

There are huge, complicated environmental issues out there and many opinions. Our role, as a land-grant college of agriculture, is to work toward solutions by providing the best scientific information. In many cases, CAFE researchers’ monitoring of environmental quality impacts not only agriculture, but also all life in the commonwealth and beyond. The U.S. Environmental Protection Agency’s invitation to the college to participate on the Gulf hypoxia task force is a perfect example.

Kentucky’s agricultural and forest producers face a complex array of changing regulations. There are state and federal laws and regulations on water quality that are the subject of much political debate. Where does CAFE fit in? We fit in ways that reflect our tripartite land-grant mission: teaching, research, and extension.

Any time regulations evolve, there is a need for educating producers on compliance. County agents work with state specialists to provide cost-efficient solutions. Research and extension personnel conduct demonstrations and advise on cost-share opportunities.

One example concerns the disposal of animals that die on the farm. When federal regulations reduced the availability of renderers to haul off fallen animals, extension and research teams developed on-farm large animal composting projects. CAFE experts take issues like these seriously, and they take pride in finding solutions.

CAFE engages a variety of students in environmental education, using the Robinson Forest in many teaching activities. Undergraduate students from the interdisciplinary major Natural Resources



and Environmental Science learn about science, technology, and policy issues regarding the environment. And many other students consider environmental topics in their horticulture, animal, crop, and social sciences classes. This broad educational experience starts with 4-H and its programs on the environment.

We are part of a network of state and federal agencies as well as consumer and producer organizations. CAFE experts communicate frequently with agency personnel. The success of any land-grant college depends on trusted relationships with the “regulators,” and that trust rests on the land-grant quality of producing the scientific basis for those regulations.

The College of Agriculture, Food and Environment. Our science makes the world better.

—Nancy Cox
Dean, College of Agriculture, Food and Environment

THE magazine contents

Fall/Winter 2014
Volume 16 No. 3

SPECIAL SECTION

6 CAFE and the Environment

- Seasoned By Fire
- Teach Them Young
- A Future As Wide As All Outdoors
- Trailblazer
- Rainy Days and Outcomes
- Reviving The Dead Zone

20 Research 2013 Annual Report

- We Grow
- Powerful Potential
- Offset the Negative
- Form Matters
- Teenagers Gone Viral

2 News in Brief

- Spotlight: Don Ely
- Think Fast!
- A Dominican Perspective
- The Numbers Are In
- Homegrown Solutions
- Bee-utiful Blooms
- Hungry To Serve

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spotlight

Don Ely

Don Ely, '66 PhD, has been on the Animal and Food Sciences faculty for more than 46 years. He has two grown sons and six grandchildren. He teaches the freshman animal applications course and the senior sheep science class, and he mentors graduate students. He probably won't slow down anytime soon.



STEVE PATTON

Q: Tell us about growing up.

A: I grew up on a farm in Comanche, Oklahoma. We raised beef cattle, hogs, and wheat, and we bought and showed lambs. I was in 4-H and then FFA. I thought I wanted to be a basketball coach, then a vocational agriculture teacher, but I ended up a professor, and that was perfect for me.

Q: Why did you choose Kentucky?

A: Growing up, I enjoyed looking at pictures of Kentucky's green pastures and white fences; I wanted to go there someday. I got a bachelor's degree in agricultural education and a master's in animal science from Oklahoma State University. They said I couldn't get three degrees from the same place, so I came to UK for my PhD. I loved my time in graduate school here. After graduation in 1966, I took a beef cattle research position at Kansas State University's Fort Hays Experiment Station. When I was there, I found out UK was hiring. I wanted to come back. I remember driving here in 1968; I came in on U.S. 68 pulling a U-Haul trailer behind a 1957 Chevrolet. It was two lane roads all the way from the Mississippi River in those days; it took a whole day.

Q: What are the biggest changes you've seen at UK?

A: The campus has changed tremendously; so have the students. We have more urban students who don't have the agriculture and livestock background. It makes teaching more challenging. I find it encouraging that they want to study agriculture.

Q: Why do you stick around when you could retire?

A: Why not? What else would I be doing? This is what I like, and as long as I can almost keep up with the students—as long as they will have me—I'll keep going. I have had great relationships with students over the years. I've remained friends with many. When they come back to see me, I like to get out my gradebook from when they were in my class. I have all of them. They get a good laugh out of that.

QUIZ BOWL

1914

AgEcon

2014

Alex Trebek has nothing on Erica Flores and Jerrod Penn. Flores and Penn, UK Agricultural Economics academic coordinator and doctoral student respectively, moderated the department's first invitational quiz bowl Oct. 17-18. The quiz bowl featured 15 mixed teams of students from six universities in a Jeopardy-like competition with categories pertaining to agricultural economics. UKAg students Nathaniel Trull and Marcus Tyler Jr., joined Megan Masters from Western Kentucky University on the 2nd place Team Secretariat. Team Man O'War, which included UKAg student Jason Simon, Evan Snider of Purdue University, and Bekah Brennan of Murray State University took third.

Participants also networked with potential employers, faculty members, and peers. Farm Credit Mid-America and the Barnhart Fund for Excellence sponsored the quiz bowl and a day at Keeneland, which capped off the weekend.

Department chair Leigh Maynard said the event was organized in honor of the department's centennial anniversary.

"The focus of our centennial celebration is connecting people, and this event was a way to bring a lot of people interested in agricultural economics together," he said.

—Katie Pratt

A Dominican Perspective

Alaysia Radford was the first in her family to travel abroad when she boarded a flight to Santiago, Dominican Republic, but she had no idea how much more the trip would mean. A Cadiz native and UKAg family sciences student, Radford said her family didn't understand why she wanted to go so far away, but her new perspective intrigued them when she returned.

"I ultimately learned that what Americans think is poverty is nothing compared to what we saw in the Dominican Republic," she said. "It is normal there for elementary children to drop out of school to help provide for their families. The Dominican children opened my eyes and showed me that I need to work harder to enhance the lives of others."

Radford traveled with other UKAg students and members of Minorities in Agriculture, Natural Resources and Related Sciences (MANRRS) to gain cultural understanding and to participate in service learning projects. The group stayed with native host families and learned about poverty, capital resources, food availability, and sustainability. They toured local agricultural operations and helped teach positive self-esteem to children at a community center.

"Our students had their own ideas about poverty and discrimination before we left, but they realized how quickly their perspective could change," said Quentin Tyler, UKAg assistant dean and director for diversity. "We visited a market on the Haiti-Dominican Republic border, and some of our students were stopped coming back across the bridge, because they 'looked' Haitian by the color of their skin."

In a country filled with "beautiful people, beaches, and culture," Sean Hardiman noted the discrimination that stems from the country's history. Hardiman, a senior majoring in international studies, is no stranger to traveling abroad. He has served in the military and been to Africa twice on deployment. Even so, he said the Dominican Republic experience was very different.

"When I was deployed in Djibouti and Ethiopia, there seemed to be a sense of pride in being African, while in the Dominican Republic there were some that hid and even denied it," he said.

Hardiman said the border between the Dominican Republic and Haiti is particularly stressed.



Though no stranger to travel, Sean Hardiman (facing the camera) said his experience visiting the Dominican Republic was different. In particular, he observed discrimination against those with darker skin color.

"Haiti doesn't get the assistance it needs to be a profitable and suitable country," he said. "Markets on the borders are opened only three times a week. Haitians bring clothing from other countries, mainly the United States, to trade for food from the Dominicans. Haitians who remain on the Dominican side when the border closes are arrested. The only guide the Dominican border patrol officials use to know who is Haitian or not is the darker skin color that some Dominicans identify as purely African traits of the Haitians. Though the Dominicans ancestry is African as well, it is oftentimes not acknowledged."

Tyler believes the students learned that discrimination and poverty plague all cultures in some way.

"Discrimination can be based on skin color, gender, nationality, ethnicity, and so many other things," he said. "I think our students came home motivated to not take anything for granted."

—Aimee Nielson

The Numbers Are In

There's nothing unlucky about the number 13 for the Department of Retailing and Tourism Management. The Journal of Hospitality and Tourism Education has ranked its master's degree program in hospitality management and tourism No. 13 in the country, up five notches since 2006.

That's not all. The website fashion-schools.org also named the department a top 5 fashion merchandising school in the South and No. 28 in the nation.

"Industries expect certain standards from our graduates, and we work hard to try to meet those expectations," said Vanessa Jackson, department chair. "Our students deserve the best career opportunities we can provide."

13

5

28

Retailing and Tourism Management, in the School of Human Environmental Sciences, offers undergraduate and graduate degrees in merchandising, apparel and textiles, and hospitality management and tourism.

Homegrown Solutions

In a society where “giant size” has become a verb, the answer to expanding waistlines, increasing health care costs, and feeding the hungry might lie in the not-so-giant realm of local food.

That is the focus of Farms Feed Kentucky, a UK Cooperative Extension pilot program where teams in seven counties are working on solutions for strengthening their communities’ food systems. Each team is made up of a dynamic blend of extension agents, farmers, and local food advocates from health departments, hospitals, schools, and government. Developed by family and consumer sciences extension professor Janet Mullins through the Kentucky Sustainable Agriculture Research and Education program, the project focuses on the three pillars of sustainability: economics, environment, and community.

“Sustainable food systems are vital in supporting human and environmental health,” Mullins explained. “Such a system could provide new economic opportunities too, giving communities the resilience to survive tougher economic times.”

In Clark County, 14 percent of residents have low access to a supermarket. With almost 1,000 farm operations in the county and countless gardens, the potential is there for Clark County residents to eat well, if only they can get access.

The team is in the process of acquiring authorization for the Clark County Farmers Market to accept vouchers for the SNAP, WIC, and senior nutrition programs. This past summer, area



churches encouraged people to plant extra food for the hungry, providing hundreds of pounds of produce to local food banks.

A little farther south, Madison County’s team is helping with support for markets and farmers and increasing the demand for local food by educating consumers.

Mullins is excited about the progress the seven teams have made. “When I see these teams’ enthusiasm and ideas to make local, healthy foods available to all Kentuckians, it is easy to be optimistic that their work will have a real effect.”

—Carol Lea Spence



Bee-utiful Blooms

An old Kentucky agricultural staple could help improve pollinator decline.

Rich Mundell, an agronomist with the Kentucky Tobacco Research and Development Center, has developed a hybrid tobacco line that flowers continuously from mid-July until frost and produces high volumes of nectar. The nectar does not contain nicotine, making it safe for pollinators.

Mundell originally bred the tobacco line specifically for producing plant-made pharmaceuticals. While making field observations in 2007, he noticed he was covered with a clear fluid that, when dried on his skin, resembled crystallized sugar. Further investigation revealed the slightly opaque substance to be nectar with high sugar content.

Mundell is currently working with several beekeepers in the state to evaluate the plant with their bee colonies.

“This plant could be an excellent source of natural nectar that is available when most other spring flowering plants are no longer in bloom,” he said.

—Katie Pratt

Hungry to Serve

Mary Boulanger wants to improve lives. So the UK pre-med senior majoring in human nutrition jumped at the chance to serve as a medical volunteer and conduct clinical nutrition research in Cusco, Peru.

Her research focused on conducting a detailed evaluation of the diet and health of Peruvians at an orphanage, a retirement home, a medical clinic, and a rural medical campaign.

"Malnutrition in young children stunts physical and mental development and is the greatest single contributor to disease," Boulanger said. "In Cusco, more than 35 percent of children younger than 5 years old suffer from chronic malnutrition, and more than 45 percent are anemic. The water is contaminated with parasites that contribute to poor health."

Through interviews at three orphanages, Boulanger learned the children have a fairly healthy diet but little access to fruits. While water filters have decreased the diarrhea and dehydration the children experience, not all faucets have filters. The children receive a vitamin daily to combat anemia and other health-related problems.

Many of the retirement home residents suffer from cancer, diabetes, high blood pressure, and arthritis. Many of the residents are extremely short, which could be due to several factors including genetics, lack of nutrition earlier in life, and age-related bone diseases. She found that their diets lack protein and fruit and they need more physical activity.

At the medical clinic, Boulanger saw a wide range of health problems including malnutrition, high blood pressure, and diabetes. Many of the patients had poor dental health as a result of minimal dental hygiene and consumption of sugary beverages and foods.

She traveled to Ocapata, a small rural village outside of Cusco, to assist a rural health campaign that provides checkups and medications to individuals with limited access to health care. While most of their diets were based in healthy homegrown foods, they still lacked essential vitamins and suffered from parasites in the drinking water.

"There is so much disparity in their health due to nutrition," Boulanger said. "In nutrition class, we learned how vitamins, minerals, and water are necessary for health, but it was eye-opening to see individuals who were actually having problems because they weren't meeting those requirements."

To improve the diets of children in orphanages and the retirement home residents, Boulanger recommended starting a



Human Environmental Sciences and pre-med undergraduate Mary Boulanger's trip to conduct clinical research in Cusco, Peru, strengthened her desire to combat public health problems by integrating medicine and nutrition.

community garden at each facility. Another recommendation was for orphanage personnel to educate the children on the importance of drinking only from faucets with filters.

At the nursing home, she suggested that volunteers encourage residents to engage in more physical activity. Her recommendations for the rural community included the installation of a community water filter to reduce the amount of health problems due to parasites. Boulanger discussed the need for education on proper dental hygiene at all locations.

"It is notable to acknowledge that the diet and health of the children in the orphanages and the retirement home residents are significantly better than if they were left in their home situations or on the streets," she said. "In all of the locations I visited, the volunteers and doctors manage to care for many people with limited resources."

For Boulanger, the Peru trip reinforced her desire to go to medical school and work in underserved communities. Her firsthand interviews with people who were knowledgeable about nutrition and its impact on health in their area and the project as a whole helped expand her understanding about nutrition and its applications in medicine.

"I want to integrate medicine and nutrition to erase public health issues," she said.

—Katie Pratt

Seasoned By Fire

By Carol Lea Spence

When flames lapped at Kentucky's eastern forests this fall, the University of Kentucky Fire Cats were on hand to beat them back.

There are plenty of chances in the state for the young firefighters to put their training to good use. Kentucky averages about 1,500 fires and almost 56,000 acres burned each year. The state has two fire hazard seasons—spring and fall. This year's spring fire hazard season, which ran from Feb. 15 to April 30, saw 1,171 fires burn 35,613 acres. An abundance of rain in Eastern and Central Kentucky during the past summer produced a large amount of understory foliage—potential fuel in the fall fire season from Oct. 1 to Dec. 15.

This is the first year for the Fire Cats, made up of UKAg forestry students. Trained by the U.S. Forest Service and employed by the Kentucky Division of Forestry, the students are receiving "a brilliant opportunity," according to UK Department of Forestry chair Terrell "Red" Baker.

"Not only do they get in a few extra hours and earn some money, but they get excellent hands-on training that could ultimately lead to career opportunities," Baker said.

Chris Osborne, manager of UK's Robinson Forest in the southeastern part of the state, is the Fire Cats' crew leader. He explained, in hardwood-dominated Eastern Kentucky, fires usually run across the ground's surface, fueled by leaf litter or logging debris.

"That being said, there are conditions and times that fire activity in Eastern Kentucky can be extreme. There are fires where you'll have 1- to 2-foot flame heights, but we do have some grass fires and other fuel types that can create some extreme fire activity with much higher flame fronts," Osborne said.

Fire Cat MacKenzie Schaeffer has been interested in fighting wildfires for a long time.

"I always thought it would be really cool to go out west and fight the big wildfires, but that's a big step to take," she said. "When they started offering this program, I thought it would

be a great opportunity for me to find out if it's something I really like and want to do when I graduate. It's been an awesome opportunity, and I've loved it."

The idea for the Fire Cats grew out of UK Forestry's long relationship with the Daniel Boone National Forest, said E.J. Bunzendahl, assistant fire manager officer for the Daniel Boone. Since 2011, UK forestry students have had to take fire training as a mandatory course for their degree. The U.S. Forest Service facilitates the online version of the wildland firefighter training. Students spend between 40 and 60 hours completing the online portion of the class, which culminates in an eight-hour required field day that the Daniel Boone National Forest hosts.

When Baker saw how interested his students were in the mandatory course, he spoke with Dan Olsen about fielding a team. At the time, Olsen was director of fire and aviation management for the Southern Region of the U.S. Forest Service. Olsen brought Bunzendahl on board. She, in turn, called the Kentucky Division of Forestry.

With approval from KDF director Leah MacSwords, Mike Harp started making the arrangements to work with the UK students.

Harp, assistant fire chief with KDF, accompanied one of the squads on what he called a "somewhat complicated small 10-acre fire."

"When I say complicated, it was because of the terrain," he explained. "If I had let the on-site crews fight that fire, it probably would have taken two or two and a half hours to put it out. But with the additional personnel from the UK Fire Cats, we knocked it out in probably half the time. They really made a difference."

In Osborne's eyes, it's a win-win situation.

"There's been really positive interaction with these kids. They've asked good questions, and they're engaged, and they've been hardworking," he said. "So far it's been a great success." ♣





STEPHEN PATTON

Teach Them Young

By Jeff Franklin

Many Kentucky students have the chance to learn about nature, natural resources, and their place in the environment in school—but not from books. Instead, they get to experience the outdoors through a two-day, overnight school trip to North Central's 4-H Environmental Camp. There, instructors hope to instill an awareness and appreciation for the world through environmental education.

Environmental camps have been offered at the camp in Carlisle since the late 1980's.

The program started when some 4-H youth development agents wanted to bring students and teachers from their county schools to use North Central in the off-season. Dwight Crum, state 4-H youth development extension specialist at the time, told agents he would create an environmental educator position and camping program if they used the camps enough in the off-season.

The environmental camps run through much of the school year. Most schools send fourth- and fifth-graders to the overnight program, with a few schools

sending first- through third-graders. Some counties use the day-only environmental camps.

Among the activities students participate in are water studies, forest and field hikes, bird and insect studies, identification of Kentucky mammals, and plant and tree identification. The goal is to hit as much of the core content for Kentucky school curricula as possible, while trying to pack as many activities as they can into the schedule.

"Each program is tailor-made for that school," said Jennifer Lynn, North Central's environmental educator. "The teachers have input as to which classes they want their students to participate in, and the 4-H agent in that county works with the teacher to come up with a schedule."

Even the night holds opportunities to learn. Lynn leads the young students on thrilling night hikes. She plays recorded owl calls, and the students wait quietly to see if a real owl answers. Often the eastern screech-owl, common in Kentucky, will reply—an eerie sound in the night woods. Lynn livens the mood by handing out

wintergreen breath mints, telling them to chomp down on the candy. As they chew, electrons are ripped off the sugar crystals, emitting sparks in the dark.

"Wow, that's cool," can be heard over the din of crickets.

Donna Fox, who heads up the camping program for Kentucky 4-H, said the environmental camps offer a great experience not only for the youth, but for the adults who come as chaperones.

"Our environmental camps are a wonderful educational opportunity for the campers," Fox said.

Lynn said there are many benefits to the environmental camping program, such as the strong professional bond that develops between 4-H agents and teachers as a result of planning the program together. Also, the students have experienced hands-on learning that teachers can build on when they return to the classroom.

"It's a rare opportunity in today's traditional classroom setting," Lynn said. ♣

A Future As Wide As All Outdoors

By Jeff Franklin

Imagine a strand of mangrove and palm, on Costa Rica's Caribbean coast, in the black of night, with nothing but the moon for light. You're there to protect the eggs of the endangered leatherback sea turtle from poachers, as the females come ashore to make their nests in the sand.

It's not the setting for a science fiction thriller, but a life-changing experience for UK Natural Resources and Environmental Science major Mariah Lewis.

The Chicago native was in the first NRES class to go to Costa Rica for summer camp. NRES students are required to attend a summer camp as part of their degree program. They may choose between a three-week intensive study of Robinson Forest in Eastern Kentucky, offered in May, or a 15-day, study abroad trip to Costa Rica in August, which was added in 2013. The Costa Rica experience left such an impression on Lewis that she wanted to research turtles when she returned to Kentucky. Steven Price, assistant professor of wildlife ecology in the Forestry Department and one of the NRES professors on the trip, teamed Lewis with a UK graduate student researching the eastern box turtle. This summer, Lewis had the chance to present her research at a national meeting in Orlando, Florida.

"I have had opportunities I don't know if I would have had, if I had any other major at UK," said Lewis. "It's a great program to be a part of, because you are so connected with everybody, and everybody is working hard to get you where you want to be."

The NRES degree is an interdisciplinary program that started as an individualized degree in the College of Agriculture in the late 1980s and finally evolved into a program named Natural Resource Conservation and Management in 1994. The program continued to morph over the years and is more structured and streamlined today, but it still allows students the



CAROL LEA SPENCE



(top) NRES offered a course in wilderness emergency medicine. "A wilderness first responder certification helps them get a job and prepares them in case something happens in the field."
—Geri Philpott

(above l-r) Natalie Redish, Frank McCoy, Mariah Lewis, Christine Buschermöhle, and Janet "Kd" Eaton in Costa Rica. Lewis returned to Kentucky wanting to research turtles.

freedom to choose their area of concentration. Mary Arthur, a professor of forest ecology and chair of the NRES steering committee, said that's the beauty of the program.

"One thing that is really neat about the program is it gives the students a baseline of common knowledge, and then they can concentrate in areas they are most interested in, coupled with their internship," Arthur said.

Students are required to do an internship that meshes well with their analytical skill and their environmental systems area, so they build actual practicum experience that enhances their classroom experience.

That's what Anna Muncy, a spring 2014 graduate, said she liked most about the NRES degree.

"I liked how diverse all the courses are. You take things that deal with forestry, ecology, plants, wildlife, geology, and some biology," Muncy said.

CAROL LEA SPENCE

“Then you pick what you prefer and cater your degree towards that. Most degrees don’t allow you to do that. Whatever you are interested in, you can take classes in.”

Faculty from five departments within the College of Agriculture, Food and Environment—Forestry, Plant and Soil Sciences, Biosystems and Agricultural Engineering, Landscape Architecture, and Agricultural Economics—as well as from the Department of Earth and Environmental Sciences in the College of Arts and Sciences, make up the NRES steering committee. Currently, fewer than a hundred students are enrolled in the program. The small class sizes and one-to-one attention from professors are what students say they enjoy most.

“I think that was one of the greatest things; I would walk into a class, and depending on the class, I would know most of the people or at least half,” said Karyn Loughrin, ’12. “I really got to know my fellow NRES students and got to talk about the topics we were all passionate about. Those are two of the strongest components in the NRES program.”

Mariah Lewis agreed with Loughrin.

“You know your professors, and you’re able to make connections with them. Because of that, it opens up opportunities to work on research with your professor, or go on cool trips like Costa Rica.”

Because of the diversity of the NRES degree, students are trained broadly to understand natural

systems and social science systems. Graduates of the program are spread across the globe in a variety of careers, including agricultural economics university faculty, lawyers focused on environmental law, consultants, policy-based careers, and naturalists. Geri Philpott, the program’s academic coordinator, said the curriculum has a lot to do with that.

“We have this amazing pool of alumni who are out there and working in the field, from Africa to Australia to Alaska and all over Kentucky as well,” Philpott said. “Having those alumni who are connected to the program helps our students when they are looking for internships and jobs.”

Graduates of the NRES program are quick to praise their professors for helping prepare them to become professionals. Muncy said Arthur’s classes helped her be ready.

“She treats you like a professional and expects that of you,” said Muncy. “A lot of people get frustrated and think she is really hard and tough, but in the end, I don’t think anyone can complain that they didn’t learn from her.”

Loughrin felt her professors were always very approachable.

“I never felt intimidated to approach one of my professors with any issue I had in a class,” Loughrin said. “Professors were very encouraging. If they knew you were interested in something, they were very open to taking students in and helping them do research.”

The bottom line? With connections, support, and experience behind them, NRES graduates are prepared to make a real impact in a career field as wide as all outdoors. ♣

Three weeks of intensive study at UK’s Robinson Forest in Eastern Kentucky can include anything from identifying birds from their calls to investigating water quality and stream life. Here a student reports his research findings to his classmates.



Trailblazer

By Katie Pratt

Some people would say Jayoung Koo is a trailblazer. Those people would be right. In a conference room at the Bullitt County Fiscal Court this past summer, Koo and a team of four student interns presented stakeholders with options for trail routes in the county. The trails would connect the northern part of the county to Bernheim Arboretum and Research Forest in the southern part and be primarily used for hiking and biking.

Koo is the college's first extension specialist in landscape architecture. Her goal is to work with Kentucky communities to create built environments that connect people to nature and support a healthy lifestyle.

"With every project, my students and I suggest ideas that are applicable to their settings, scale, and cultural characteristics, among other things," Koo said. "Benefits of built environments include improved infrastructure and stronger bonds between community members, and ideally, they support economic growth."

Koo was approached for the Bullitt County project by the fiscal court and two stakeholder groups, Concerned Families of Bullitt County and Future Fund Land Trust.

"UK has a good reputation and a good history of putting together projects like this, so we were excited to partner with them," said Steve Henry, president of the Future Fund Land Trust.

Bill Duffy, president of the Concerned Families of Bullitt County, said his organization saw the



STEPHEN PATTON

project as an important opportunity for it to make a positive impact on the county.

"We don't have public parks in Bullitt County, so this will be the start of building a park system in the county," he said. "We would like the trail to follow existing waterways to Bernheim to take advantage of nature and connect to the trail system Dr. Henry has been working on."

Henry began preservation work along Floyds Fork, a tributary of the Salt River, 21 years ago when the former lieutenant governor was a Jefferson County commissioner.

Eric Lee, a fifth-year landscape architecture major from Owensboro, credited the competitive summer internship with using what he learned in the classroom about landscape design and helping him to think on his feet.

"You can prepare for presentations all you want, but stakeholders always have more questions," he said. "This forces you to understand your part in the project along with everyone else's part, so you know and understand the broad spectrum of the entire project."

Koo, Lee, and other students continued to work with Bullitt County stakeholders on this project during the fall semester. Once a trail is determined, Duffy said the Bullitt County groups would begin to work out arrangements with landowners along the trail.

Paths to Progress

Since coming to UK a little more than two years ago, Koo has noticed a common theme among communities.

"Most of the requests I've gotten so far are from communities who want to improve their outdated, deteriorated, or unsustainable infrastructure," said Koo, who also works with the college's Community and Economic Development Initiative of Kentucky.

This past spring, Koo and another group of students worked with Discover Downtown Middlesboro and the National Park Service to develop potential trail systems that would connect the city to Cumberland Gap National Historical Park.

"Isaac Kremer, executive director of Discover Downtown Middlesboro, asked us to come up with some ideas to improve and enhance the city's built environment to improve residents' quality of life," Koo said. "The students identified three trails in the city that would improve connectivity within city limits and eventually connect to the national park."

They presented their options to Kremer.

"The students were consummate professionals, very accepting of feedback, and showed a genuine concern for the community," Kremer said.

Through a grant from the Federal Highway Administration's Recreational Trails Program, Discover Downtown Middlesboro will soon begin construction on a nearly two-mile path to connect the city with the national park. The group is seeking additional funding avenues to enhance walking and cycling infrastructure in town. Kremer believes it can eventually help Eastern Kentucky attract tourism and grow the economy.

"Trail system development in Kentucky has the potential to be done on such a massive scale that it will bring positive social and economic change over broad areas," he said. "We are excited to be on the ground floor of this movement."

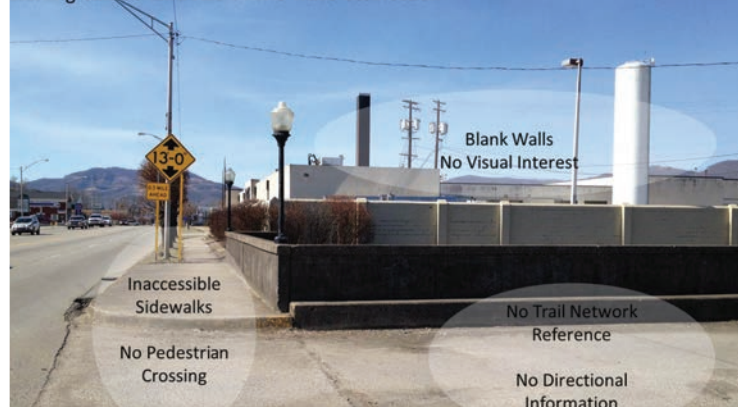
He said word is getting out across the state about the professionalism of the UK students and faculty.

"Now people are referring to the Middlesboro model, where UK teams up with the community and state and federal stakeholders to get results," he said.

As towns and counties discover the benefits of built environments, Koo and her students will help them revive their existing infrastructure—blazing trails to a brighter future for Kentucky. ♣

Discover Downtown Middlesboro asked UK Landscape Architecture students to find ways to improve and enhance the city's built environment to improve the quality of life for local residents.

Existing Cumberland Ave Boone Trace Connection



Proposed Cumberland Ave Boone Trace Connection



Jayoung Koo and her students discuss options for hiking and biking trails that would connect the northern part of Bullitt County to Bernheim Arboretum and Research Forest in the south.

Rainy Days and Outcomes

By Carol Lea Spence
Photography by Matt Barton

UKAg researchers look long-term at the ramifications of acid rain

Deep in the back hills of UK's Robinson Forest flows Cole's Fork, a headwater system for a 6,000-acre watershed. Getting there is its own adventure, jostled in a tin can of a Jeep over deeply rutted trails that skirt drop-offs of several hundred feet—a place that might be more easily reached on muleback.

UK forestry professor Chris Barton steers and talks at the same time, a real talent given the terrain. "The streams at Robinson Forest are considered some of the highest quality water in the state. Cole's Fork is considered an exceptional water resource for Kentucky."

Wading into the middle of Cole's Fork to take measurements, we also waded into the middle of this story, one that goes up—into the atmosphere—and down—into the earth. And it's a story that goes back a long way with an ending yet to be written.

It was the 1980s, and acid rain was on everyone's lips, literally and figuratively. Though scientists had been aware of the problem since 1872 and had studied it seriously since the 1950s, the situation had become severe enough by the 1980s to warrant serious measures. In 1989, President George H.W. Bush put forward additions to the Clean Air Act that would address a burgeoning crisis.

Acid rain is the catchall phrase for any precipitation that reacts with sulfur dioxide and nitrogen oxides in the atmosphere and becomes acidified. It can result in acidified streams and soils, aluminum changing from a solid to a liquid (never a good thing), and vegetation death. While natural forces can, in part, cause acid rain, industry has contributed the most to the equation. According to the U.S. Environmental Protection Agency, burning coal to generate electricity caused 69 percent of sulfur dioxide and 20 percent of nitric oxides in the air.

Who, Us? Worry?

Alarm bells rang when acidification began killing forests in the Northeast and in northern Europe. These are heavily industrialized areas with slightly acidic granite-based soils without buffering potential, so the acid inputs acidified the soil even further. Water traveling through the soil entered the watershed and acidified streams.

Kentucky, too, was plagued by acid rain—approximately 92 percent of the state's electricity is generated by coal-fired power plants—but the soils are known to have a higher buffering capacity.



“Here in Kentucky, we have soils that have a higher pH. When you have acids that come in contact with those soils, there’s enough alkaline material to neutralize the effects of that acidity,” Barton said.

Though extensive research had been conducted in the ’70s and ’80s in New England, little research had taken place in Kentucky during that time. The U.S. Forest Service in the mid-1990s, hoping to get a current picture of the situation and to pick up on any trends, funded Tasios Karathanasis, UK Plant and Soil Sciences professor, to conduct a pilot project at two sites in the Daniel Boone National Forest.

“The main concern we had here in Kentucky was that we have a lot of coal-powered plants, and we knew they had increased emissions,” Karathanasis said. “At the time they were trying to follow the new regulations and reduce emissions, but we did not have any data on how that was working.”

Barton was a graduate student then, working under Karathanasis for his master’s and doctoral degrees. Though the project didn’t have anything to do with his thesis or dissertation, it provided an excuse to get out into the woods, which he loved; he took it on.

They dug pits in Wolfe and McCreary counties on ridge top sites with sandy soils that are normally more acidic than surrounding areas. Cutting shelves into the sides of the pits at 1-foot and 2-foot depths, they placed pan lysimeters on each shelf—a system that would collect the rainwater percolating through the soil. About once a month from 1994 through 1999, Barton traveled to the sites and drew water from the lysimeters for analysis.

Periodically poor quality rainwater would break through the soil, resulting in significant spikes in nitrate and sulfate levels.

“We hypothesized that if this continued over time, it could

affect the soil chemistry,” Barton said. “Perhaps with continued inputs, we might start to see some of these effects they were recording in more northern environments.”

The good news was that National Atmospheric Deposition Program analyses of rainwater quality from the early ’90s to the present showed a reduction in sulfates of about 55 percent and nearly 40 percent in nitrates in that part of Eastern Kentucky. The regulations were working.

“The interesting thing about that is the amount of coal burned in Kentucky for electric power generation almost doubled during that time,” Barton said. “Basically, the energy industry in Kentucky was in compliance with the Clean Air Act. They achieved the reduction in the air pollutants. You had this environmental quality act that was implemented, and it actually worked from the air perspective.”

An Exceptional Water Source

Members of the Forestry Department have taken a weekly water sample from Cole’s Fork since the early 1970s, measuring temperature, conductivity, dissolved solids, dissolved oxygen, pH, and oxidation reduction potential—a measure of the water’s ability to neutralize contaminants.

Similar to what is being found in atmospheric levels, there has been about a 50 percent reduction in the amount of sulfates in the Cole’s Fork stream system. The geology in this watershed is predominantly sandstone, shale, and coal. Like the landscape where Barton’s soil pits are located, it’s not a geology that readily buffers acids.

“We’ve noticed that the pH really hasn’t changed that much over the years. If acid rain were affecting this forest, we would start to see those pH levels go down,” Barton said.



"The Daniel Boone National Forest is known for its richness and diversity of species. That's a direct reflection of the soil."
—Claudia Cotton



Claudia Cotton and Tyler Sanderson demonstrate how they collect water from pan lysimeters buried at a ridgetop in the Daniel Boone National Forest.

They have also not seen indications that aluminum in the soils has become mobile, which happens at pH levels below 5. When aluminum changes from a solid to a solution, trees take it up. This proves fatal. In the streams, many fish species are susceptible to the metal, too. In Cole's Fork, pH levels have remained around 6 and no aluminum has been detected in the water.

"So this system, for the most part, at the watershed level, appears to be in relatively good shape with regards to acidifying trends from acid deposition," Barton said.

Digging Deep

Claudia Cotton, forest soil scientist for the Daniel Boone, manages more than 700,000 acres of national forest. A UK forestry alumna and Barton's former student, she was aware of his 1990s soil study. When funds became available in 2011 from a settlement between Duke Energy and the EPA, she and Barton jumped on the opportunity to revisit the original sites to see if what Karathanasis and he had predicted had actually happened.

The Wolfe County site is lush and greenly still in high summer. Wild blueberries bushes are scattered on the hillside and tall, straight-backed trees form a high canopy over the research area. The only indication that scientific work has happened here are capped plastic pipes inconspicuously sticking out of the

ground. The area is leaf littered and branch-strewn like the rest of the woods—on purpose to avoid attention.

Given that rainwater and stream samples had improved, it's not too much to think that soil chemistry also would improve or at least stay the same. Instead, soil samples taken from the sites in 1993 and then again in late 2011 showed that the soil pH has dropped from a slightly acidic pH in the mid 4s to 5s, to a very acidic 3.8 to 3.6. There is also a precipitous decline in the amount of calcium from the early '90s to today. Calcium helps buffer acid inputs.

"The results were actually a little bit alarming at first. You would have thought with an improvement or a decrease in the acid inputs, you wouldn't see that. We're still trying to figure out what happened," Barton said. "Maybe it was the fact that the acid inputs long ago are still having an effect on those forest soils. Or maybe all it takes is one big peak to drive that system in the wrong direction. Most of the soil scientists who have looked at our data are actually kind of shocked."

On the other hand, there were mixed results when the team analyzed the soil solution, the water percolating through the soil into the lysimeter trays. One site followed the pattern they'd seen in the rainwater, a 60 percent reduction in sulfates. The other site didn't change at all. There were also mixed results with the soil solution pH.

"It makes this type of study very difficult to comprehend, because you don't know exactly what's going on and you can't go out and sample every rain event the way we have it set up," Barton said.

At the Core

A Virginia pine resists a bit, letting out a hollow tock, tock, tock as Tyler Sanderson twists a corer into its trunk. It won't hurt the tree, but it helped Sanderson, who at the time was working on his master's degree in forestry, record the effects acidification might be having on the vegetation at the Wolfe County site. The tree relinquishes the core with a drawn-out sound like a forest floorboard creaking, and reveals an 8-inch long, quarter-inch diameter of finely ringed wood.

As Cotton explained, "The vigor and the resiliency of the forest directly reflect the health and composition of the soil."

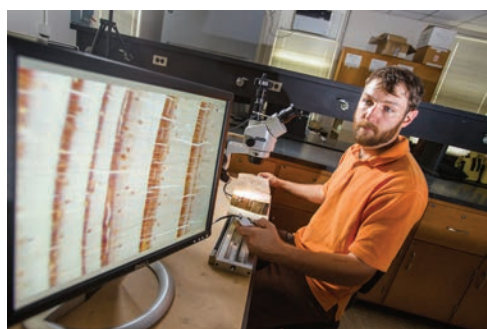
No one has really quantified the effect of acid rain on forest productivity or tree growth, which is what Sanderson set out to do.

He cored about 20 trees from the Wolfe and McCreary sites and studied their growth rings to see if they slowed down or increased dramatically at times, potentially due to the change in the soil chemistry.

Barton believes the vegetation part of the study will be a "great addition" to the work, and "definitely the most difficult to interpret." Trees don't naturally grow uniformly, so any changes could be because of weather, or the age of the tree, or changes in the atmosphere or soil.

Knowing there was a decline in sulfur dioxide in the atmosphere, the scientists thought they might be able to detect that in the wood with increased growth. They didn't, but they also didn't see a major decline in growth over the years, so as far as they can tell, the trees have not been affected by the acid deposition.

"We don't see anything alarming that would suggest that these trees are going to crash in the near future," Barton said.



(top) Tyler Sanderson cores a Virginia pine as part of his study on the effects of acid rain on vegetation.

(bottom) Back in the lab, Sanderson determined tree growth with the help of a computer that measures the width of each ring. Sanderson was able to use the College of Engineering's Environmental Research and Training Laboratories to analyze the concentration of elements in the samples.

Determined to Unearth

More work has to be done before a clearer picture emerges from the data.

"If we were looking at precipitation quality, we might think everything is completely rosy, but when we look at it from an ecosystem level, there are a lot of things going on that are promising and others that aren't," Barton said.

Figuring out why the soil chemistry continues to decline will be important to understanding how to reverse those effects or prevent additional impacts to the system. The next step for Barton and Cotton is to find more sites in Eastern Kentucky with documented information

on ridge top soils, resample those sites, and determine if what they're seeing is localized or a regional phenomenon.

Despite the unanswered questions, Barton is encouraged by much of the data he's collected.

"(These federal regulations) have been extraordinarily effective in meeting the goals of the Clean Air Act," he said. "Had they not enacted those regulations, perhaps this cycle would be a little bit further along, and maybe we would be seeing some decline or some loss in productivity."

Karanthanas summed it up. "We are making progress." ❖

Reviving The DEAD ZONE

By Aimee Nielson



A dead zone in the Gulf of Mexico is formed by nutrients that wash from the Mississippi River into the gulf waters.

Somewhere along the Louisiana coast, a frustrated fisherman is no doubt looking out on the Gulf of Mexico wondering how he can stop the oxygen-depleted dead zone from encroaching on his livelihood. But it's way beyond his control; the problem begins nearly 1,500 miles upstream at the headwaters of the Mississippi River. Water flows and collects runoff from roughly 41 percent of the United States, and **Kentucky is a large contributor.**

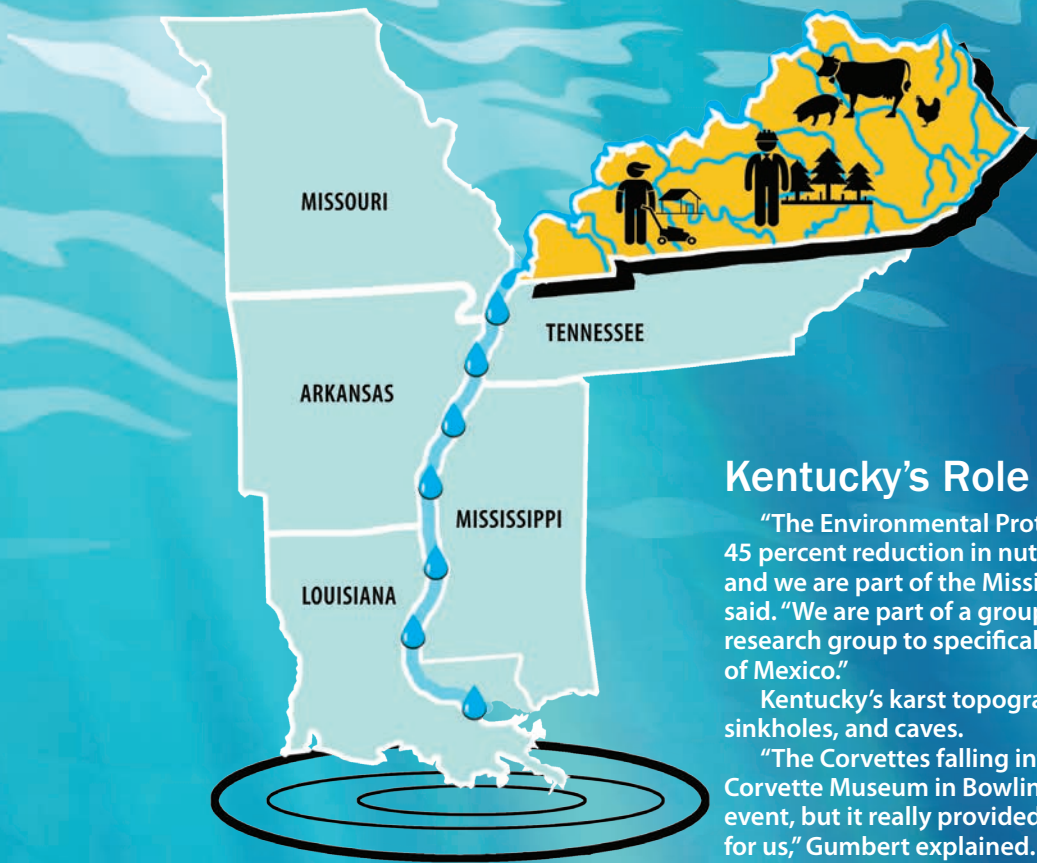
"Every Kentucky river, creek, and stream eventually meets the Mississippi River," said Steve Higgins, director of environmental compliance for the Kentucky Agricultural Experiment Station. "That means virtually everything farmers, landowners, and homeowners put into those waters eventually reaches the Gulf of Mexico."

Higgins works with Amanda Gumbert, UKAg water quality extension specialist, to conduct extension programs and educate farmers about ways they can manage nutrients to lessen Kentucky's impact on the dead zone.

"We explain specific practices that farmers can do on their farms to prevent the loss of excess manure, sediment, and fertilizer," she said. "We are trying to help them understand that their local creek goes to a bigger creek that goes to a river that eventually goes into the Gulf. So many people don't understand the watershed concept. They think that if they don't live on the Ohio River, they aren't impacting it, but they are. We all impact it. So we are trying to educate and change that mindset to one that understands all water flows downstream and impacts water far beyond Kentucky."

(Top) The dead zone in the Gulf of Mexico was the size of Connecticut in 2014. Measured each summer, the zone's size is a yardstick of any progress in the reduction of nutrient inputs into the gulf.

Photo by Nancy Rabalais, Louisiana Universities Marine Consortium



Ebb and Flow

A dead zone in the Gulf of Mexico is formed by nutrients that wash from the Mississippi River into the Gulf waters. Nitrogen and phosphorus, mostly from agricultural lands upstream, do the most harm. These nutrients form algal blooms that basically suck up oxygen in deep water, making it impossible for marine life to survive—a condition referred to as hypoxia. Some fish and shrimp swim away from the area and reach more oxygen-rich water. In areas where oxygen is not fully depleted, fish may survive, but reproduction and spawning suffer.

Each year scientists take a survey “cruise” to determine the size of the dead zone, because it ebbs and flows depending on nutrient load and weather. The 2014 cruise revealed the zone is about as large as Connecticut. That’s smaller than its average size of 5,500 square miles, but nowhere near the goal scientists have set of fewer than 1,900 square miles by 2015.

The zone peaks from late spring until late summer, when Mother Nature typically has the greatest chance to intervene. Weather can significantly impact it. In 1988, a severe drought caused the Mississippi River to stop flowing, making it impossible for excess nutrients to reach the area. Tropical storms act as a giant whisk, churning the waters and breaking up the zone.

Dead zones are not just a phenomenon in the Gulf of Mexico; they can develop in any large body of water such as the Great Lakes or the Chesapeake Bay. Dead zones in the Great Lakes can make them unsafe for swimming and threaten drinking water for large populations.

Kentucky’s Role and Responsibility

“The Environmental Protection Agency has called for a 45 percent reduction in nutrients in the Mississippi River, and we are part of the Mississippi River basin,” Gumbert said. “We are part of a group of southern states forming a research group to specifically deal with hypoxia in the Gulf of Mexico.”

Kentucky’s karst topography means a lot of springs, sinkholes, and caves.

“The Corvettes falling into the sinkhole at the National Corvette Museum in Bowling Green was an unfortunate event, but it really provided a great teaching opportunity for us,” Gumbert explained. “They had no idea that opening could form right there underneath them. There’s a lot of movement and shifting underneath us all the time. Our groundwater interacts with our surface water. We are trying to get people to make the connection that what they do on their land directly affects someone’s drinking water. Anything we put on the land can eventually end up in the water supply or, on a bigger scale, the Gulf of Mexico.”

In 1994, the Kentucky General Assembly passed the Kentucky Agriculture Water Quality Act with a goal of protecting surface and groundwater resources from pollution. It applies to any landowner with 10 or more acres being used for agricultural and forestry activities. Basically, farmers or landowners need to focus on best management practices in six areas: silviculture (forestry), pesticides and fertilizers, farmstead, crops, livestock, and streams and other waters.

Part of the solution is convincing farmers to implement agriculture water quality plans that address the way they deal with excess nutrients. Gumbert and Higgins are working with Kentucky producers to help them understand the legislation and find ways to implement the best management practices.

“Many farmers are willing to comply, others don’t know where to start, and that’s where we come in,” Higgins said. “We want them to understand the basics of getting a soil test to know how much fertilizer they really need on their crops. We want them to think about a covered area to store livestock manure until it is dry and then apply it to crops based on a soil test; use the nutrients in the manure to save money in fertilizer costs.”

Awareness Begins at Home

Todd Clark is a first-generation farmer in Fayette County. He and his wife started farming about 20 years ago near the Fayette-Scott county line. Clark Farms is a diverse farm with poultry, beef cattle, sheep, pigs, tobacco, and hay. Clark is passionate about local food and doing things in a natural and environmentally friendly way on the farm. He's worked with extension to learn how to implement best management practices.

"Hopefully everyone wants to protect where they live," he said. "When you start selling direct to the consumer, it changes your mindset, not only about how you raise the animals but how you impact the area where you raise them. It's important to me that my watershed is ultimately the drinking water for Georgetown—for my mom and four of my five brothers and sisters. I don't want to be responsible for contaminating the water and causing a problem."



STEPHEN PATTON

Clark has about 1,000 free-range Rhode Island Red hens that do a pretty good job of spreading their own fertilizer around the pastures. Combined with rotational grazing of beef cattle and hay production, it is a mutually beneficial way of saving money, keeping pathogens at bay, and taking care of the environment. He also maintains fencing around streams and ponds to keep animals out of the water and installs filter fabric and gravel around feeding areas and concrete water troughs.

"I don't have to go as far as the dead zone (in the Gulf) to be concerned about water quality," Clark said. "I am concerned here, before it ever gets to the Kentucky River, to the Ohio, and to the Mississippi. I think it goes hand-in-hand with the local food movement—being concerned about where you are and the people around you."

Beyond the Farm

Agriculture is the largest contributor to nitrogen and phosphorus runoff, but urbanites are not blameless, although they are not subject to the ag water quality act.

(I) Todd Clark shows Amanda Gumbert some best management practices he uses on his Fayette County farm. "I don't have to go as far as the dead zone to be concerned about water quality. I am concerned here, before it ever gets to the Kentucky River, to the Ohio, and to the Mississippi."



STEPHEN PATTON



"If you're going to put chemicals on your lawn, do a soil test and read extension publications that tell you how to have a 'greener' lawn," Gumbert said. "If you have a lawn care service, ask them what they are using. Don't ever dump anything down a storm drain. Sweep excess fertilizer off the sidewalk, so it's less likely to be washed into the storm drain. Pick up after your pets, compost your kitchen waste."

Gumbert explained that if urban dwellers don't follow these guidelines, they will feel it in their wallet when the water treatment fees start to rise.

"It's everyone's responsibility to reduce the problem in the Gulf," she said. "If we start fixing it here, it will definitely have a positive impact down there." ♣



(top) Todd Clark raises free-range chickens that naturally fertilize his pastures. By rotationally grazing his beef cattle, Clark has found a beneficial system to keep pathogens at bay.

(left) Fencing around streams and ponds keeps animals out of the water, which decreases the nitrogen load.

WATERSHED *Atlas*

Kentucky boasts more than 90,000 miles of rivers, creeks, streams, and tributaries—more miles than any state except Alaska.

Brian Lee, professor in the Department of Landscape Architecture, began the Kentucky Watershed Atlas Project in 2003 to characterize the state's 9,109 watersheds based on more than 100 different variables. A watershed is all the land that drains into a particular body of water, like a creek, stream, or river.

"By viewing the landscape from a watershed perspective, we can better understand how land use and management decisions impact waterways and water quality," Lee said.

Using semi-automated, computer-based models that calculate and combine data around the clock, Lee can compare and contrast forested versus cropland watersheds, or rural versus more concrete-covered urban areas to better develop strategies for improving water quality.

"I use satellite collected data to see how the land changes over time," he said. "I can use the data to narrow down problem areas and also to find areas where we likely have really good water quality."

Lee also uses the data to classify watersheds into types to better understand changes that negatively or positively affect water quality. In particular he is interested in characterizing how watershed composition affects nitrogen and phosphorus yield and load to find ways to reduce the excess.

More information about the atlas is available online at http://www.uky.edu/Ag/LA/KLEAR/Watershed_Atlas.htm.

We Grow

This is the last column I will write as director of the Kentucky Agricultural Experiment Station, after serving in a dual role during my first year as dean. Looking back over my 13-year involvement with the experiment station provides a good view of growth in the college and of Kentucky's agriculture, as well as legislative and economic ebb and flow.

The 2001 Research Annual Report heralded external research grants valued at \$10.5 million; during 2013 the value was more than \$26 million. That increased funding represents success in recruiting and supporting talented faculty, staff, and graduate students. External awards reached as high as \$33 million during some years, but contractions in federal funding and the removal of directed congressional appropriations resulted in a slight decline over time in all aspects of higher education funding.

Other highlights of the 2001 report included results of experiments that proved eastern tent caterpillars to be the probable source of Mare Reproductive Loss Syndrome, MRLS, which caused mares to lose pregnancies. Subsequent experiments demonstrated that caterpillar hairs embedded in the gastrointestinal tract and transmitted infection into the circulatory system. We now describe MRLS as the "tipping point" that caused the college and the industry to think differently about ourselves and to work more closely together.

In the intervening years, the college expanded equine programs to include environment, education, and economics. For example, the Horse Pasture Evaluation Program has evaluated more than 18,000 acres on 120 farms. The Kentucky Equine Survey, the first since 1977, found that Kentucky is home to 242,000 horses with

a \$3 billion economic impact. These improvements and others place the college's horse offerings closer to our other successful animal programs, such as beef, sheep, dairy, and poultry.

Also since 2001, the partnership with the U.S. Department of Agriculture's Agricultural Research Service has resulted in a federal laboratory on campus that focuses on forage and animal production, and in the New Crop Opportunities Center being created.

The research projects highlighted in this issue represent not only the continued progress since 2001 but also the diversity of research in the college. We celebrate the renewal of the Nutrition and Superfund Chemical Toxicity grant to the Superfund Research Center—the largest grant awarded to the college; environmental remediation of coal slurry; mineral effects on cattle health and production using state of the art molecular biology; and cutting-edge research on adolescent development.

It has been a distinct honor to serve the researchers of the college and to applaud them for their success, their great ideas, and most of all, their passion for science!

—Nancy M. Cox
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RESEARCH FUNDING

GIFTS & ENDOWMENTS

\$4,153,522

FEDERAL CAPACITY

\$6,589,268

STATE

\$27,226,866

GRANTS & CONTRACTS*

\$26,443,145

*includes funding secured by teaching and extension faculty

HISTORY OF GRANTS & CONTRACTS

2013	\$26,443,145
2012	\$22,105,234
2011	\$32,312,992
2010	\$34,221,048
2009	\$23,829,306
2008	\$30,972,002



Elisa D'Angelo has built a wetland that removes toxins from coal slurry impoundments using natural processes.

Powerful Potential

Elisa D'Angelo built a wetland with powerful potential—a system that removes toxic elements that might leach out of coal slurry impoundments.

“Our goal is to help the coal industry reduce liabilities associated with mining and coal preparation and help communities near the hundreds of coal slurry impoundments in the Appalachians,” said D'Angelo, Plant and Soil Sciences associate professor.

To produce a cleaner-burning coal, companies must reduce ash and lower sulfur and mercury. The preparation process separates coarse refuse, similar to rocks, from smaller particles called fines. Coarse refuse is used to build dams that confine slurry containing the fines.

“Sometimes impoundments leak into natural water bodies,” D'Angelo said. “But little was known about the chemical composition, so it was impossible to know the potential impacts.”

D'Angelo, aided by Biosystems and Agricultural Engineering Professor Richard Warner and Jason Unrine, Plant and Soil Science assistant professor, analyzed samples from slurry impoundment and compared the results to water quality criteria.

“Of the dozen trace elements we measured, only one element was potentially causing a problem,” D'Angelo said. “It was right above what they call the warm water aquatic habitat criteria.”

She designed a multi-stage wetland that focused on that element, selenium, as well as on several other elements that could pose a problem at other impoundments.

Her pilot wetland consists of five stages, which use various natural materials, including wood chips, corncobs, and gravel, intended to remove each element in sequence. The first stage raises the pH. The second stage causes dissolved iron, arsenic, manganese, and selenium to fall out in a solid form and ultimately settle in the third stage.

“When contaminants are dissolved, they tend to be more mobile in the environment and reactive with the human body. When converted to solid forms, they're not as mobile or reactive,” D'Angelo explained.

The fourth and fifth stages, respectively, filter the remaining liquid through a gravel bed and reduce sulfate.

“What we found was, 96 percent of selenium was removed in just Stage 1,” D'Angelo said. “That was great news!”

D'Angelo's next step is to sell the idea to the coal industry. “It could be a viable green technology for treating this class of waste.”

—Carol Lea Spence



Bernhard Hennig, Dean Nancy Cox and UK President Eli Capilouto.

Offset the Negative

UK's Superfund Research Center is working to help offset the negative health impacts that can occur when humans are exposed to toxic chemicals and to help accelerate the clean-up of hazardous waste sites in Kentucky.

The center, led by the College of Agriculture, Food and Environment's Bernhard Hennig, recently received a \$12.2 million Nutrition and Superfund Chemical Toxicity grant from the National Institutes of Health to continue this important work. This is one of the largest NIH grants ever received by UK.

The U.S. Environmental Protection Agency defines Superfund sites as uncontrolled or abandoned places where hazardous waste is located. Kentucky has more than 200 such locations, including 14 active sites on the National Priorities List, a list of the worst sites in the country.

Kentucky also has rates well above national averages of chronic diseases, such as cardiovascular disease, cancer, diabetes, and hypertension. The center's biomedical research focuses on the idea that nutrition can help reduce negative health effects from exposure to hazardous chemicals, Hennig said. The team is also looking at the impacts exposure has on prenatal development.

Environmental scientists are working to develop new methods to detect hazardous chemicals and clean up contaminated sites. The research is likely to have other applications as well, including uses in treating drinking water and removing toxic metals from power plant water, said Lindell Ormsbee, associate director of the center and Raymond-Blythe professor of civil engineering.

The grant, funded through the NIH's National Institute of Environmental Health Sciences supports the work of more than 50 scientists and students from 15 departments within CAFE, Arts and Sciences, Engineering, Medicine, and Public Health.

"This project brings the best scientists from many different disciplines together for a high-impact collaboration that advances our knowledge of some of the most pervasive chemical contaminants in our environment," said Dean Nancy Cox. "These scientists also collaborate with colleagues from other state and national agencies and work within affected communities on strategies that may help combat the effects of contaminants and improve overall health."

More information on the Superfund Research Center can be found at the center's website, <http://www.uky.edu/Research/Superfund>.

—Laura Skillman



STEPHEN PATTON

(l-r) Phil Bridges, Jamie Matthews, and Roy Burris evaluated the most metabolically effective form of selenium for cattle.

Form Matters

Cattle consuming forages grown in Kentucky may not be getting necessary amounts of selenium, a trace element that's necessary for growth, reproduction, and immune status. Producers often need to add supplements to their cattle's diets.

An interdisciplinary team of UK Animal and Food Sciences researchers consisting of Jamie Matthews, nutritional physiologist; Roy Burris, extension beef specialist; and reproduction physiologist Phil Bridges, conducted a series of mineral intake trials to evaluate the most metabolically effective form of selenium to include in cattle mineral mixes. They conducted a three-year study with grazing beef cattle at UK's Research and Education Center in Princeton.

The team used Calan gates, a specialized piece of equipment used to control and record feed intake, to measure individual animal intake of mineral mixes containing selenium. They then expanded the pilot trials to production herd-sized experiments. The researchers used DNA microarray analysis, a process that allowed them to isolate genetic contents of cells and determine which genes were expressed, or turned on. Of particular interest were genes involved with growth, reproduction, and immunity.

The principal take-home message from these trials was that each different form of supplemental selenium consumed, whether inorganic, organic, or a mixture of the two, affects gene expression in the liver, cows' skeletal muscles, and testes of their newborn calves. Since the trial found that gene expression of newborn calf testes was dependent on the form of selenium consumed by their dams, the team is conducting an experiment to determine if the form of selenium can improve fertility in sexually mature bulls.

"One of the things we are most proud of about this study is we are getting both the molecular and the practical, and the more we do that, the quicker the translation to the farmer," said Matthews.

And getting the results of the research into the hands of beef producers is important to the team.

"We have to have enough confidence in our research to make a recommendation, and we feel that we are doing solid research that matters," Burris said.

The college and the Alltech-University of Kentucky Animal Nutrigenomics Alliance jointly funded the research.

—Jeff Franklin



Teenagers Gone Viral

Most parents wonder what makes their teenagers tick. University of Kentucky professor Alexander T. Vazsonyi has spent his entire career researching that very topic.

Vazsonyi is the college's *John I. and Patricia J. Buster Endowed Professor of Family Studies*. He has published numerous peer-reviewed articles related to student achievement, problem behaviors, health-compromising behaviors, and violence.

One of his current studies examines the social media habits of Kentucky teens.

Vazsonyi and UK graduate students Gabriela Jiskrova and Albert Ksinan surveyed students at Paris middle and high schools during the 2013-2014 school year about their online habits and parental supervision of online activities.

The amount of time students spent online increases as they age, his survey revealed. Of the middle school students, 73 percent spent two hours or less online each day. Half of the high school students surveyed said they daily spent three or more hours online. Instagram was the preferred social media platform for both groups.

Cyberbullying also increased with age. Of those surveyed, 44 percent of high school students and 18 percent of middle

What makes teenagers tick?
Alexander Vazsonyi is an expert.



school students said they were sent either a slur, threat, or other provocation at least one time in the past year, with 9 percent of high school students and 2 percent of middle school students reporting such attacks at least once a week.

In the school system, parental internet monitoring decreased with students' age. More than half of middle school students reported their families had rules about when and how long adolescents in the home were allowed to be online. Only 17 percent of high school students said their families had similar rules.

"This was an opportunity for us to understand how important social media is to our students and to begin to learn how to engage our students in different ways," said Gary Wiseman, superintendent for Paris Independent Schools. "The online safety issue gives us an opportunity to examine our policies and filtering devices to ensure we are addressing the correct issues."

Vazsonyi plans to conduct the same study with middle school and high school students in the Lincoln County and Bourbon County school districts during the 2014-2015 school year.

—Katie Pratt

We Grow promising futures

"We try to focus on the family. It's really the key to things, to find ways they can live healthier and better lives."

As a family and consumer sciences agent in a rural county, Martha Yount sees the challenges families face every day. Challenges with poverty. Challenges with the loss of opportunities. Health challenges.

She and FCS agents and specialists have brought the latest ideas, education, and support to Kentuckians from the hollows of the east to the expansive lands of the west, and all the urban areas in between.

Working with valuable community partners, FCS personnel have opened the doors to greater food security, success in schools, better health and informed financial management, and built stronger communities in the process.

A century of
Family and Consumer Sciences Extension
growing brighter futures for Kentuckians.
Here's to the next 100 years.

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The Morgan County Sorghum Festival in West Liberty. Attractive shops illustrate how the town has come back from a devastating tornado in 2012. Morgan County extension agents, who lost their office in the storm, are committed to helping the region heal.