IOWA STATE UNIVERSITY
College of Agriculture and Life Sciences

STORIES

IN AGRICULTURE AND LIFE SCIENCES VOL.9 NO.2 2015

PROTECTING SOIL AND WATER

STORIES
IN AGRICULTURE AND LIFE SCIENCES

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IOWA STATE UNIVERSITY
College of Agriculture and Life Sciences

Printed with soy inks

MIX Paper from responsible sources FSC® C007419

I NEEDED TO LEARN
A FEW THINGS.

As I prepared for this issue on the college's efforts to protect our land and water resources, I knew I had more than a few things to learn.

The issues are complex. Information presented in the media or online can be confusing, to say the least, or subjective. So, I went where hundreds of thousands of Iowans go annually to get sound, scientific information. I went to Iowa State University Extension and Outreach.

I watched videos. I read articles. I attended field days. (I love a good field day.) I discovered farmers, literally in my backyard, who were doing more to protect our state's natural resources than I ever imagined. My neighbor has a working bioreactor and shared his experiences at a recent field day. Landowners just across the section from our acreage installed a wetland I had unknowingly driven by countless times.

As I reviewed stories, I learned about the role of cover crops in holding soil and water in place. I learned how bioreactors convert nitrate into a harmless gas (page 30). I learned how "field plumbing" diverts water through saturated riparian buffers (page 24) where it isn't filtered, but rather processed by microorganisms and plant roots reducing nitrate. I was reminded that soil and water quality have been active research priorities of Iowa State University for decades like work at the long-standing Gilmore City research site (page 19) or through the efforts of experts like Tom Kaspar (page 22).

We've touched on Iowa State's work in water quality and soil health often over the years in *STORIES,* but this issue is a chance to really dig in (pun intended) to the research currently underway that is informing landowners, farmers and policymakers in Iowa and beyond.

I encourage you to learn more, just as I did. (It's one of the things I enjoy most about my job.) A good place to start would be to take a 24-minute lesson on the soil nitrogen cycle, drainage and nitrate loss from CALS faculty members Matt Helmers and Mike Castellano (visit www.stories.cals.iastate.edu for a link). They'll help you get down to the science behind what's happening in Iowa's land and water. See page 16 to learn more.

When you put down this issue, I hope you'll agree with CALS alum Dean Lemke (page 34), who's worked in environmental stewardship in Iowa for more than 40 years, who says, "Iowa enjoys the best-understood science on how to achieve agriculture's water quality goals of any state in the country."

Kind regards,

Melea Reicks Licht

Image: Melea Reicks Licht

Visitors to a late summer Iowa Learning Farms field day learn about bioreactors at this site in rural Story County. The landowner says the bioreactor showed instant benefits in reducing the amount of nitrate moving downstream via field tile lines. (Read more on page 30.)

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ON THE COVER:

Lisa Schulte Moore leads a group of visitors through the Neal Smith National Wildlife Refuge near Prairie City, Iowa, while sharing her research on placing prairie strips within agricultural watersheds. Read more about Schulte Moore, associate professor of natural resource ecology and management, and benefits of prairie strips on page 26.

This fall I was reappointed to my third term as dean of the College of Agriculture and Life Sciences. I welcome the opportunity to continue to lead one of the world's very best agricultural and life sciences colleges.

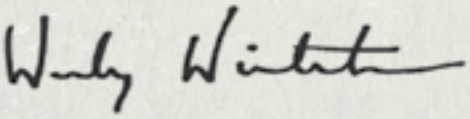
I shared a few thoughts with our faculty and staff looking ahead to the coming year and beyond. A new university strategic planning process will begin, plus we will develop a college strategic plan. Both will guide how we think about future directions and opportunities.

In the past we've engaged in broad, diverse conversations about high-priority or emerging issues. In keeping with the theme of this issue of *STORIES*, I'm proud to say that the work of the ISU-led science assessment team of the Iowa Nutrient Reduction Strategy is viewed as a national model on how states use science to address water quality. We've been leaders in launching major initiatives in the bioeconomy and, this past year, in monarch butterfly conservation. This year I have established a task force to lead a college-wide dialogue on sustainability. I want to gather input and ideas that will make sustainability an even larger part of our research, teaching and extension programs, so that we can take advantage of new opportunities by creating innovations and continue our efforts in conserving natural resources.

As I see it, near the very top of our college priorities is maintaining and enhancing the student experience. As the university has grown in recent years, we must think thoughtfully and carefully on how we continue to sustain our hallmark advising and mentoring of students. We must continue to build on our excellent global programs that prepare students for careers and improve their understanding of different cultures and ways of life. Helping entrepreneurial students harness good ideas as vehicles of business, economic development and job creation is one of the most exciting areas I can think of, and we need to strengthen our efforts in these programs.

A recent survey of our alumni showed 73 percent felt our faculty and staff took a personal interest in them while they were students. That is a fantastic impact. But I believe we should aim for 100 percent. What more can we do to ensure our graduates leave with that feeling?

I welcome your thoughts on how we make our great college even better. Let me know your insights on how we continue to fulfill our mission to the state of Iowa and extend our impact to the world.



Wendy Wintersteen
Endowed Dean of Agriculture and Life Sciences

Image By Barbara McBreen

ALMANAC

TOP 10 WORLDWIDE, 3 YEARS RUNNING

CALS ranked in the top 10 for global programs of agriculture and forestry the last three years.

RESEARCH INNOVATION

- CALS technologies generated more than $10 million dollars in royalties over the past five years.
- The college brought in more than $55 million in sponsored research funding last year and nearly $313 million over the past five years.

RECORD ENROLLMENT, RECORD OPPORTUNITIES

- 5,375 students (undergraduate and graduate)
- **3rd largest** college in the nation
- first time in history women make up the majority of undergrads **(50.7 percent female, 49.3 percent male)**
- Undergrad enrollment has increased 88.4% over the last 10 years
- CALS hosts the largest agricultural and life sciences career fair in the nation
- 98 percent placement rate for recent grads (job placement and pursuit of further education)

40,000 + STRONG

40,800 CALS alumni are making a difference around the world.

- 22,000 live in Iowa

ON THE FARM

Nearly 15,000 people visit Iowa State research farms each year.

EVERYWHERE FOR IOWANS

Last year, ISU Extension and Outreach helped farmers and agribusiness professionals make informed decisions through more than 210,000 learning opportunities.

Burning and cutting brush is one of many ways to keep prairie areas healthy. ***Matt Monahan,*** *a junior in forestry, enjoyed his internship with the Iowa Natural Heritage Foundation this summer.*

PRAIRIE PATROL

MAINTAINING IOWA'S HERITAGE

Story and images by Barbara McBreen

The group of students who worked for the Iowa Natural Heritage Foundation this summer called themselves the Shade Slayers. From left front the students include: ***Amy Andrews****, Central College;* ***Megan Deitrich****, Dordt College;* ***Lauren White****, Iowa State environmental science;* ***Olivia Rauen****, Iowa State animal ecology;* ***Sarah Leichty****, Iowa State environmental science. Iowa State students in the back row from left include:* ***Matt Monahan****, forestry;* ***Zach Burhenn****, forestry;* ***Dustin Oaks****, environmental science; and* ***Jake Hill****, environmental science.*

Mosquitoes, ticks, pouring rain and 100-degree heat are a few of the elements Matt Monahan endured to clear and clean prairie remnants across Iowa this summer.

Monahan, a junior in forestry, was hired as an intern to work for the Iowa Natural Heritage Foundation. He was one of seven Iowa State students working for the foundation. The foundation works to preserve prairies, wetlands, bluff areas and oak savannas across Iowa.

"It's really cool when you can stand in a field and all you can see is prairie – no roads, no poles, no buildings," Monahan says. "I enjoy those moments and think about what it was like when you could only see prairie for miles."

Melanie Louis, Iowa Natural Heritage Foundation land stewardship assistant, helped coordinate the students and worksites. She says the students traveled across Iowa, camping near the work sites, spending 10-hours a day, four days a week for 11 weeks clearing invasive plants.

"If we didn't have these enthusiastic, dedicated, hardworking interns we wouldn't get a quarter of the work done that we need to do in Iowa," Louis says. "These students are the future of conservation."

Summer internships help students network with peers and experience possible career choices. Rick Hall, natural resource ecology and management professor, says he encourages students to pursue as many summer internships as possible.

"It's probably the best way for them to gauge their future employment to decide what they want to do and what aspect they want to emphasize," Hall says.

Walking through timber, maneuvering chain saws, cutting trees, pulling weeds and burning brush are the jobs students took on to clean prairie areas. This summer's team named themselves the Shade Slayers because shade from invasive plants and trees prevents prairie plants from thriving.

Prairie once covered 80 percent of the state before Iowa was settled. Today, it is an endangered ecosystem. In the past, wildfires would roll across the prairie and clean out shade plants and provide a fresh start for native plants. Now, prairie restoration requires planned burns, brush removal and lots of labor.

Researchers are finding planting native prairie can help meet Iowa's water quality goals. Lisa Schulte Moore, associate professor of natural resource ecology and management, says the perennial and diverse character of native prairie, along with the plants' deep roots and stiff stems, can help hold soil in place and slow water movement, allowing water to infiltrate the soil (read more about Schulte Moore's work on page 26).

"We always knew prairies were important for conserving Iowa's wildlife, but we're beginning to understand the important role native plants can play in improving agriculture," Schulte Moore says.

Zach Burhenn, a forestry senior, worked alongside Monahan and says the internship helped him understand Iowa's diverse landscapes.

"I couldn't believe the incredible uniqueness of Iowa's natural heritage areas; the diverse prairies with out-of-this-world beauty, oak savannas with branches rippling like streams and forests full of fun and fungi," Burhenn says.

Protecting natural resources is high on Monahan's list. As a Fred Foreman Scholar he receives funding to allow him to pursue a number of club and internship experiences rather than relying heavily on hourly work to support his education. Monahan says those experiences have prepared him for a number of positions. He's open to either forestry or land stewardship after he graduates in December 2016. S

STORIES EXTRA: www.stories.cals.iastate.edu

Watch the Shade Slayers in action as they cut, clear and burn invasive species in the Indiangrass Hills prairie area in southwest Iowa in a video online.

***Jered Stratton**, a senior in genetics, works at the National Animal Disease Center analyzing swine influenza virus DNA sequences. The research helped him win national recognition as a Goldwater Scholarship Honorable mention awardee.*

CONNECTING THE STRANDS OF MUSIC, MAGIC AND GENETICS

Story by Barbara McBreen, Images by Jim Fosse and Barbara McBreen

*In between mentoring, teaching, studying and working at a research lab, **Jered Stratton**, a senior in genetics, takes time to relax with his guitar every chance he gets.*

Play is an important part of learning, and for Jered Stratton learning is magic.

That's the message Stratton, a senior in genetics, presented in a seminar he co-taught for students in the Honors Program. The topic is focused around a 20 year-old game called Magic: The Gathering.

"They convinced me strategizing was a byproduct of this game and told me the game made them better students," says Susan Yager, English professor and faculty director of the Iowa State Honors Program.

The seminar introduces students to game-based learning, which Stratton points out, is observable in nature.

"Some biologists say bear cubs play and wrestle and it's how they learn to protect themselves," says Stratton.

Yager says the students who met with her about the seminar represent the Honors Program at its best.

"They exemplified everything we want the program to do," Yager says. "Have students meet like-minded people, challenge each other, grow together and have fun."

Magic is a card game, but Stratton says it doesn't matter if it's chess or another game—playing helps develop critical thinking and strategizing skills. Those critical thinking skills are apparent in his job at the National Animal Disease Center.

There he analyzes the genetics of swine influenza viruses. Amy Vincent says the research is an important part of the USDA's influenza prevention efforts to identify and investigate viruses.

"The public databases have thousands of viruses with DNA sequences and what Jered does is look at relationships among these sequences to find differences in the patterns," says Vincent ('97 animal science, '02 veterinary medicine, '04 PhD immunobiology) a National Animal Disease Center research veterinary medical officer.

The research helped Stratton win national recognition as a Goldwater Scholarship Honorable mention awardee. It's a nationally recognized award for students who plan to pursue doctorate degrees. His research focused on identifying which parts of the hemagglutinin protein are recognized by the immune system in swine H1N1 and H1N2 viruses.

"We looked at how viruses similar in DNA sequences were able to evade antibodies. Using these associations we could find the specific amino acids, or parts of the protein, that caused the majority of antigenic difference, or ability to avoid the immune system," Stratton says.

Music is another talent of Stratton's. He plays mostly classical guitar music, but also mandolin and electric guitar.

"No matter what I'm dealing with at the time, I instantly feel better once my hands start playing," Stratton says. "My fingers do the work and I just enjoy the music."

Stratton plans to attend graduate school and pursue his interests in genetics, magic and music.

STORIES EXTRA: www.stories.cals.iastate.edu

Tune in to watch Jered Stratton performing the Bach Cello Suite in a video online.

*Food is a family tradition for **Keoni Aricayos**, a junior in food science from Hawaii. He's most interested in food safety and would like to own a food truck someday. He gained experience working for B-Fabulous BBQ and Catering out of Huxley.*

A NATURAL BORN FOODIE

Story and image by Barbara McBreen

His grandmother owned one of the first Japanese restaurants in Los Angeles, his father runs a taco truck in Hawaii and his step-grandfather is a sushi chef.

It's that tradition of food and an interest in science that inspired Keoni Aricayos, a junior in food science, to study at Iowa State University.

"I love food, but who doesn't love food," Aricayos says. "I was interested in agriculture and I wanted to try something new, so when I found the food science degree I decided to come to Iowa State."

His friends and family thought he was crazy moving to a university located in the Midwest where winters are cold and snowy. Aricayos had never experienced winter and had only seen winter scenes on television, but he relished the experience.

"It blew my mind when the leaves started falling. I couldn't wrap my head around how the trees became sticks," Aricayos says. "Then I couldn't believe the snow, and it was amazing to watch puddles of water became ice."

He's also had some new culinary experiences. He'd never tasted Scotcharoos or biscuits and gravy before moving to Iowa. He does miss the fresh fish dishes he grew up eating and cooking. In Hawaii, he remembers cooking as a community after catching fresh fish from the ocean.

A culinary tradition is strong on both sides of Aricayos' family. His grandmother, Nene Fukuchi, once owned one of the largest Japanese restaurants in Los Angeles. His father saw a need in Hawaii and an opportunity to open a taco truck.

"Hawaii is notorious for serving bad Mexican food," Aricayos says. "My dad was craving Mexican food, so he opened a Mexican food truck and he's pretty successful."

Food safety is Aricayos' main area of interest.

"Combining food and science together is my dream," he says. "My nutrition and microbiology classes are my favorites because those topics can be applied to everyday life."

Cooking food is an art Aricayos enjoys. He has a small container garden where he grows herbs, which he uses to create his own art.

"Each person creates food their own way. You have flavors, spices, colors and you can change it up anyway you want. It makes people happy," he says.

Aricayos' served as a College of Agriculture and Life Sciences Student Council representative for the food science club and is the chair of the club's philanthropy committee. He's also in charge of the club's annual fudge fundraiser.

"He's very passionate about food and his activities for the food science club," says Terri Boylston, food science and human nutrition professor and adviser.

Aricayos will graduate in December 2016 and hopes to pursue a career that will allow him to travel. He plans to invite his parents to Iowa for graduation to get a taste of winter and enjoy some of Iowa's culinary art.

SHARING FARMHER STORIES

Story by Barbara McBreen
Images by Marji Guyler-Alaniz

"Everyone tells you to turn your passion into a job," says Lexi Marek. "That's just what I learned this summer from Marji at FarmHer– how to turn my passion into a business. Along the way I also did something I love, which is to promote agriculture."

Marji Guyler-Alaniz started FarmHer to engage and inform young women who wanted to pursue agriculture as a career. She shares the story of women in agriculture through her photographs, but supports the business through a branded clothing line.

"One of the great things about Lexi is that she farms and she has an instant connection with the women we photograph," Guyler-Alaniz says. "I've always done this myself, but she's been one of the best things that's happened to FarmHer."

Marek, a junior in agriculture and society, spent the summer interning with FarmHer. She helped coordinate social media, website design, the newsletter and the 2016 calendar. Most of the summer she worked from her family farm near Riverside, Iowa, but in August she and Guyler-Alaniz traveled to a conference in Oklahoma. On the way they stopped to shoot a few FarmHer photo sessions.

"On one photo shoot we were outside working with cattle and a storm rolled in. The sky turned navy blue, we grabbed our cameras, ran for the barn and took photos from the hayloft," Marek says.

"It was an intense storm and we were out in the open," Guyler-Alaniz says. "I think I was more frightened than Lexi because I'm never outside in that kind of weather."

At the start of her internship Marek was thinking of ways to reach out to women and promote agriculture. In June, Marek came up with an idea to have a GROW FarmHer Conference in Iowa for young women. It was similar to a conference she heard about in Illinois where FarmHer already has a presence. She received funding through a 4-H scholarship and started planning the GROW FarmHer conference, which was held Nov. 13 in Ankeny.

"My goal for the conference is to expand into other states and reach many, many more future FarmHers," Marek says.

Carly Cummings ('11 agricultural business), program coordinator for the Agricultural Entrepreneurship Initiative, has worked with Marek in several capacities. She says Marek is a powerhouse of energy and involved in several clubs and activities.

"She is always willing to help and she has made the ISU National AgriMarketing Team a great place for students to learn and grow," Cummings says.

Helping women understand the numerous opportunities in agriculture is what Cummings says is important about the conference and FarmHer. Cummings says she's enjoyed working with Marek and encourages other alums to become mentors.

"I enjoyed mentoring and learning from Lexi," Cummings says. "It's extremely rewarding to watch students grow as individuals and as a professionals."

Marek grew up on a sixth generation family farm, where she began showing pigs at five years old. She describes herself

***Lexi Marek** (above) interned for FarmHer this summer assisting with communications and refining her photography skills. Photographer Marji Guyler-Alaniz captured these photographs of the Marek family as they prepared to exhibit animals at the Washington County Fair.*

as an advocate for agriculture and it's evident in everything she takes on.

Since she came to Iowa State she's been involved with the College of Agriculture and Life Sciences Ambassadors, National Agri-Marketing Team, Block and Bridle, Agriculture Communicators of Tomorrow, National Junior Swine Association board member, Alpha Gamma Delta Sorority, Alpha Zeta Honor Society and co-chaired the 2015 Iowa State Bacon Expo.

Last year Marek organized the ISU Block and Bridle Club Hunger Fight held in the ISU Kildee Hall Farm Bureau Pavilion. More than 370 volunteers packaged more than 60,000 Meals from the Heartland packets in four hours.

After graduation Marek hopes to attend graduate school and focus on communications. She says she will be looking for opportunities to promote and grow the conference she put together this year. She will always be looking for ways to encourage young women to pursue agricultural careers and be an advocate for agriculture. S

STUDENT WINS GLOBAL INNOVATION CHALLENGE

Hanyu Yangcheng, graduate student in food science and human nutrition, won first place at the Institute of Food Technologists Global Student Innovation Challenge. Yangcheng created KIK, a food stabilizer system that has the potential to revolutionize dairy products by making them taste and feel better and last longer.

WINTERSTEEN APPOINTED TO THIRD TERM

Dean Wendy Wintersteen ('88 PhD entomology) has been appointed to a new five-year term. Over the past five years she managed record enrollment growth each year while also growing sponsored funding and philanthropic support, and increasing student diversity.

GAUL RECEIVES FACULTY-STAFF INSPIRATION AWARD

Mike Gaul ('86 MS horticulture), director of CALS Career Services, received a 2015 Faculty-Staff Inspiration Award from the ISU Alumni Association on May 29. The award was established for alumni to recognize current or former faculty or staff members who had a significant influence during their student experience. **Bethany Olson** ('14 agricultural business, international agriculture) provided remarks at the ceremony and ISU Alumni Association chief executive officer **Jeff Johnson** presented the award. Gaul was nominated by **Kelli Cameron** ('02 agricultural and life sciences education).

CURTISS RENOVATIONS EARN ENVIRONMENTAL AWARDS

Two Curtiss Hall renovation projects have earned Iowa State its 10th and 11th LEED® certifications. The College of Agriculture and Life Sciences' student services mall, completed in July; and Harl Commons, completed in September 2013, each achieved LEED Gold certification. The LEED ratings for Curtiss Hall are the University's first for interior renovations.

ROASTERIE COFFEE FOUNDER PRESENTS DEAL LECTURE

The owner and founder of The Roasterie Coffee, Inc., **Danny O'Neill**, presented the 2015 William K. Deal Endowed Leadership Lecture Oct. 7 at Iowa State. **William Deal** ('58 agricultural and life sciences education) established the lecture series to help prepare future leaders and innovators. O'Neill's presentation, "How Baling Hay Prepared Me to Become the Coffee 'Bean Baron,'" is available online at www.stories.cals.iastate.edu.

CALS STUDENTS WIN BIG ACROSS THE BOARDS

Phi Tau Sigma (honor society of food and technology)—*student chapter of the year, Institute of Food Technologists*

Agricultural Business Club—*outstanding student chapter in the nation, Agricultural and Applied Economics Association*

Livestock Judging Team—*third place, overall honors, National Barrow Show*

Soils Judging Team—*second place team and second place overall, Region Five Collegiate Soil Judging Contest*

CARGILL PARTNERS WITH GLOBAL RESOURCE SYSTEMS

Cargill has provided a $485,500 gift to the Global Resource Systems (GRS) program to enhance student recruitment, support faculty and award four new Cargill GRS Scholarships. CALS grad **Todd Hall** ('82 animal science), senior vice president of Cargill, visited campus in September to kick off the partnership and visit with GRS students.

HEARTY HELLOS

Chester Britt, professor and chair, Department of Sociology

David Freeman ('08 food science), program manager, Center for Crops Utilization Research, Iowa State University City of Cedar Rapids partnership

Kevin Keener, director, Center for Crops Utilization Research and BioCentury Research Farm

Joshua Rosenbloom, professor and chair, Department of Economics

PAVING THE WAY FOR PERENNIALS

Story by Fred Love
Image by Christopher Gannon

*Agronomist **Emily Heaton** says the new federal push for clean energy may create an opportunity for Iowa farmers to plant perennial grasses such as miscanthus on sections of farmland that often don't turn a profit.*

A recently announced goal to reduce U.S. carbon emissions by 30 percent by the year 2030 may help to open new markets for Iowa biomass derived from perennial grasses.

That makes Emily Heaton's quest to "save the world with giant grasses" all the more timely.

Heaton, an associate professor of agronomy, says the Environmental Protection Agency's "Clean Power Plan" lays the groundwork for a "perennial economy" that could create demand for grasses such as switchgrass and prairie cordgrass. Miscanthus, a giant grass that originates in Asia and the subject of much of Heaton's research, may also fit the bill.

Heaton studies perennial grasses, or grasses that grow back year after year, to get a better handle on their environmental benefits. She says Iowa stands to gain much by replacing some of the acres currently devoted to corn and soybean with tall grasses. Planting perennial grasses on about 15 percent of the farmland in the state could lead to a 90 percent reduction in sediment losses and a fourfold increase in plant and animal diversity, she says.

"More perennials in Iowa means more roots in the ground, which keeps soil and water and nutrients where they should be," Heaton says.

While the environmental benefits of perennial grasses are clear, the economic benefits have lagged behind, largely because there's little demand for the biomass the grasses produce. But the new federal clean energy plan suggests that new sources of biomass may play a key role in meeting the carbon reduction goals.

Heaton says that may create an opportunity for Iowa farmers to plant perennial grasses such as miscanthus on sections of farmland that often don't turn a profit.

Over a million acres of Iowa cropland lose money every year, usually due to poor soil conditions, she says. It might make more sense to plant prairie grasses there to reduce cost and increase environmental performance. If demand for biomass grows, planting perennial grasses may become a profitable choice for Iowa farmers, Heaton says.

Heaton, who joined the faculty at Iowa State in 2008, played a pivotal role in a collaboration with the University of Iowa to grow biomass for energy production on campus. Heaton helped orchestrate the planting and harvesting of miscanthus on 28 acres in eastern Iowa. The project received the Governor's Iowa Environmental Excellence Award in a ceremony in early August.

As a doctorate student at the University of Illinois, Heaton worked on the first side-by-side trials of miscanthus and switchgrass in the United States, a project she says fits well with the land-grant mission of schools like Iowa State.

"We had questions we wanted to answer, so we went out and found those answers," she says. "Then we made that new knowledge available for people to advance even further."

CARVING A PATH TO THE NATIONAL ACADEMY OF SCIENCE

Story by Nathan Cook
Image by Christopher Gannon

Cathy Kling's passion for environmental issues has been engrained since she was a Girl Scout camping, hiking and enjoying the outdoors. But, her early exposure to economics didn't go quite as well.

"There was an economics class in my high school. The teacher thought it was really funny on the first day to tease all the girls in the class and tell them 'you came to the wrong place, this is economics, not home ec.' That was perfectly acceptable at the time. In retrospect, it makes me realize that we've come a long way," she laughs.

Kling, director of the Center for Agricultural and Rural Development, decided to give economics another try. She earned a degree in business from the University of Iowa and a doctorate in environmental economics at the University of Maryland. She joined the Iowa State faculty as an associate professor in 1993.

Since then she's contributed greatly to the advancement of natural resource and environmental economics. Kling is known for conducting innovative research throughout her career that melds environmental science with classical economics. She pioneered research on integrated water quality and economic models to help

*Professor **Cathy Kling's** work in environmental economics has earned her a place alongside the world's finest scientists and scholars. Her name is etched in Beardshear Hall among her fellow Iowa State National Academy of Science members. Kling is the 11th in the university's history to be elected and the first woman.*

Image: Melea Reicks Licht

guide the design and implementation of conservation policies in the Midwest.

The methods she developed to evaluate how people value environmental amenities and how they support environmental improvements led to the Iowa Lakes Valuation Project. The long-running survey of Iowans about the use of Iowa lakes has informed both citizens and policymakers about the value of the state's water resources.

Kling's expertise has garnered her several accolades, but in the last two years she has received two awards that have placed her with elite company. She was elected to the National Academy of Sciences (NAS) in April of 2014 and recognized as a Charles F. Curtiss Distinguished Professor in Agriculture and Life Sciences at Iowa State the year prior.

> ***"As important as water is to human beings, it's really quite surprising how little we know about the value we place on water quality in alternative uses."***

"It's with great pride that I learned of Dr. Kling's election to the National Academy of Sciences," says Iowa State University President Steven Leath. "Dr. Kling joins some of the most distinguished scientists in the history of this institution as a member of the academy."

About 80 scientists are elected to the National Academy of Sciences every year. Kling is only the 11th Iowa State University professor in the university's history to be elected and the first woman.

The National Academy of Sciences is a private, nonprofit institution that was established under a congressional charter signed by President Abraham Lincoln in 1863. It recognizes achievement in science by election to membership, and—with the National Academy of Engineering, Institute of Medicine, and National Research Council—provides science, technology and health policy advice to the federal government and other organizations. The honor includes being able to sign the "Great Book" which contains signatures of every past scientist elected to the academy. And, her name is engraved alongside her fellow Iowa State academy members on the first floor of Beardshear Hall on the Iowa State University campus.

"Getting the Charles F. Curtiss award was fantastic. I was flying high from that, and then being elected to the NAS was better than anything I could have imagined," she says.

Though she was already well-known amongst her peers, she says the awards have furthered her visibility. "It's clear to me that both of those things have put my name out there—I'm getting more and more requests to do projects," she says.

"When I first started doing this work and learning about the Gulf hypoxia in the late 1990s, very few people even knew about the problem or what hypoxia was," she says. "If I would mention it during a talk I would often get a blank look from a lot of people. Now, however, it's on the radar for most people that know something about agriculture."

Her work focusing on large-scale problems, like oxygen depletion in the Gulf, have become well known. Before that, however, she started small.

"When I moved here I really wanted to learn about the issues that were relevant to Iowa. Initially, it was only local water quality that had my interest," she says. "At some point, I became aware of the hypoxia work that was being done in the Gulf."

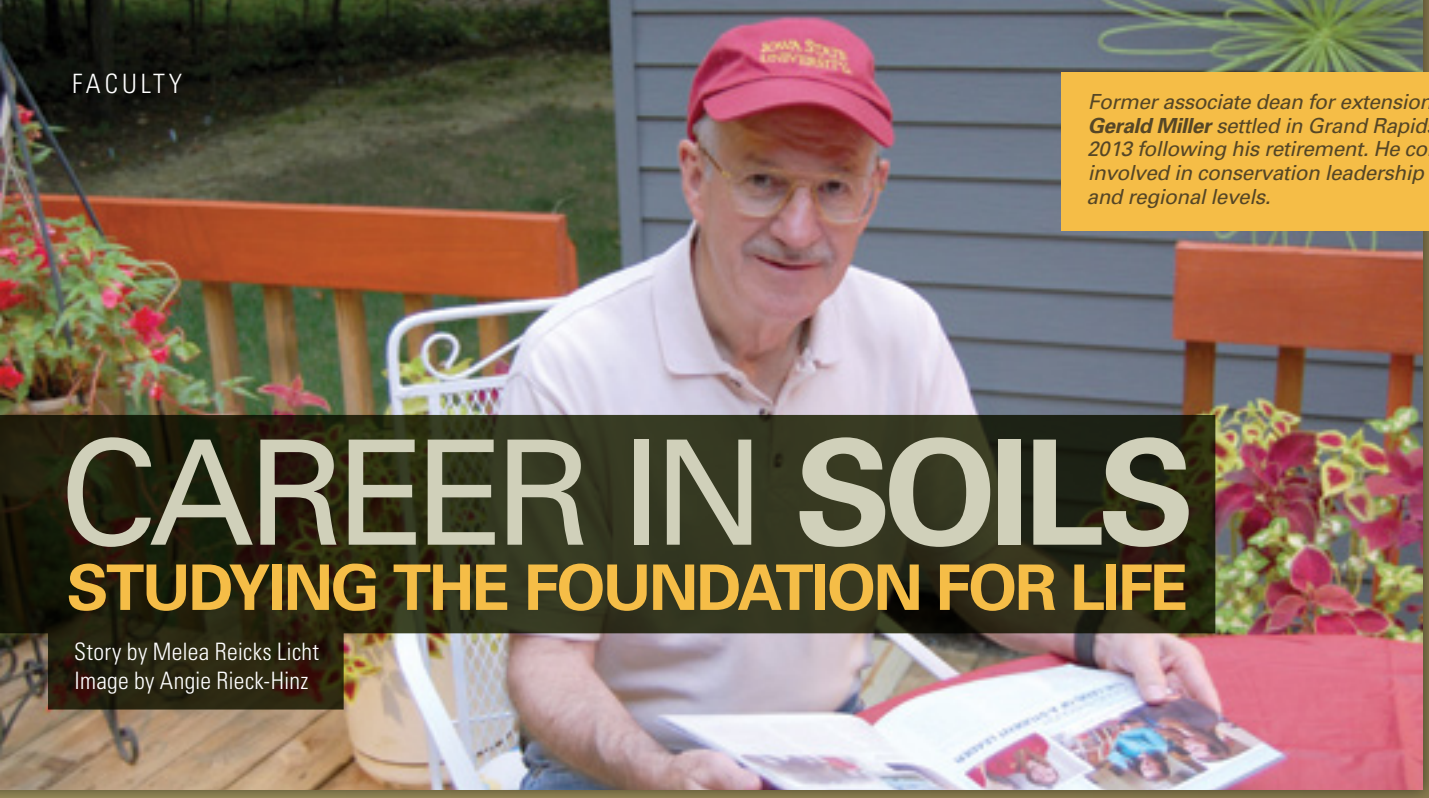
Kling then joined a National Science Foundation project with Nancy Rabalais, a marine ecologist tracking the size of the hypoxic zone from year to year. The research group's efforts have gained national attention and one of their papers was accepted to the Proceedings of the National Academy of Sciences last year.

"I hope that our research has helped the discussion concerning what can be done and where future research may be the most fruitful in identifying solutions. Environmental problems like the hypoxic zone are complex and have taken years to develop—solutions will likewise take a long time to evolve."

Looking toward the future, Kling says she continues to be interested in studying economic incentives as a means to address water quality issues in agriculture and the valuation of water quality improvements.

"As important as water is to human beings, it's really quite surprising how little we know about the value we place on water quality in alternative uses."

As for advice that she would give to the next generation of women looking to enter the field of economics, Kling says, "I hesitate to give advice since everyone's situation differs so much, but I have had an intellectually rich career, have met many fascinating and thoughtful people, and would certainly choose this path again." S



*Former associate dean for extension and outreach **Gerald Miller** settled in Grand Rapids, Michigan, in 2013 following his retirement. He continues to be involved in conservation leadership at the state and regional levels.*

CAREER IN SOILS

STUDYING THE FOUNDATION FOR LIFE

Story by Melea Reicks Licht
Image by Angie Rieck-Hinz

2015 was declared the International Year of Soils by the United Nations General Assembly to increase public awareness and understanding of soil.

To Gerald Miller every year of his 36-year career was the Year of Soils. Miller ('71 MS soil science, '74 PhD), emeritus professor of agronomy, served as associate dean for extension and outreach in the College of Agriculture and Life Sciences.

Thanks to Miller's advocacy the Iowa House of Representatives approved a resolution supporting the International Year of Soils and declaring soil's importance to "Iowa's future prosperity and healthy environment."

"Soil along with water, is the basic foundation for life on planet Earth. Without soil, terrestrial animals, including people, would be dependent on fresh and marine waters for their food source. Not a viable option," says Miller.

After joining Iowa State University in 1974 as an extension agronomist, Miller spent the next 25 years building two careers—one at Iowa State, and the other in the Iowa National Guard.

Miller commanded Army National Guard units at company, battalion, brigade and division levels throughout the 1970s and 1990s. First commissioned as a Second Lieutenant in ROTC at Virginia Tech in 1965, Miller served in active duty in the Army in the mid-1960s.

At Iowa State, he led extension education programs and conducted applied studies for soil survey and soil and water management. He oversaw the annual plan of work and budget for more than 120 faculty and staff located on campus and across the state.

"Jerry believed in teamwork. In fact, the USDA-NIFA Committee for Shared Leadership in Water Resources named a national award after him—the Gerald A. Miller Outreach Team Award," says John Lawrence, associate dean for extension and director of ISU Extension and Outreach Agriculture and Natural Resources.

Putting teamwork into action, Miller served as the project director for the Heartland Regional Water Coordination Initiative. The initiative brought together water quality coordinators, extension and research faculty from multiple land grant universities. They built institutional partnerships to increase the capacity of citizens, landowners, agencies and community leaders to better address water quality concerns.

In retirement, Miller continues to be involved in the Iowa Cooperative Soil Survey, Iowa Soil Properties and Interpretation Database and Iowa Soil and Land Use website. He recently helped update Iowa State University's Corn Suitability Rating system.

He and his wife Betty settled in Grand Rapids, Michigan, in 2013 where he's taken a seat on the Kent County Conservation District Board and serves in conservation leadership at the state and regional levels.

Miller undoubtedly will continue celebrating soil long after the calendar flips to the new year. He says there is still much to teach and to discover about soil.

"I wish people understood soil is not dirt! Soil is alive with abundant microscopic life. Each kind of soil consists of chemical, physical and biological properties. Soils have depth, length and width on the landscape," Miller says. "Dirt is defined as soil out-of-place, like under your fingernails or on your skin and clothes."

"The biological component of soils is the least understood and ripe for scientific discovery," he says. "My forecast is many future discoveries in medicine will be derived from our isolation and understanding of microbes in different kinds of soil." S

STORIES EXTRA: www.stories.cals.iastate.edu

Celebrate the Year of Soils. Find links to Iowa House Resolution 31 and educational resources from several organizations participating in the Year of Soils.

VOICES

MEASURING PROGRESS

Story by John Lawrence

The Iowa Nutrient Reduction Strategy (NRS) was officially launched by Governor Brandstad in May 2013. It is a voluntary science-based strategy to achieve the Gulf Hypoxia Task Force goal of reducing the amount of nitrogen and phosphorus reaching the Gulf of Mexico by 45 percent. Twelve states along the main stem of the Mississippi and Ohio rivers are striving for that goal so as to reduce the size of the so-called "dead zone" in the Gulf to its 1980-1996 level.

Iowa is leading the effort. In fact, an Iowan is leading the task force. Iowa Secretary of Agriculture Bill Northey ('81 agricultural business) is the co-chair of the task force along with a representative of the U.S. Environmental Protection Agency (EPA). Iowa also is a leader because of the effective partnership formed to develop and implement our state strategy. The Iowa Department of Agriculture and Land Stewardship, Iowa Department of Natural Resources and the College of Agriculture and Life Sciences formed a team to develop a single strategy for both regulated cities and industries and non-regulated agriculture.

The college led the science assessment providing the research foundation for land use, in-field and edge-of-field practices for agriculture to implement to achieve the goal. ISU Extension and Outreach is leading farmer education and implementation efforts. The EPA has asked other states to follow the Iowa model with the land grant university as a partner and science as the foundation.

Implementing the scope and scale of practices needed to reach the task force goal is a monumental challenge. Equally challenging is systematically measuring and reporting progress to those questioning if a voluntary program will be effective.

Because it will take time to fully implement the strategy, and because nutrient loading in surface water is impacted by weather and thus variable, Iowa has taken a "logic model" approach to measuring progress. Logic models describe the logical pathway necessary to reach a long term goal and define indicators for each step along the path.

How do we measure progress?

Water. Do you measure watersheds, an ambient network of locations across the state, where major rivers leave the state? Do you measure annually, monthly, daily? Do you calculate, model or measure? It is probably all of the above. Ultimately, we need to see reduction in nutrients.

Land. Before we see a change in water, we need to see changes on both the land and in cities. Indicators include acres of recommended practices implemented (cover crops, reduced tillage, split application of fertilizer); acres of different crops grown (alfalfa, pasture, perennials); acres protected by edge-of-field practices (bioreactors, saturated buffers, constructed wetlands); number of upgraded water treatment facilities.

Human. Changes occur when people change their behavior towards the land and in cities. Indicators include changes in farmer knowledge and attitude; number of ag retailers actively promoting NRS practices; landowners putting NRS practices into lease agreements.

Inputs. Behavior changes and practices are implemented when investment of resources is made. Indicators include state/federal cost-share funds; agencies and organizations investing staff, media and other resources to increase farmer knowledge and implementation; investment in equipment required for new practices.

Think of the indicators as dials on a logic model dashboard. It will take many years to see a sustained improvement in water quality. In the near term we need to begin moving the needle in the right direction on the other indicators if we are going to reach our goal.

John Lawrence is associate dean for extension and outreach in Iowa State University's College of Agriculture and Life Sciences and director for Agriculture and Natural Resources Extension and Outreach.

MEASURABLE INDICATORS OF DESIRABLE CHANGE

INPUTS

- People
- Funding
- Agency resources
- Private sector resources

HUMAN

- Partner organizations
- Partner agribusinesses
- Farmer knowledge and attitude
- Point source communities and management knowledge and attitude

LAND

- Land use changes
- Practice adoption
- Point source implementation

WATER

- Calculated load reduction
- Measured loads in priority watersheds
- Organized watersheds reported load changes
- Measured loads at existing monitoring stations

MANAGING THE N FACTOR

Farmers and landowners have made great strides in reducing soil and phosphorus loss thanks to the adoption of soil conservation practices over the past several decades. To address another great challenge facing the protection of soil and water—the loss of nitrate-nitrogen—new methods will need to be incorporated into efforts to protect land and water.

WAYS TO PREVENT NITRATE LOSS

LAND USE/IN FIELD:

Land use practices can reduce nitrate loss by 10-85 percent.

- *Add cover crops to corn-soybean rotations*
- *Extend crop rotations and pasture rotations*
- *Incorporate energy crops*

EDGE-OF-FIELD:

Edge-of-field practices can reduce nitrite loss by 30-50 percent.

- *Build wetlands*
- *Install saturated buffers*
- *Construct bioreactors*

IN FIELD NITROGEN MANAGEMENT:

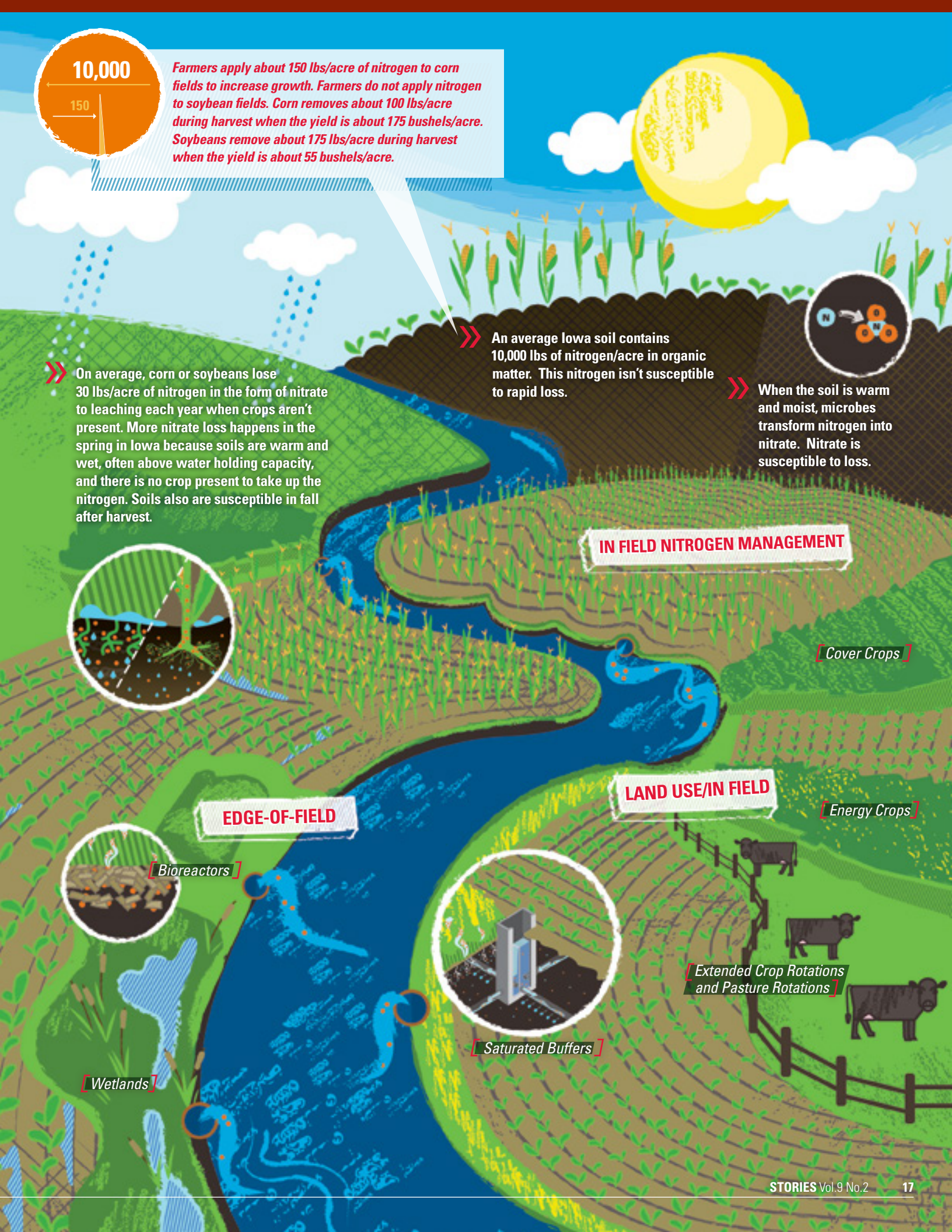
Nitrogen fertilizer use is not the primary reason for nitrate loss, nevertheless improved nitrogen fertilizer management is important and can contribute to reducing loss.

- *Most nitrate loss to Iowa waterways is caused by a mismatch in timing between nitrate production from soil organic matter and nitrate demand from rapidly growing crops. The majority of nitrate is lost when crops are in early growth stages (in April–June).*
- *Due to this fact, nitrate loss from corn and soybean crops is the same despite the fact that fertilizer is applied to corn and not applied to soybean.*

STORIES EXTRA: www.stories.cals.iastate.edu

Learn more about managing nitrogen with Iowa State University experts Matt Helmers and Mike Castellano in videos online and find links to Iowa State University Extension and Outreach resources.

Sources: Matthew Helmers, professor of agricultural and biosystems engineering, Michael Castellano, associate professor of agronomy, Jamie Benning, water quality program manager, John Lawrence, associate dean and director agriculture and natural resources extension and outreach


10,000
150
Farmers apply about 150 lbs/acre of nitrogen to corn fields to increase growth. Farmers do not apply nitrogen to soybean fields. Corn removes about 100 lbs/acre during harvest when the yield is about 175 bushels/acre. Soybeans remove about 175 lbs/acre during harvest when the yield is about 55 bushels/acre.
An average Iowa soil contains 10,000 lbs of nitrogen/acre in organic matter. This nitrogen isn't susceptible to rapid loss.
When the soil is warm and moist, microbes transform nitrogen into nitrate. Nitrate is susceptible to loss.
On average, corn or soybeans lose 30 lbs/acre of nitrogen in the form of nitrate to leaching each year when crops aren't present. More nitrate loss happens in the spring in Iowa because soils are warm and wet, often above water holding capacity, and there is no crop present to take up the nitrogen. Soils also are susceptible in fall after harvest.
IN FIELD NITROGEN MANAGEMENT
Cover Crops
LAND USE/IN FIELD
Energy Crops
EDGE-OF-FIELD
Bioreactors
Extended Crop Rotations and Pasture Rotations
Saturated Buffers
Wetlands

VOICES

Story by Michael Castellano and Matthew Helmers

THE SCIENCE BEHIND NITRATE TRANSPORT

Nitrate is both a critical nutrient for crop production and a substance that can impair water quality. We would like to clarify the science of when, where and how nitrate is transferred from Iowa crop fields to waterways. This science underpins strategies for Iowans to improve water quality.

Corn and soybean fields are the primary cause of nitrate in Iowa waterways. In an average year, one acre planted to corn or soybeans loses about 30 pounds of nitrogen in the form of nitrate to Iowa waterways. In 2014, Iowa planted more than 23 million acres of corn and soybeans.

Most nitrate is lost from corn and soybean fields before they are planted and start to vigorously grow. During these times, if the soil is warm and wet, microbes naturally produce nitrate from the soil. Microbial nitrate production exceeds nitrate uptake by corn and soybeans in all but two or three months of the year. Without corn or soybeans to use it, nitrate is transported by rain from soil to waterways.

In contrast to annual corn and soybeans, perennial crops, pastures and prairie lose very little nitrate. When soils are warm and wet, these perennial plants are using the nitrate produced by microbes.

Strategies that create plant demand for nitrate during times when corn and soybeans are not growing can significantly reduce nitrate loss. Cover crops are one example. Cover crops are planted primarily to reduce nitrate loss and soil erosion. In the late summer, cover crops can be aerially seeded into standing corn and soybeans. Cover crops reduce nitrate loss by taking up the nitrate and releasing it back to the soil when the crop is killed before corn and soybean planting in the spring.

Although corn receives nitrogen fertilizer and soybeans do not, nitrate loss from fields planted to both crops is similar. Why? Because most nitrate loss is due to the absence of plant nitrate uptake rather than nitrogen fertilizer inputs. That is why, although important, improved nitrogen fertilizer management is insufficient to meet Iowa's water quality goals.

Regardless of whether it is derived from soil organic matter or fertilizer, nitrate not taken up by plants is susceptible to loss from the crop root zone when rainfall exceeds the capacity for plants to use the rain and the soil to hold the rain.

About half of Iowa corn and soybean fields have tile drainage pipes installed under the soil to manage water levels in the fields and support economically viable crop production. In corn and soybean fields with tile drains, nitrate is routed to streams. However, nitrate is also lost in fields that are not tile-drained. In these areas, nitrate can move to streams through subsurface water flow.

Strategies to reduce nitrate movement from tile-drained and non-drained crop fields have some similarities. In both cases, improved nitrogen fertilizer management and changes in land use practices can reduce the concentration of nitrate in the soil when corn and soybeans are not vigorously growing. These strategies include nitrogen fertilizer management, cover crops, diversified crop rotations and perennial vegetation such as crops dedicated to biomass energy production and pasture.

In areas where nitrate is transported through tile drainage systems, there are also edge-of-field practices including wetlands, denitrification bioreactors and saturated stream buffers that reduce nitrate after it leaves the field.

It is important to note that while nitrogen fertilizer management can reduce nitrate loss, it will not solve the problem. There is still the lack of demand for nitrate when corn and soybeans are not growing. Edge-of-field practices, cover crops and perennials will be more effective than nitrogen fertilizer management.

There is no single strategy to effectively reduce nitrate loss. Individual farms will require different combinations of nitrate strategies.

The Iowa Nutrient Reduction Strategy Nonpoint Source Science Assessment presents several scenarios of what it might take to achieve the nitrate reduction goals set by the Gulf of Mexico Hypoxia Task Force.

One thing is clear: All the scenarios require extremely high levels of implementation of a wide variety of methods. That is why all landowners in Iowa will need to engage in nutrient reduction strategies if we are to reach our water quality goals.

Michael Castellano ***Matthew Helmers***

Michael Castellano is an associate professor in the Department of Agronomy and William T. Frankenberger Professor in Soil Science. Matthew Helmers is a professor in the Department of Agricultural and Biosystems Engineering and the Dean's Professor in the College of Agriculture and Life Sciences.

GENERATIONS OF RESEARCH, RECOMMENDATIONS, RESULTS

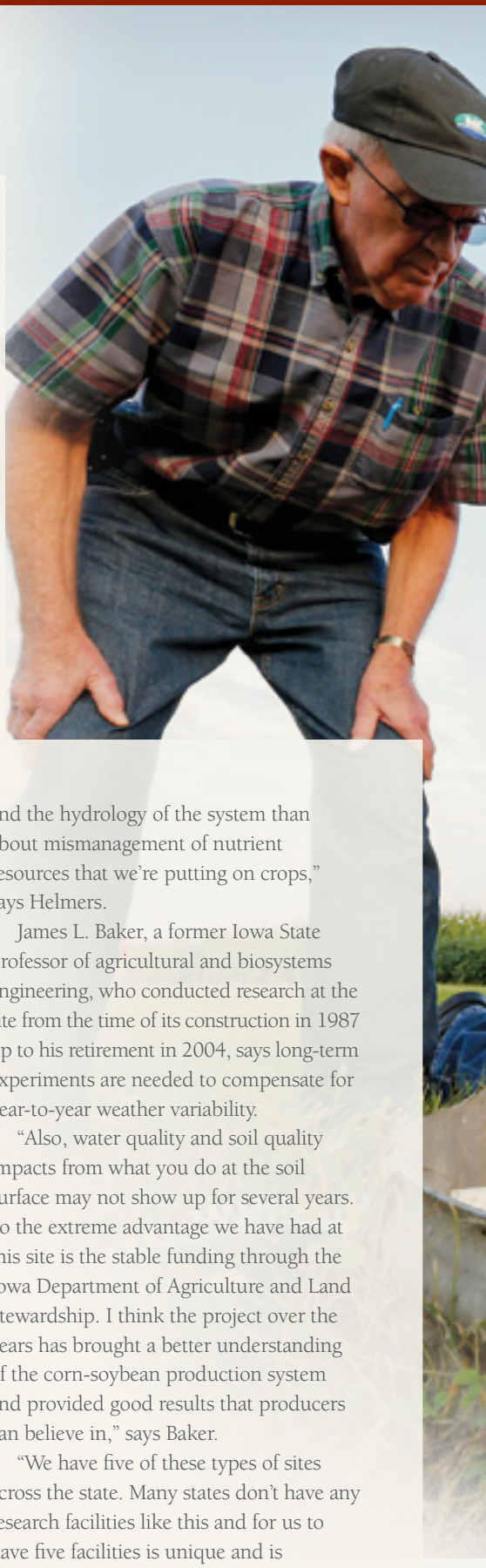
Story by Lynn Laws
Images by Christopher Gannon

Six generations of Bob Lynch's family have farmed near the edge of Gilmore City in the center of Iowa's prairie pothole region. When the Pocahontas Soil and Water Conservation District purchased land nearby in 1990 to work with Iowa State University to conduct water quality research, area farmers were invited to participate. The Lynch family welcomed the opportunity.

Initial research at the Gilmore City site and on neighboring farms was aimed at determining if pesticides and fertilizers from farm fields were entering potential drinking water sources through agricultural drainage wells. Research results showed pesticides were not contaminating ground waters, but the amount of nitrate entering the wells frequently exceeded the EPA drinking water standard. The findings and recommendations led to the establishment of cost-share programs to assist farmers in closing the wells and constructing alternative drainage systems.

The agricultural drainage well on Bob Lynch's ('77 farm operations) family farmland has since been closed, and over the years they implemented more and

***Matt Helmers**, professor of agricultural and biosystems engineering, addresses more than 90 farmers and agricultural leaders at a field day at the Iowa State drainage research and demonstration site near Gilmore City. The August event marked the 25th anniversary of the site.*



more conservation practices, as they learned about them. The practices include no-till soybeans, strip-till corn and cover crops, which have increased organic matter on their fields, reduced the amount of nitrogen they use and reduced ponding.

"With cover crops in the no-till system, a lot of times that first two to three inches of rain just soaks right in because of all the holes we have from the earthworms, microorganisms and roots. It doesn't pond a lot. When we have more rain than that, or it persists over time, then it ponds. We are in the prairie pothole region up here, so that's going to happen," says Lynch.

Local research, local impacts

Carl Pederson, an agricultural specialist with Iowa State University Extension and Outreach who has conducted research at the site, says long-term research sites reduce farmer risks associated with experimenting with new practices and products.

"Farmers like to see how we do it first and how it worked out. For example, maybe area farmers are reluctant to try cover crops. They want to see how it looks on our field plots first, over multiple seasons. They're always welcome to come over and see how those practices are working," says Pederson ('90 agricultural mechanization).

This August, Lynch, along with his father, Larry ('55 farm operations), son, Jay, and 90 farmers and agricultural specialists from Iowa State and other organizations, attended a field day at the drainage research and demonstration site at Gilmore City. Iowa Secretary of Agriculture, Bill Northey, and others spoke, marking the 25th anniversary of the site.

"At Iowa State University, for greater than two decades, we've been very fortunate to have a state-of-the-art subsurface drainage research facility, where we're able to measure all the water that's flowing from tile drains and collect flow-weighted water samples for research," says Matt Helmers, professor of agricultural and biosystems engineering at Iowa State. The site was established primarily in response to Iowa's 1987 Groundwater Protection Act and focused on agricultural drainage well research. Since that time the focus has shifted to understanding nutrient loss with subsurface drainage.

Research at the Gilmore City site has produced answers to questions about plant nitrogen needs, application rates, timing, application methods and forms of nitrogen and additives. In the last 12 years, they have also examined the impact of a winter, cereal rye cover crop on nitrate concentration and loss in tile lines. Findings include the fact that a cereal rye cover crop can reduce nitrate loss to tile lines by greater than 20 percent.

Other sites throughout the state have shown greater reductions in nitrate loss due to the integration of cereal rye demonstrating that performance can vary. Future work at the Gilmore City site will study how to maximize the benefits of cover crops in this area of the state.

Understanding the N factor

Helmers says the Gilmore City site was key to obtaining relevant, Iowa-based data for a 2012 science assessment, which was used to develop Iowa's Nutrient Reduction Strategy. Helmers and others have been able to use the assessment to recommend best management practices for meeting Iowa's water quality goals.

Perhaps the most important recent finding, confirmed by long-term collection of research data at the site, is that nitrate loss to tile lines in Iowa farmland is primarily due to the absence of nitrate uptake by live plant roots in the fall and spring of the year. Iowa soils are naturally rich in nitrogen. Nitrate not taken up by plants, whether naturally present in the soil or added for crop growth, moves with water.

"That's a really important finding. It illustrates that this is more about land use and the hydrology of the system than about mismanagement of nutrient resources that we're putting on crops," says Helmers.

James L. Baker, a former Iowa State professor of agricultural and biosystems engineering, who conducted research at the site from the time of its construction in 1987 up to his retirement in 2004, says long-term experiments are needed to compensate for year-to-year weather variability.

"Also, water quality and soil quality impacts from what you do at the soil surface may not show up for several years. So the extreme advantage we have had at this site is the stable funding through the Iowa Department of Agriculture and Land Stewardship. I think the project over the years has brought a better understanding of the corn-soybean production system and provided good results that producers can believe in," says Baker.

"We have five of these types of sites across the state. Many states don't have any research facilities like this and for us to have five facilities is unique and is allowing Iowa to be a leader in looking at how in-field management practices impact water quality," says Helmers. S

Bob Lynch *(second from right), his father,* ***Larry,*** *and son,* ***Jay,*** *have been involved in research with Iowa State University since 1990. The Lynches talk with Iowa State's* ***Matt Helmers*** *(second from left) about conservation practices they've adopted over the generations.*

COVER CROPS Q&A

Q&A on Cover Crops with Tom Kaspar, plant physiologist at the USDA-ARS National Laboratory for Agriculture and the Environment

Story by Ed Adcock
Image by Christopher Gannon

Tom Kaspar ('76 biology, MS '79 crop production and physiology, '82 PhD), plant physiologist at the USDA-ARS National Laboratory for Agriculture and the Environment located on the Iowa State University campus, has worked on cover crop projects since the early 1990s. He's worked with faculty in agronomy, agriculture and biosystems engineering, plant pathology and microbiology and horticulture.

His first research projects investigated cover crops as one way to keep soil in place following soybean harvest to comply with the provisions of the Natural Resources Conservation Service's Highly Erodible Land Conservation program. Today, cover crops are being used as a way to recycle nutrients and keep them out of streams and rivers to comply with targets set by the Iowa Nutrient Reduction Strategy.

How effective at reducing nitrates have cover crops been?

Field research over the last 12 years has shown that when cover crops grow well they can reduce the nitrate lost in tile drainage with corn and soybean production by an average of 55 percent.

That kind of reduction in the nitrate reaching surface waters from cropland would really help improve Iowa's water quality. Unfortunately, only about 1.5 percent of the state's farmland, or 380,000 acres, were in cover crops based on the 2012 ag census. So we have a long way to go to reach to full potential of cover crops to improve water quality.

What are some other findings from the research?

Nitrate losses in drainage don't differ much between corn and soybean years, even though soybeans aren't fertilized. Some of the nitrate in drainage water comes from soil mineralization.

Nitrogen management alone won't solve nitrate losses in drainage because of the five to seven months each year without living plants to take up water and nitrate.

What are some of the challenges producers face when considering cover crops?

Cover crops don't provide short-term economic returns, seeding them in the fall is one more operation during the busy harvest season and terminating them in the spring can delay planting.

Cover crops are a long-term investment in soil health and there is definitely a learning curve, but growing plants is what farmers have done all their lives.

A growing number of innovative Iowa farmers have already adapted cover crops to their farms.

How can producers overcome these challenges?

Before jumping in, visit field days, like those sponsored by Iowa Learning Farms and Iowa State University Extension and Outreach, to learn from farmers and researchers.

Keep it simple and start small. Use a cover crop that someone in your area has successfully used rather than something completely new.

Consider using cereal rye, the most winter hardy of all the cover crops, which can be planted late and still survives the winter. A lot of other cover crop species are not winter hardy and need to be aerial-seeded before harvest to grow enough to provide any benefits.

Pay extra attention when planting into cover crops. Make sure they are dead and that your planter is maintaining good seed depth and closing the seed furrow. S

WETLANDS

A WIN-WIN FOR WATER QUALITY, WILDLIFE

Story by Ed Adcock
Image by Iowa Farm Bureau Spokesman

*Professor **Bill Crumpton** shares his wetland research often with landowners, farmers and members of the media.*

Wetlands targeted to intercept water from heavily tiled cropland in Iowa have been called "heavy lifters" in the effort to carry Iowa's nutrient reduction strategy. These wetlands can both improve water quality and provide habitat for wildlife.

The Iowa Conservation Reserve Enhancement Program (CREP) provides incentives to landowners to voluntarily restore wetlands targeted for water quality improvement through a joint effort of the Iowa Department of Agriculture and Land Stewardship (IDALS) and the USDA Farm Service Agency cooperating with local Soil and Water Conservation Districts.

Bill Crumpton, a professor in Iowa State's ecology, evolution and organismal biology department whose research provided the technical foundation for the program, has spent the last 10 years measuring the water quality benefits of these wetlands.

"This is a successful program. It's effective and it's scalable," Crumpton says.

The results demonstrate that the wetlands are very effective at reducing nitrate loads across a wide range of conditions. Microorganisms that live in wetlands convert nitrates into a harmless gas and on average, a wetland that's 1 percent of its watershed area—for example, 10 acres of a 1,000-acre watershed—can take out 50 percent of the nitrates.

"In the science panel of the nutrient reduction strategy, we couldn't get to a 45 percent reduction (of nitrates) without a lot of targeted wetland restorations," he says. "You can take land out of production, and you can get there. But retiring almost half of the crop ground in Iowa is not an attractive alternative."

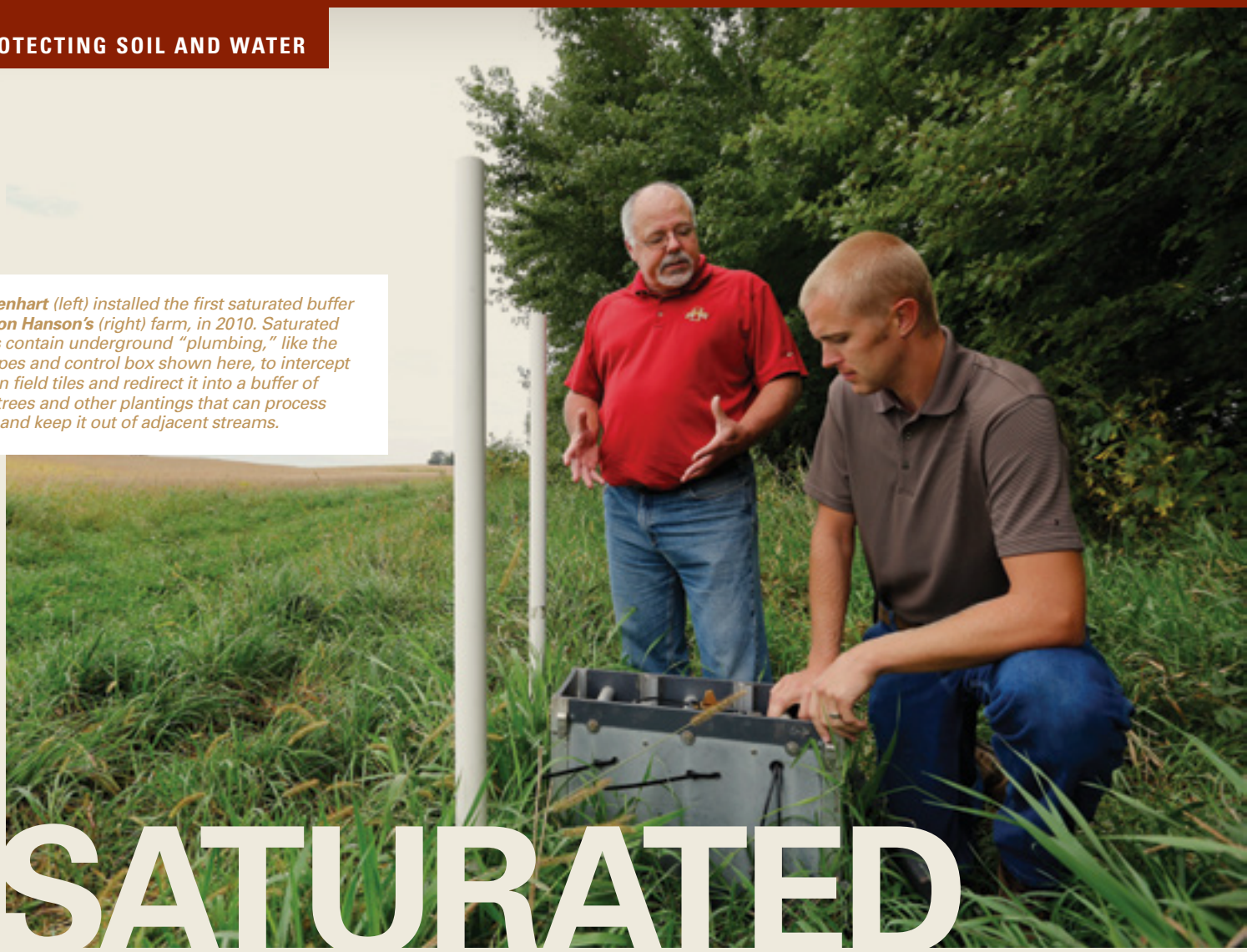
Even with better nutrient management, it is likely that 150,000-300,000 acres of wetlands, perhaps 1 percent of all Iowa cropland, would be needed to get to the 45 percent nitrate reduction target in the Iowa Nutrient Reduction Strategy, he says.

Crumpton says wetlands have several advantages.

"Wetlands are permanent structures. We make a commitment once and then we have that capacity for generations," he says. "In addition, wetlands create sorely needed habitat and recreational opportunities."

Kent Schwartz calls the CREP wetland on 18 acres of his land near Gilbert a "win-win-win," benefitting taxpayers, those studying wetlands and the local environment. As the landowner, he enjoys the habitat created for wildlife.

"Stewardship of resources is important to me," he says. "The CREP site has provided me with a view into the world of conservation, ecosystems, ecology and public-private partnerships in environmental protection. It has been a resource for learning and local enjoyment, and my five children have a better understanding of stewardship because of this project." S



__Tom Isenhart__ (left) installed the first saturated buffer on __Jason Hanson's__ (right) farm, in 2010. Saturated buffers contain underground "plumbing," like the PVC pipes and control box shown here, to intercept water in field tiles and redirect it into a buffer of grass, trees and other plantings that can process nitrate and keep it out of adjacent streams.

SATURATED SUCCESS

Story by Lynn Laws
Images by Christopher Gannon

Tom Isenhart is a catalyst for getting research results to the people who need it most. The professor of natural resource ecology and management has built partnerships with landowners and farmers for decades all with the same goal to improve water quality.

"Dick Schultz (professor, natural resource ecology and management) and I have been partners on a project in Bear Creek Watershed since 1990," says Isenhart. "There we've worked with a significant number of landowners in establishing riparian buffers, for water quality and all the other benefits, such as wildlife habitat, carbon sequestration and biodiversity."

Riparian buffers are areas of trees, shrubs and grasses planted between crops and streams. Bear Creek has been deemed one of 12 National Showcase Restoration Demonstration Watersheds.

Field plumbing

Isenhart's most recent work is in partnership with Dan Jaynes, soil scientist for the National Laboratory for Agriculture and Environment. Five years ago Isenhart ('82 botany and environmental studies, '88 MS water resources, '92 PhD) and Jaynes came up with a new edge-of-field practice called saturated buffers.

Saturated buffers address nutrient rich water that would normally bypass riparian buffers and enter streams through outlets in subsurface drainage systems. Those systems, commonly known as field tiles, are a kind of plumbing installed under crop fields meant to prevent ponding.

In a saturated buffer, additional plumbing is added under riparian buffer areas to divert some of the water from field tiles into the buffer. As the water moves through the buffer and towards the stream, microorganisms and plant roots process the nitrate.

Research results are impressive.

"During the first four years of the study, the amount of water diverted from field tiles into saturated buffers has been 40 to 50 percent. How much water we can divert depends on how much water is moving through the tile—we can't treat it all. But in the water that has been diverted, all of the nitrate has been removed," says Isenhart.

Science in practice

Funding for the initial saturated buffer installation came from the Leopold Center for Sustainable Agriculture. Since then, 16 demonstration watersheds have been established through the Iowa Water Quality Initiative, begun in 2013 by the Iowa Legislature to help implement Iowa's Nutrient Reduction Strategy. Isenhart and others at Iowa State are working with landowners within these watersheds to implement and assess practices that hold promise to reduce nitrogen and phosphorus losses to our waters.

"It was just five years ago when Dan and I put the first saturated buffer on Justin Hanson's farm up on Bear Creek, and now it's being considered for approval as a statewide cost-shared, nitrate removal practice. That's what I really like to see: the science used," Isenhart says.

Justin Hanson's father and uncle began exploring nutrient management practices with researchers at Iowa State in 1995, after talking to a neighboring farmer who was working with Iowa State to plant a riparian buffer.

"In 2010, Tom and his team asked what we thought about installing a saturated buffer system and we were really excited about it," says Hanson ('02 agricultural studies). "We were told this winter by Tom and his team 50 to 70 percent of the nitrate, which would have otherwise gone into our stream, had been removed by the saturated buffer. So we're pleased."

Isenhart estimates potentially 32 million pounds of nitrate per year could be prevented from entering Iowa steams using saturated buffers.

Researcher and teacher

Isenhart loves teaching, in and out of the classroom, whether working with students or providing technical assistance to landowners. He is an adviser for the Forestry Club and the student chapters of the Society of American Foresters and Pheasants Forever.

Sara Berges ('09 MS ecology and evolutionary biology) says Isenhart inspires a love of learning through his enthusiasm for natural resource management.

"That excitement rubs off on everyone around him," says Berges. "Tom also encourages students to dig deeper to gain a better understanding of the underlying principles behind what they are learning." Berges says her Iowa State field research experience laid a good foundation for her current work as project coordinator with the Allamakee Soil and Water Conservation District.

Important partners

Isenhart's graduate students and partners at Iowa State and the University of Iowa are researching stream bank erosion at Onion Creek in Story County and Walnut Creek in Jasper County. Having many partners who bring diverse talents to the table is essential to solving water quality and flooding issues in Iowa, says Isenhart.

"The folks with Hydroscience and Engineering at the University of Iowa bring their expertise in flood mitigation and floodplain management," says Isenhart. "Our skills here at Iowa State are on the agriculture and water quality side—what we can do to bring more resilience to those flood plains. By reaching across the universities and private colleges and organizations we can bring all the expertise to bear on the issues."

Isenhart says the most important partners are landowners.

"In Iowa, well over 90 percent of our land is owned by private landowners and these are working lands. In order for us to make improvements in water quality, we really need to work in concert with the objectives of landowners."

Hanson agrees. "I appreciate Tom's interest in our operation, not only for what he's interested in, but what interests us, too. We really appreciate working with him." S

*Field tiles—a kind of plumbing installed under crop fields to prevent ponding—send water to outlets like the one shown above, on **Jason Hanson's** (right) farm. An innovation created by **Tom Isenhart** (left) and **Dan Jaynes** (not pictured) is proving to be effective in removing nutrients that move with tile water, like nitrate, before the water reaches the outlet.*

***Lisa Schulte Moore** shares her research on the implementation and management of prairie strips with members of the Iowa Chapter of the Soil and Water Conservation Society at the Neal Smith National Wildlife Refuge. Her work shows significant benefits to placing prairie within agricultural watersheds.*

Story by Ed Adcock
Images by Christopher Gannon

PRAIRIE STRIPS

IMPROVING SOIL HEALTH

Returning a small part of Iowa farmland to prairie is bringing a huge number of benefits according to Iowa State University research. The STRIPS project—Science-based Trials of Rowcrops Integrated with Prairie Strips—has proven the benefits of placing prairie strips in Iowa cropland.

"We examined what benefits could be provided by strategically placing about 10 percent of prairie within agricultural watersheds," says Lisa Schulte Moore, an associate professor of natural resource ecology and management who helped originate the project. "In part we wanted to examine whether the prairie provides greater benefits than the land area it occupies. We call these disproportionate benefits."

The results recorded at the original test site at the Neal Smith National Wildlife Refuge near Prairie City, Iowa, have documented

- 44 percent reduction in water runoff,
- 95 percent reduction in soil loss,
- 90 percent reduction in phosphorus runoff and
- 84 percent reduction in nitrogen runoff.

Schulte Moore says these benefits have come with no per acre difference in crop yields or weed abundance in the cropped areas of the fields. A bonus: an improved habitat for beneficial insects and wildlife.

The project's team started work on the concept in 2003, began site identification in 2004 and the strips were seeded in 2007. A diverse mix of plants includes grasses and wildflowers that produce deep root systems and stiff stems, which reduce erosion and runoff by slowing water and holding soil in place.

Over time, there have been about 50 faculty members, scientists, post-docs and graduate students involved in the project.

Schulte Moore shares STRIPS leadership with Matt Helmers, in the agricultural and biosystems engineering department, and works with the team to promote the concept through demonstrations and meetings for farmers.

The STRIPS team has helped implement prairie strips on 20 farms in Iowa and one in Missouri. Those include demonstration sites at the Iowa State research farms at Armstrong, McNay, Rhodes and a Committee for Agricultural Development farm south of Ames. Schulte Moore says they are aware of at least three more STRIPS-inspired sites in Iowa.

"We are working with an additional half dozen farmers and farm landowners to implement prairie strips in Iowa this fall, and partners in adjacent states—from Minnesota to Texas and Kansas to

STORIES EXTRA: www.stories.cals.iastate.edu

Learn more about the prairie STRIPS project and other collaborative research about on-farm prairies online.

Kentucky—also are in the process of implementing prairie strips," she says.

One of those landowners is Gary Guthrie ('79 pest management and agronomy) near Ames. He installed 4.2 acres of strips last spring on part of an 80-acre field after hearing about the project's results.

"I have worked in Bolivia and El Salvador. I have seen depleted soils and so I know we need to do everything in our power to maintain the soil and enhance water quality," he says.

He is marking the 50th anniversary of his family's ownership of the farm with the strips creation as well as implementing no-till management and cover crops.

"We need considerably more diversity in our Iowa landscape to break some of our pest and disease cycles," Guthrie says. "I believe the prairie strips are a small part of that."

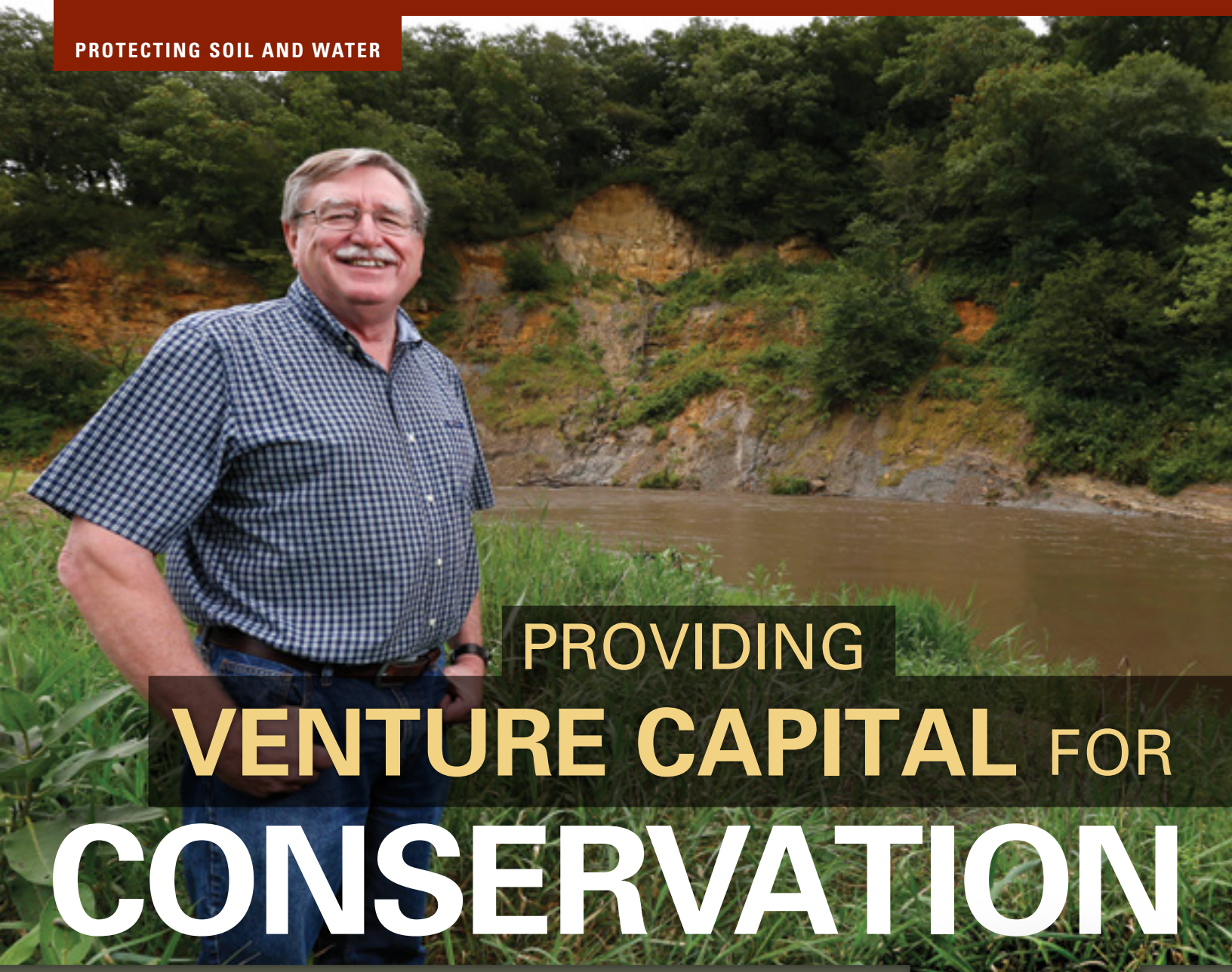
The STRIPS project recorded a doubling of the number of birds and bird species using the areas with prairie strips compared with those in row crops. Evidence also suggests the strips could provide habitat for pollinators and other beneficial insects.

"These results need to be placed in context, however, as our initial experiment was conducted within the boundaries of a wildlife refuge that has lots of great habitat," Schulte Moore says. "This is one of the reasons why our second phase of research, which is being conducted in agricultural settings more typical of Iowa, is so important."

Several recent federal, state and foundation grants—including from the U.S. Department of Agriculture Farm Services Agency and National Institute of Food and Agriculture (USDA-NIFA), Iowa Department of Agriculture and Land Stewardship, Leopold Center for Sustainable Agriculture, McKnight Foundation and Walton Family Foundation—will help the program expand its mission. The three-year, $500,000 grant from NIFA will allow the program to widen its scope and test its methods in new geographic areas and agricultural practices.

STRIPS also represents a collaboration between the regent's universities, Schulte Moore says.

The Tallgrass Prairie Center at the University of Northern Iowa, which provides information on how to establish and manage on-farm prairies, is now providing technical service for implementing prairie strips on farms and hosted field days this season with Iowa State University staff. And biomass material harvested from the prairie strips at the Eastern Iowa Airport will be burned by the University of Iowa's energy plant through its Biomass Energy Initiative.



PROVIDING VENTURE CAPITAL FOR CONSERVATION

Story by Laura Miller
Image by Christopher Gannon

Farmers are great entrepreneurs, taking risks, using resources and knowledge to produce something people need. That same entrepreneurial spirit helps farmers protect Iowa's soil and water.

That's how Mark Rasmussen sees the role of Iowa State University's Leopold Center for Sustainable Agriculture. The center that he's directed since 2012 is a place to find venture capital for research, particularly for nutrient management and water quality.

"I see the Leopold Center as a source of seed money to explore innovative ideas that can lead to bigger projects," Rasmussen explains. "Our strong point is that people from divergent disciplines can approach a problem and test different solutions, which is really important when you're talking about something like water quality."

Created in 1987 by the Iowa Groundwater Protection Act, the Leopold Center owes its existence to the quest for better water quality. The Iowa Legislature outlined a three-pronged mission for the new center: identify and reduce adverse impacts of farming, develop profitable farming systems that conserve natural resources and work with ISU Extension and Outreach to share results. Legislators also directed the new center to conduct an expansive research program that went beyond water quality including productive soil, viable rural communities, marketing, safety and health.

As a result, the center has supported pioneering work on sustainable farming practices such as riparian buffers, cover crops, crop rotations, prairie conservation strips, no-till and rotational grazing. Since its inception, the center has funded 94 nutrient management-related projects with an investment of more than $5.3 million.

*"One community working together" is how **Mark Rasmussen** explains the Land Ethic, proposed by Iowa-born conservationist Aldo Leopold and namesake for the center Rasmussen now directs. The Leopold Center is among the supporting organizations for Whiterock Conservancy along the Middle Raccoon River near Coon Rapids, Iowa, where land is managed for farming, wildlife habitat and recreation.*

Every $1 of investment generated $7.16 to support related research and activities.

Rasmussen is not a newcomer to entrepreneurship. A microbiologist with an MBA, he has led research and commercialization on imaging technology at the National Animal Disease Center in Ames. He holds four patents useful to the livestock industry.

"You may finance 10 things and maybe only one will present a workable solution, but you always gain knowledge and in that way every project succeeds," he says. "At the Leopold Center we're not necessarily looking for some widget to invent but a way of doing things that will bring sustainability to Iowa agriculture."

Rasmussen points to successes that can be traced to center support.

Research in the early 1990s showed the best time to test soil for nitrogen was in late spring, leading to development of a soil test kit giving farmers immediate results. The center also put research dollars in corn gluten meal, a natural weed suppressant, and in more efficient anhydrous ammonia application. The latter project led to a product that the American Society of Agricultural Engineers named one of the top "best new products and technologies" over 20 years.

One early investment is still yielding valuable insights. Some of the first funds awarded in 1988 paid for a state-of-the-art water quality monitoring system at the ISU Northeast Research and Demonstration Farm near Nashua.

The site has 36 one-acre plots, each with its own subsurface drainage system that can isolate water samples for analysis. Combined with more than two decades of records on tillage and cropping practices, these plots give researchers a precise look at how nutrients, chemicals and pesticides move through groundwater.

These plots have been used for three major water quality studies, also funded by the Leopold Center. The initial project was a 13-year investigation into the impact of liquid swine manure applications on surface and groundwater quality, resulting in better methods and timing of applications. Since 2006, the plots also have been used to compare cropping systems and management practices with stover removal, no-till and cover crops among the variables studied. Woodchip bioreactors got their first test from 2009 to 2012. Currently, researchers are using the plots to learn how antibiotic-resistant pathogens in swine manure applications persist and move underground.

> ***"Leopold envisioned a balanced system of land-use that included farming, forestry, wildlife habitat and many other values."***

The Iowa Nutrient Reduction Strategy, launched in 2013, cites an extensive body of scientific literature, much of which received funding from the Leopold Center. More than 80 percent of the practices listed in the strategy were informed by center-funded research.

Like most entrepreneurial efforts, some research requires years before reaching fruition. It was 1990 when USDA agronomist Tom Kaspar received his first research grant from the center to study cover crops. Kaspar now works with farmers throughout Iowa on cover crops.

"It takes time for changes like this to take hold, it can be a generational thing," Kaspar observes. "On the other hand, some farmers always have made soil conservation a priority. The same farmers who were interested in no-till are the ones trying cover crops."

He credits the center's interest in cover crops for bringing Iowa into the Midwest Cover Crops Council, even providing startup funds for a half-time coordinator. Center staff also helped him organize the first cover crop conference in Iowa in 2010, attracting 120 people from 13 states. In 2015, the same meeting was attended by almost 350 people. (Read more about Kasper on page 22.)

Rasmussen says one thread running through 28 years of center research has been a concern for soil health, an important part of the land ethic proposed by Iowa-born conservationist Aldo Leopold.

"Leopold envisioned a balanced system of land-use that included farming, forestry, wildlife habitat and many other values," Rasmussen says. "We try to follow that. In looking at all the practices and projects that have emerged, how many would never have happened without the Leopold Center?" S

STORIES EXTRA: www.stories.cals.iastate.edu

Learn more about the Leopold Center and its work in nutrient management, water quality and more online.

CONVERTING NITRATE TO THE AIR

***Landowner Clark Thompson** is working with researchers Michelle Soupir (left) and Natasha Hoover ('10 environmental science, MS '12) examining the potential benefits of a bioreactor on his farm near Ames. Thompson hosted a field day at the site of his bioreactor sharing what he's learned with neighbors, farmers and other landowners.*

Story by Dana Woolley
Image by Christopher Gannon

Bioreactors are water quality improvement tools gaining interest from landowners and researchers. The edge-of-field equipment is designed to receive water from drainage tiles and filter that water through woodchips where nitrogen is converted to a harmless gas.

Michelle Soupir, an associate professor of agricultural and biosystems engineering, has two woodchip bioreactor projects currently underway.

Her main interest is efficiency. Soupir studies the effectiveness of the bioreactor system and fill materials in removing nitrates from tile water drainage. She hopes her projects add valuable field data to support the use of bioreactors to improve water quality in Iowa and beyond.

"We are looking at different fill materials and how long these materials remain effective in nitrate removal. We are also adding amendments of varying concentrations to manipulate the system," says Soupir. "Our other project examines bioreactor effectiveness through controlling water hydraulic retention time and measuring bromide concentrations to study flow characteristics in the bioreactor."

So far, trends in Soupir's data indicate bioreactors operate more efficiently in warmer temperatures and bacteria is removed in the field.

Soupir says growing interest in bioreactors as nitrate removal systems is due to a number of reasons.

"Bioreactors feature flexibility in design, minimal land management changes and cost-share incentives to land owners," she says. "However, the effectiveness of the bioreactor can vary from farm to farm."

By determining best practices, Soupir hopes her research can be used to prescribe an ideal system to help Iowa farmers improve water quality.

One of her study's bioreactors resides on a farm in Story City, Iowa, where the land is in a corn-soybean rotation. Landowner Clark Thompson first learned about bioreactors at a water conference in 2011 in Ames and has since stayed in touch with Iowa State experts. He was involved in the concept and planning of the original bioreactor project.

"I run a no-till farm operation, and the bioreactor has been a passive and fairly effective device," says Thompson. "The bioreactor was constructed for ease of sampling, so not only is it a useful conservation practice, it's useful in teaching and research. It's a real win-win."

Image: Melea Reicks Licht

Soupir's work has allowed her to connect with landowners, like Thompson, and Iowa State University Extension and Outreach experts across the state.

"I've really enjoyed working with farmers and landowners. Their interest in learning more about these projects is encouraging. The more we learn, the more we'll be able to improve bioreactor design," she says.

The Iowa Nutrient Research Center and the Iowa Soybean Association are major supporters of Soupir's research. She recently received funding to continue the studies into a third year. She hopes to further investigate the effectiveness of using woodchip bioreactors in the removal of bacteria to improve water quality. S

CALS ALUMNI HONORED
BY COLLEGE, ALUMNI ASSOCIATION

CALS graduates were honored by Iowa State for service to the college and agricultural and life sciences industries during Homecoming events in October.

CALS Awards

Floyd Andre Award: **Harold Hodson, Jr.** ('61 animal science, '65 PhD)

George Washington Carver Distinguished Service Award: **Don Koo Lee** ('75 MS forestry, '78 PhD)

Henry A. Wallace Award: **James P. Tobin** ('78 agricultural and life sciences education)

Outstanding Young Professional Award: **Lisa Wasko DeVetter** ('07 biology, horticulture, '10 MS horticulture, agronomy, soil science)

Iowa State Alumni Association Awards:

Alumni Medal: **James L. Patton** ('66 agricultural and life sciences education, '71 MS)

Alumni Merit Award: **Robert D. Bullard** ('76 PhD sociology)

LYONS RECEIVE MASTER BREEDER AWARD

Lyon Jerseys, owned and operated by **Joe Lyon** ('51 dairy science) and **Eric Lyon** ('76 dairy science), was honored with the 2015 Master Breeder Award from the American Jersey Association. The dairy is located near Toledo, Iowa.

GAISER LEADS SCHOOL
OF ENVIRONMENT, ARTS AND SOCIETY

Evelyn Gaiser (MS '91 animal ecology) has been appointed associate dean in Florida International University's College of Arts and Sciences, and executive director of the School of Environment, Arts and Society. Gaiser is an internationally recognized scholar in wetland and aquatic ecology, and specializes in algal community structure in lakes and wetlands.

IOWA PORK PRODUCERS ASSOCIATION
NAMES NEW DIRECTOR

Pat McGonegle ('83 animal science), has been named chief executive officer of the Iowa Pork Producers Association (IPPA). McGonegle came to IPPA from the National Pork Producers Council, and began his duties October 1.

FREDERICKS NEW PRESIDENT
IOWA SOYBEAN ASSOCIATION

Wayne Fredericks ('73 animal science), a farmer from Osage, is the new president of the Iowa Soybean Association board of directors. Fredericks was also elected to represent Iowa on the board for the American Soybean Association.

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***Steve Berger** has a cereal rye cover crop aerial seeded into his soybean and corn fields at harvest time or soon after. The cover crop will provide protection from soil erosion and nutrient losses during the periods when a cash crop is not present.*

'GRANDFATHER OF COVER CROPS,' AWARD-WINNING CONSERVATIONIST

Story by Lynn Laws
Images by Lynn Betts

Steve Berger deems Iowa's rich farmland soils the second most important Iowa asset—outranked only by family. Everything he does on his 2,200 acre corn-soybean operation, the hundreds of hours he volunteers to educate other farmers and his philanthropy reflect his conservation ethic and his love of farming.

Berger ('86 agricultural business) attributes these values to his father, Dennis, with whom he still farms near Wellman, Iowa. But, he credits Iowa State University Extension and Outreach for his father's decision in the 1970s to stop tilling the family's farmland.

"We had a really progressive Washington County Extension Director, Jim Frier ('56 farm operations). He was encouraging farmers in the 1970s to adopt no-till. We've benefitted because we stuck with it," says Berger.

***Steve Berger** says 15 years of cover cropping has improved soil porosity on his 2,200 acres in Washington County. "The soil can hold more water and take in rain at a faster rate."*

The family's farmland has been almost 100 percent no-till for 35 years. Fifteen years ago Berger decided to add cover crops to his fields to aid in holding the soil on the land during the seasons when no cash crop was growing. He stuck with that decision as well.

Through trial and error and over time, making adjustments to his corn planter, nitrogen applications and pest management strategies, he learned how to make it work on his fields. In addition to slowing soil erosion, it has improved soil health and water holding capacity, while maintaining or increasing cash crop yields.

Berger's conservation efforts and successes were acknowledged in 2014 with the Spencer Award for Sustainable Agriculture from the Leopold Center and, in 2015, with the Conservation Legacy Award from the American Soybean Association.

It has taken time, says Berger, of his success with cover crops. "When you're working with the soil, it's not like a light switch. You can't just change things and see immediate results. The soil needs time to transition."

Berger says the conversion time of three to four years is difficult for farmers.

"There's a cost to growing cover crops. In this age of high land rents, demanding landlords and bankers and farmers who don't agree, it's hard to make these longer-term decisions, but there's a big pay off if you can stick with it," says Berger.

The 'pay off,' says Jason Steele, is that the soils on Berger's land are "phenomenal." Steele ('00 agronomy and animal science) is a soil scientist for the National Resources Conservation Service (NRCS) and a farmer. He has done soil tests on Berger's farm since Berger became a part of their Soil Health Campaign in 2012. As a part of that campaign, Berger is a cover crop mentor for farmers less experienced with cover crops. He shares what he has learned at NRCS and Soil and Water Conservation District field days.

"It makes a difference with audiences that Steve is a farmer using no-till and cover crops and that he is not afraid to tell other farmers and landowners about the failures as well as the successes he's had," says Steele.

Berger gained appreciation and compassion for farmer risks and challenges during his college years amid the 1980s farm crisis and especially during the year after his graduation when he worked as a liaison between the Farmer-Creditor Mediation Service and Iowa Governor Branstad's office. During the 1980s, crop demand and profits had plummeted, exceptionally high interest payments on farm loans often exceeded farm income and thousands of previously successful farmers had to sell their farms.

"Most of my classmates did not want to go home and farm after graduation. It was nothing like it is today," says Berger. "You can see the investment in agriculture that's been made since then. It's a real exciting time now and I can appreciate it because of past experiences."

Berger's appreciation shows through generous sharing of his time, knowledge and treasure. Countless Iowans benefit from his dedication to and passion for farming, learning, teaching and Iowa State University.

Matthew Helmers, professor of agriculture and biosystems engineering, has invited Berger to speak at Iowa State Extension and Outreach field days and has dubbed him the 'grandfather of cover crops.'

Berger jokingly protests, saying, "Hey, I'm not that old."

"I just mean that he's one of our most experienced cover crop farmers in the state. People view him very positively for making cover crops work on his farm and for helping others," says Helmers.

Helmers and Berger are both eager to learn more about soil microbiology.

"We're all still learning. Soil science is really a frontier. We'll know a lot more in five or ten years," says Berger. "Farmers are really hungry for knowledge about this."

In addition to collaborating with Iowa State scientists to do on-farm research and speaking at field days for Iowa State Extension and Outreach and Iowa Learning Farms, Berger's service to Iowa State is impressive. He served on the Agricultural Endowment Board, the College of Agriculture and Life Sciences Advisory Council and the Iowa Soybean Research Center Advisory Council. He's an Iowa Learning Farms Partner and a financial supporter of Iowa State University—from helping to purchase additional acres to conduct farm research to donating to the new addition of the FarmHouse fraternity.

ENVIRONMENTAL STEWARDSHIP IS LIFE'S WORK FOR LEMKE

Story by Susan Thompson
Image by Christopher Gannon

*Following retirement from the Iowa Department of Agriculture and Land Stewardship, **Dean Lemke** moved to his family farm near Dows, homesteaded in 1876. Throughout his 43-year career he worked to help Iowans reach environmental goals and steward resources for future generations.*

Dean Lemke's interest in environmental stewardship began as a young boy on the family farm.

"Dad repeatedly made the point we have to leave the land and natural resources for future generations in better condition than when we got them," he says.

As an undergraduate, partly triggered by the first Earth Day in 1969, Lemke ('72 agricultural engineering) felt his life's work come into focus.

"I knew the emerging environmental movement needed to extend to food and agriculture," he says. "I wanted to be part of guiding that environmental renaissance in the most effective direction, while optimizing critically important global food production."

Most of Lemke's career was spent at the Iowa Department of Agriculture and Land Stewardship (IDALS), where he developed and administered water quality programs and collaborated in research to develop environmental technologies for farmers. Most recently, he was lead author of the agricultural nonpoint source section of the Iowa Nutrient Reduction Strategy.

"The level of engagement by farmers, landowners, crop advisers, ag retailers, agribusinesses, the Iowa Legislature, plus many others, far exceeds that of any previous effort during my 43-year career," he says.

Lemke praises the work of Iowa State University and other scientists who developed the strategy's science assessment. "Iowa enjoys the best-understood science on how to achieve agriculture's water quality goals of any state in the country," he says.

"The best days of my career were those spent working on science issues with colleagues in the College of Agriculture and Life Sciences, other colleges on campus and extension," he says. "We pondered new understanding of environmental responses, worked to develop technologies and new approaches to environmental stewardship, and brought science to sometimes contentious public policy discussions."

"Iowa enjoys the best-understood science on how to achieve agriculture's water quality goals of any state in the country."

In 2013, Lemke retired from IDALS and took a part-time position with the Agribusiness Association of Iowa as its nutrient management and environmental stewardship director.

"We are seeing rapid acceleration of proactive environmental culture among Iowa's 150 ag retailers and 5,000 crop advisers," he says. "The agribusiness sector increasingly will provide the technology leadership farmers need to reach environmental goals."

When Lemke isn't helping others reach their environmental goals, he's working on his own. Following his IDALS retirement, he and his wife Peggy moved from Des Moines onto the family farm near Dows. The farm was homesteaded in 1876 by his great-great grandparents.

Lemke and two sons are equal partners in the 800-acre corn and soybean operation. Bryan, a banking and financial institution consultant, lives in Minneapolis with his wife and their three children. Nathan is a lead scientist for the Air Force Research Laboratory in Albuquerque where he lives with his wife and their two children.

All come to Iowa each year for a couple of weeks during planting and harvest. The farm's mission statement makes it clear the Lemke conservation ethic continues today—"Six generations since 1876 producing food and environmental stewardship of land and water resources." S

*PFI staffers **Sarah Carlson, Meghan Filbert, Nick Ohde, Stefan Gailans, Sally Worley** and **Julie Wheelock**, all CALS graduates, hold one of the 50 signs PFI members have placed on their farms around the state of Iowa.*

CAMPAIGNING FOR COVER CROPS

Story by Melea Reicks Licht
Images by Christopher Gannon

Sarah Carlson has a favorite t-shirt.

"We came up with 'Don't Farm Naked, Plant Cover Crops' as a way to spark some playful discussion about a serious agriculture issue—bare soil more than six months of the year on a majority of Iowa's farmland," Carlson says.

The tongue-in-cheek, screen-printed slogan offers real advice Carlson (MS '08 sustainable agriculture, crop production and physiology) hopes more Iowa farmers choose to follow.

Carlson is the Midwest Cover Crop Research Coordinator with Practical Farmers of Iowa (PFI).

She's taken her message on the road speaking at hundreds of field days on PFI member farms and Iowa State University Extension and Outreach workshops. Carlson first joined the organization's staff in 2007 as its research and policy director.

"A cover crop is a plant that covers the soil between cash crop seasons," says Carlson. "Here in Iowa we need a good balance of cool season plants opposite our warm season corn and soybeans to be able to cover the soil a longer period of time. We have negative externalities when we don't have plants covering the soil five to six months of the year."

PFI holds about 200 events each year and collaborated on 42 research projects with 65 farmers in 2014. Carlson says the organization, in its 30th year, brings together farmers interested in conducting scientifically rigorous field trials and open to sharing on-farm research results with others. PFI has grown to nearly 3,000 members and diversified to include all production systems.

"We provide opportunities for farmers to share information with each other about research happening at their farm. Cover crops has become really popular among our membership and beyond," Carlson says. "Last year alone we were able to reach 13,000 people at 70 events about cover crops in which farmers taught other farmers how to do cover crops successfully."

Carlson earned degrees in biology and geography at Augustana College before serving a stint in the Peace Corps. She lived in the southern highlands of Ecuador in South America serving as an agricultural business and extension volunteer for more than two years.

"Farmers are the same no matter where you are at. Some are early adopters and some are not. Most prefer to learn from their peers and fiddle with new ideas each growing season. I'm doing very similar work in Iowa today except in Ecuador I worked with a potato, corn rotation interseeded with squash," Carlson says.

She credits her mentor agronomy professor Mary Wiedenhoeft ('80 agronomy) with helping her learn to talk with farmers.

"Mary is a fantastic adviser and has influenced much of my work," Carlson says. "I learned about PFI because of Mary and learned how to interact with farmers. I learned how to be humble and ask good questions." S

***Sarah Carlson,** Midwest Cover Crop Research Coordinator with Practical Farmers of Iowa, says more of the organization's members are turning to cover crops to improve soil health and water quality on their farms.*

ADVANCED ANALYTICS

COLLABORATING FOR GREATER GROWTH

Story by Melea Reicks Licht
Images by Syngenta

*Iowa State grad **Joseph Byrum** has worked in plant breeding for nearly 20 years, securing more than 50 patents. He says the challenge of serving society's growing food needs is the driving force behind his work.*

Joseph Byrum's work in plant breeding has been called "transformative" by his peers. For farmers his efforts translate into two sought-after words: higher yields.

Byrum ('99 PhD plant breeding), Syngenta's global head of soybean research and development, has worked in plant breeding for two of the world's leading companies for nearly 20 years. In that time he's patented more than 50 traits, processes and discoveries that have generated $1 billion in revenue.

He has experience across the entire value chain—manufacturing, corporate affairs, procurement, regulatory, business development and account and alliance management.

Bill Beavis, agronomy professor and G.F. Sprague Chair for Population Genetics at Iowa State University, collaborates with Byrum.

"Joe's team is fundamentally changing how plant breeding systems are improved by inviting systems engineers to use the same tools used in designing manufacturing, financial, management or economic systems," Beavis says. "As a result, they're realizing improved genetic gain with fewer resources."

Byrum's work as the chief architect of Syngenta's "Good Growth through Advanced Analytics" program won the 2015 INFORMS Franz Edelman Award for Achievement in Operations Research and the Management Sciences. He also is a fellow at the Aspen Institute, an educational and policy studies organization based in Washington, D.C. that provides a nonpartisan venue for dealing with critical issues.

The INFORMS Edelman competition acknowledges significant contributions of analytics and operations research in the profit and non-profit sectors. The award,

***Joseph Byrum** worked with fellow ISU alumni **Gregory Doonan** ('97 biology, '09 MS plant breeding) and **Ronald Mowers** ('81 PhD agronomy, statistics) on the 10-person "Good Growth through Advanced Analytics" team that earned them and Syngenta the prestigious Edelman Prize in April. Shown accepting the award are: **Jack Kloeber,** principal at KROMITE; **Bruce Luzzi,** Syngenta Soybean Seeds Project lead; **Dan Dyer,** Syngenta head Seeds Product Development; and **Byrum,** head Seeds Product Development Soybean.*

now in its 44th year, is considered the world's most prestigious recognition for excellence in applying advanced analytics to benefit business and humanitarian outcomes.

Byrum had operational, administrative and financial oversight of the Good Growth through Advanced Analytics program. The multi-phased, multi-year project resulted in a set of tools using big data techniques, advanced mathematics and new technologies to develop soybeans with higher yields. Byrum says the new tools will improve soybean breeder decisions through more accurate estimates of variety performance, increased selection intensity, greater useful genetic variation and reduced generation time without using more land, water or other inputs.

"There's tremendous opportunity at the interface of engineering and agriculture. Joe and his colleagues are leading the way for better integration of advanced analytics to make better decisions," says Beavis.

The new mathematical tools developed by Byrum and colleagues resulted in cost avoidance for soybean research and development of more than $287 million from 2012-2015.

"Before we began using these tools, we realized that an average annual increase in yield across our soybean varieties was about 0.8 bushels per acre," says Byrum. "That average is now closer to 2.5 bushels per acre."

The new approach was realized through a cooperative network of experts within and outside industry through open innovation. Syngenta has since initiated a multi-year effort to customize and launch similar tools across all major crop areas.

"We strive to be at the forefront of innovation addressing the impending global food security problem," says Byrum. "We are proud of this recognition and how Syngenta is helping farmers grow more from less through innovation in plant breeding techniques. There is no other single point in the food chain one can have such an impact on the quality of life in a society."

Byrum worked with fellow Iowa Staters Gregory Doonan ('97 biology, '09 MS plant breeding), Ronald Mowers ('81 PhD agronomy, statistics) and current graduate student Tracy Doubler on the 10-person Good Growth through Advanced Analytics team. Other members were Dave Culhane, Craig Davis, David Foster, Bruce Luzzi, Stephen Mack and Chris Zinselmeier.

"There is no other single point in the food chain one can have such an impact on the quality of life in a society."

He says his experience and education at Iowa State helped him capitalize on professional opportunities, and believes the quality of an Iowa State education in plant breeding and genetics is "unparalleled."

"At Iowa State we train plant breeders to be integrators of various disciplines—plant genetics, pathology, statistics, engineering—they pull what they need from each of these. Joe is a perfect example," says Patrick Schnable, C.F. Curtiss Distinguished Professor, Iowa Corn Endowed Chair in Genetics and Baker Scholar of Agricultural Entrepreneurship. Schnable directs the Plant Sciences Institute and Center for Plant Genomics at Iowa State University.

"We consider data an asset, in plant breeding and broadly, that affects all disciplines. Thanks to recent high impact faculty hires here at Iowa State, future graduates will be well-positioned to do what Joe has done for plant breeding in their own disciplines," Schnable says.

In recent years, President Steven Leath has directed the hiring of several faculty in the strategically important area of big data including experts in data mining; information management; bio- and materials-informatics; sensor technologies; agricultural and environmental systems; and multi-scale modeling, among others.

"What I got from Iowa State University is a combination of intellectual tools and practice in collaboration, which helped me sort through the multitude of key priorities and figure out how to solve complex problems," says Byrum. "The balanced curriculum, grounded in quantitative training, provided the background to succeed. In addition to the analytical, multi-disciplinary approach, what's equally compelling is the school's international presence and leadership focus."

These are all traits Byrum says he draws on often to lead, inspire and direct change.

"The opportunity and need for entrepreneurship in plant genetics is extensive. Continuing to innovate and focus on the most exciting opportunities both serves the needs for society and it is intellectually challenging," Byrum says.

What's the next innovation he'll be focusing his efforts on?

"I'm very interested in exploring the impact and application of quantum computing on agriculture," Byrum says. S

David Ausberger, *left, a farmer from Jefferson, talks with Sean McMahon, Iowa Agriculture Water Alliance (IAWA) executive director, about the cover crop he planted this fall. Ausberger is a member of the Iowa Soybean Association, one of the three IAWA founding organizations. He was the 2014 winner of the American Soybean Association's Conservation Legacy award, a national honor given to just one farmer each year.*

ALLIANCE TO IMPROVE WATER QUALITY

Story by Susan Thompson
Image by Christopher Gannon

In May 2013, Iowa officials released the Iowa Nutrient Reduction Strategy. In August 2014, three Iowa commodity groups formed the Iowa Agriculture Water Alliance (IAWA) to increase the pace and scale of farmer-led efforts to improve water quality. Created and funded by the Iowa Corn Growers Association, Iowa Soybean Association and Iowa Pork Producers Association, IAWA hired Sean McMahon to lead the effort.

McMahon has worked on natural resources policy for more than 20 years. He was the North America agriculture program director of The Nature Conservancy, focused on strategies to make agriculture more sustainable. He also has held positions with the National Wildlife Federation, National Audubon Society and Department of the Interior.

"I've spent my entire career working on environmental issues and seeking solutions to tough challenges. Strategic partnerships between environmental organizations and various industries, including agriculture, are crucial to developing solutions to our most challenging problems," McMahon says. "IAWA is unique in that we are partnering directly with farmers and agriculture associations to improve water quality."

"IAWA, along with other public and private partners, is facilitating additional financial resources and new ways of delivering conservation services to farmers," he says. "We are working directly with agricultural retailers, precision ag companies and conservation experts to reach more farmers than possible with current efforts. We also are partnering with cities to create new revenue streams for funding conservation practices."

McMahon says the producer groups that created the alliance, and their farmer-directors, take improving water quality seriously.

"They've invested their time and resources into helping raise awareness of the challenge as well as the solutions," he says. "In addition to statewide farmer outreach, we are working within the associations to reach farmer-members with information about conservation practices, planning, programs and other opportunities that improve water quality."

Iowa State is another partner in the IAWA efforts.

"Iowa State played a strong role in defining the challenge and conducting the science assessment behind the solutions in the nutrient reduction strategy," McMahon says. "This helps guide our work. It allows us to calculate the modeled load reductions from implementing conservation practices, so that tells us what water quality improvements we can expect."

John Lawrence, associate dean for extension in the College of Agriculture and Life Sciences, and agriculture and natural resources director for ISU Extension and Outreach, chairs the IAWA advisory council.

McMahon says it will take years to see water quality improvements at the watershed scale, let alone statewide.

"We've had a century and a half of agricultural impacts on water quality in Iowa, so we can't expect to solve this challenge overnight," he says. "We need every Iowa farmer to participate to achieve the goals of the strategy." S

STORIES EXTRA: www.stories.cals.iastate.edu

Learn more about partnerships fostered through the Iowa Agriculture Water Alliance online.

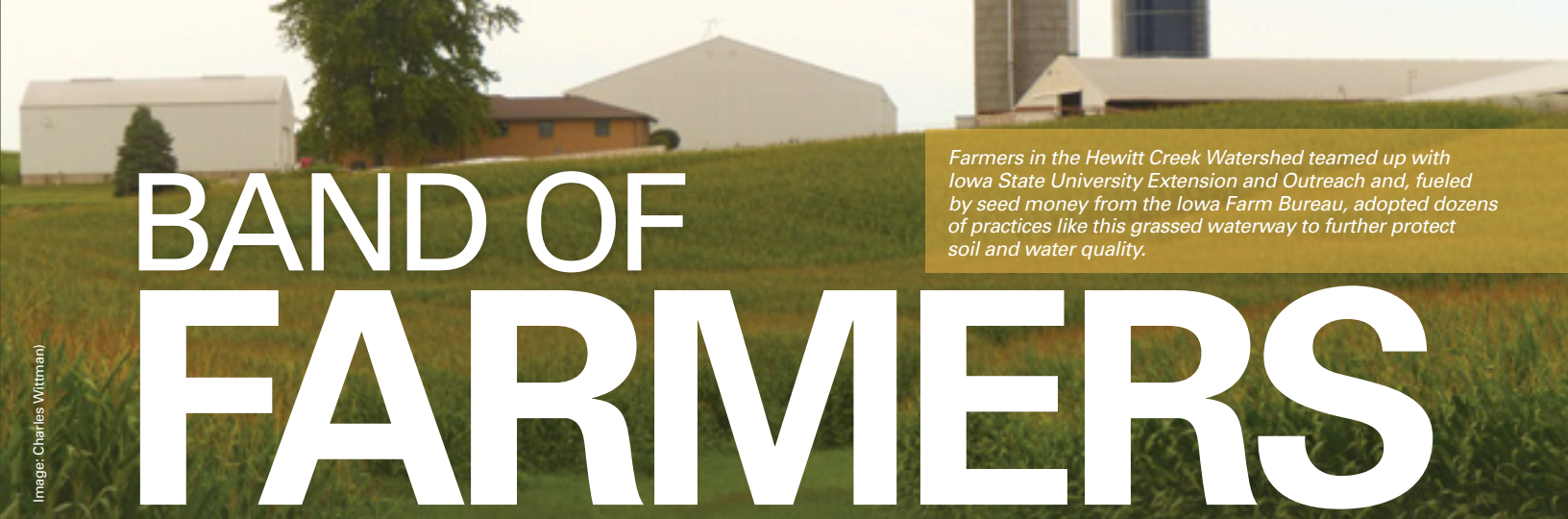

Image: Charles Wittman)

Farmers in the Hewitt Creek Watershed teamed up with Iowa State University Extension and Outreach and, fueled by seed money from the Iowa Farm Bureau, adopted dozens of practices like this grassed waterway to further protect soil and water quality.

BAND OF FARMERS

By Brian Meyer

Ten years ago, farmers in northeast Iowa banded together to improve their watershed. Now it's being called a model for improving water quality across Iowa and the nation.

The 23,000-acre Hewitt Creek watershed drains into the Maquoketa River in northeast Iowa. In 2004, farmers and other watershed residents met and decided to do something about the condition of local streams, including one that landed on the state's impaired waters list.

The farmers' first step was to team up with Iowa State University faculty and extension and outreach specialists to develop a farmer-led plan linking management practices to desired water quality outcomes. Iowa State provided them with information on science-proven practices to make a difference in improving water quality, and how to track data and interpret performance measures.

But what really kick-started change in the watershed was seed money provided by the Iowa Farm Bureau Federation.

The Iowa Farm Bureau's funds helped farmers implement conservation practices, monitor environmental and economic performance and demonstrate a farmer-led approach to implementing watershed improvements. Farmers invested their own funds and in-kind contributions to the project, too.

The Iowa Farm Bureau funds were leveraged to secure nearly $1 million from the Iowa Department of Agriculture and Land Stewardship's Iowa Water Improvement Fund. The success shown also led to a $5 million USDA grant for programs to improve three Mississippi Basin subwatersheds, including Hewitt Creek.

Over a decade, the farmers adopted dozens of practices such as cover crops, grassed waterways, terraces, buffer strips, soil and nitrate testing, no-till planting, denitrification bioreactors and enhanced storage and application of manure.

The farmers have hit several benchmarks they set for reduced concentrations of nitrates and phosphorus. Nitrate levels have been below the EPA's safe drinking water standard nearly every year. After significant rains, phosphorus has tested below 1 part per million. One bioreactor site demonstrates that more than 30 percent of nitrates can be removed before tile water enters the creek.

Other visible changes tell the story. More fish swim the waters—and more families go fishing. Eagles, too, enjoy the fishing.

Widespread participation has been key. Jeff Pape is an Iowa Farm Bureau member who leads the Hewitt Creek Watershed Improvement Association. He and other farmers recruited their neighbors until participation rate in the watershed was 85 percent.

"Traditionally, leadership of water quality improvement projects can be a top-down thing, but at Hewitt Creek, the ownership of the project is at the farmer level," says Chad Ingels ('91 horticulture, MS '13 professional agriculture), Iowa State University Extension and Outreach watershed projects coordinator. "I've been impressed how the farmers have taken on leadership roles and their willingness to share their experiences with other farmers. They prove that although the goals may be difficult, they're not insurmountable."

***Jeff Pape,** chair of the Hewitt Creek Watershed Improvement Association, talks about how farmers use bioreactors and other technologies to protect water in this "Iowa Minute" Farm Bureau feature. Visit www.stories.cals.iastate.edu for a link to the video.*

Image: Iowa Farm Bureau Federation

STORIES EXTRA: www.stories.cals.iastate.edu

Check out ISU Extension and Outreach's "how-to" on grassroots water quality improvement—the Hewitt Creek Model. Visit www.stories.cals.iastate.edu for link to the publication.

*A few recipients of the Paul Doak Agricultural Business Recruiting Scholarship gathered on campus for a group photo this fall: **Brandon Mayer** (back left), **John Green**, **Erin Kurdelmeyer** (front left) and **Emily Cook**. Doak's former students created the scholarship to honor him and support students with financial need.*

A CHALLENGE IN TRIBUTE TO A GREAT MENTOR

Story and image by Melea Reicks Licht

Some mentors have the ability to inspire and influence even decades after their careers officially end.

Paul Doak, Iowa State University emeritus professor of economics, is one of those people.

Doak ('65 PhD agricultural economics) taught in the Department of Economics from 1962 to 1992. The emphasis of his professional career was on teaching and advising students majoring in agricultural business.

He served as adviser of the Ag Business Club and taught agricultural marketing, agribusiness operations and career seminar courses. Doak, who is now 86 and living in Columbia, Missouri, says he was privileged to have been a member of the economics department and will always cherish his experiences with students, staff and colleagues.

Josanne Six, current director of budget and finance for the College of Agriculture and Life Sciences, was one of the many people impacted by Doak during his tenure at Iowa State. She made the initial gift and worked to develop the Paul Doak Agricultural Business Recruiting Scholarship in 2009 to honor her former supervisor in agricultural business and longtime mentor. The scholarship is awarded to students majoring in agricultural business who have verified financial need, with preference given to students who are the first generation of their families to go to college.

Recently, Doak's former student Roger Carlsson ('78 agricultural business) generously pledged to match gifts and pledges of up to $250,000 to the Paul Doak Agricultural Business Recruiting Scholarship.

"I chose Iowa State for its excellent ag business program, and also because of the College of Agriculture and Life Science's reputation of excellence in its field. I had seen the trading pits of the Chicago Board of Trade when I was 16 as a foreign exchange student from Sweden. I knew when I saw those floors that was my calling," Carlson says.

After studying at the London Business School Carlsson returned to the United States. He founded the FCT Group of Companies, an international investment firm with offices in Chicago, London, Dubai and Singapore. He established the Carlsson Family Foundation in 1998 to manage his charitable contributions and to provide a research vehicle for other donors wishing to make informed charitable decisions.

Carlson says he learned values at Iowa State like hard work, perseverance and tenacity. He gives Doak and the strong foundation he received in the college much credit for his professional success.

"My experience was colored by working and studying concurrently. This required a great deal of planning and prioritizing as well as time management," Carlsson says. "Dr. Doak took the time to help me find a balance that made my degree possible. He was more of a friend, and made sure I didn't make any unwise choices."

There has been good responses, but the ongoing effort will need strong alumni support by the end of the calendar year to take full advantage of Carlsson's challenge.

"I visited campus and met current students who were both working and studying and could benefit from more scholarships," Carlsson says. "I was introduced to Josanne Six, and I was impressed with her and her personal care for Dr. Doak. The scholarship is a wonderful idea, both as a legacy to Dr. Doak and to help current students in need."

For information about contributing to the Paul Doak Agricultural Business Recruiting Scholarship visit www.stories.cals.iastate.edu or contact the Iowa State University Foundation at (515) 294-7677.

IN OUR NEXT ISSUE

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IN AGRICULTURE AND LIFE SCIENCES

LEADERSHIP

College of Agriculture and Life Sciences **GRADUATES** are known for outstanding **LEADERSHIP** in **INDUSTRY,** in the **BOARDROOM,** in the **LAB,** in **FEDERAL AND STATE** agencies and more. In the next **STORIES** in Agriculture and Life Sciences read about leadership as part of the **CULTURE** in the college starting with **STUDENT LEADERS** who are **DRIVING CHANGE,** starting new **TRADITIONS** and gaining outstanding **EXPERIENCE** to continue to **MAKE A DIFFERENCE** at Iowa State and in the agriculture and life sciences sectors.

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Building a Culture of Conservation

IOWA LEARNING FARMS is an Iowa State University Extension and Outreach program that encourages the adoption of conservation practices by partnering with farmers and researchers to identify and promote conservation while remaining profitable.

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