2021 ISSUE

KANSAS STATE UNIVERSITY

College of Agriculture

AgReport

THE POWER OF THE *Land-grant University*

The History of the *Land-grant University*

Although the term "land-grant universities" may be new to many, these unique universities have played a critical role in every major research advancement related to agriculture and in making it possible for millions to attain a college degree.

The land-grant university system began in 1862, a year into the Civil War, when President Abraham Lincoln signed the Morrill Land-grant Acts, which were written by U.S. Rep. Justin Smith Morrill, the self-taught son of a blacksmith. The acts gave 30,000 acres of land per congressman to help endow a college in every state with stipulations:

- Admission decisions could not be based on race. It took until 1890 for that part of the agreement to be made into law.

- The schools were also required to focus on agriculture and mechanical arts (mainly engineering) to prepare students with the skills and knowledge needed to advance the work of farmers and ranchers and prepare our country for the burgeoning Industrial Age. Lincoln and Morrill believed the colleges at the time were not capable of meeting the "practical" needs to advance the war-torn country.

In 1863, Kansas State Agricultural College (now Kansas State University) became the nation's first operational land-grant college and the first to admit women. Today, there are 112 of these institutions, 19 are historically Black colleges and universities, and 33 are tribal colleges and universities.

Later, the Hatch Act of 1887 established federal funding of research via agricultural experiment stations at land-grant institutions, according to a formula based on the number of small farms in each state. Then in 1914, the Smith-Lever Act created the Cooperative Extension Service as part of each land-grant school, which literally extends the reach of those institutions by empowering them to make knowledge freely available to everyone in their respective state, not just those attending that school.

It resulted in the three-part mission of every land-grant institution – education, research and extension. The research and education provided by these schools have revolutionized agriculture in every area, including plant and animal genetics; food and feed safety; nutrition; plant and animal disease monitoring and detection; soil health; sustainable farming and development; and increased profitability and efficiencies for ag producers, businesses and industries.

The work of these land-grant universities made the U.S. the world leader in agriculture, ensuring a more abundant, safe and nutritious food supply across the globe and a stronger economy for Kansas and our nation.

PHOTO ANDERSON HALL IN 1885; K-STATE ARCHIVES

Dear Friends,

In this issue of the AgReport, we celebrate the land-grant university system established during the height of the Civil War when new, big ideas were critical to help heal our divided nation and support a new economy. During such a turbulent time, it took the courage and forward thinking of President Abraham Lincoln and congressional leaders of the day to promise the resources to endow a land-grant college in every state. The investment has surely paid off.

Land-grant universities have played a critical role in agricultural innovation, strengthening our agricultural economy, protecting the health and safety of our citizens, and ensuring our ability to feed a growing population. In dollars and cents terms, every dollar spent on agricultural research in Kansas returns $17, according to TEConomy Partners, a company which provides research, analysis and strategy for innovation-driven economic development.

Unfortunately, a severe lack of funding to modernize agricultural research facilities across the country has been tying the hands of researchers in the development of new and better solutions and in preparing the future scientists we need to create those solutions.

Today, U.S. investment is below 1980s levels while other countries such as China and Brazil are investing heavily – outspending us by billions of dollars in agricultural research, according to a report released in March by Gordian, a leader in construction cost data. This trend could ultimately have dire economic and security implications for our nation.

Agriculture, food and related industries contribute $1.1 trillion to our nation's economy and support 22 million jobs a year. In Kansas, agriculture represents 54% of the state's economy, and 21% of our people have agriculture-related jobs. While other countries invest to become more competitive, we must do the same.

As congress considers options to improve American infrastructure, leaders of the nation's land-grant universities hope food and agriculture research facilities will be a priority to rebuild America, protect our agricultural economy and ensure our ability to advance science.

J. Ernest Minton,
Dean, College of Agriculture
Director, K-State Research and Extension

PHOTO DAN DONNERT
IN THE PHOTO ERNIE MINTON
LOCATION HALE LIBRARY

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College of Agriculture and K-State Research and Extension

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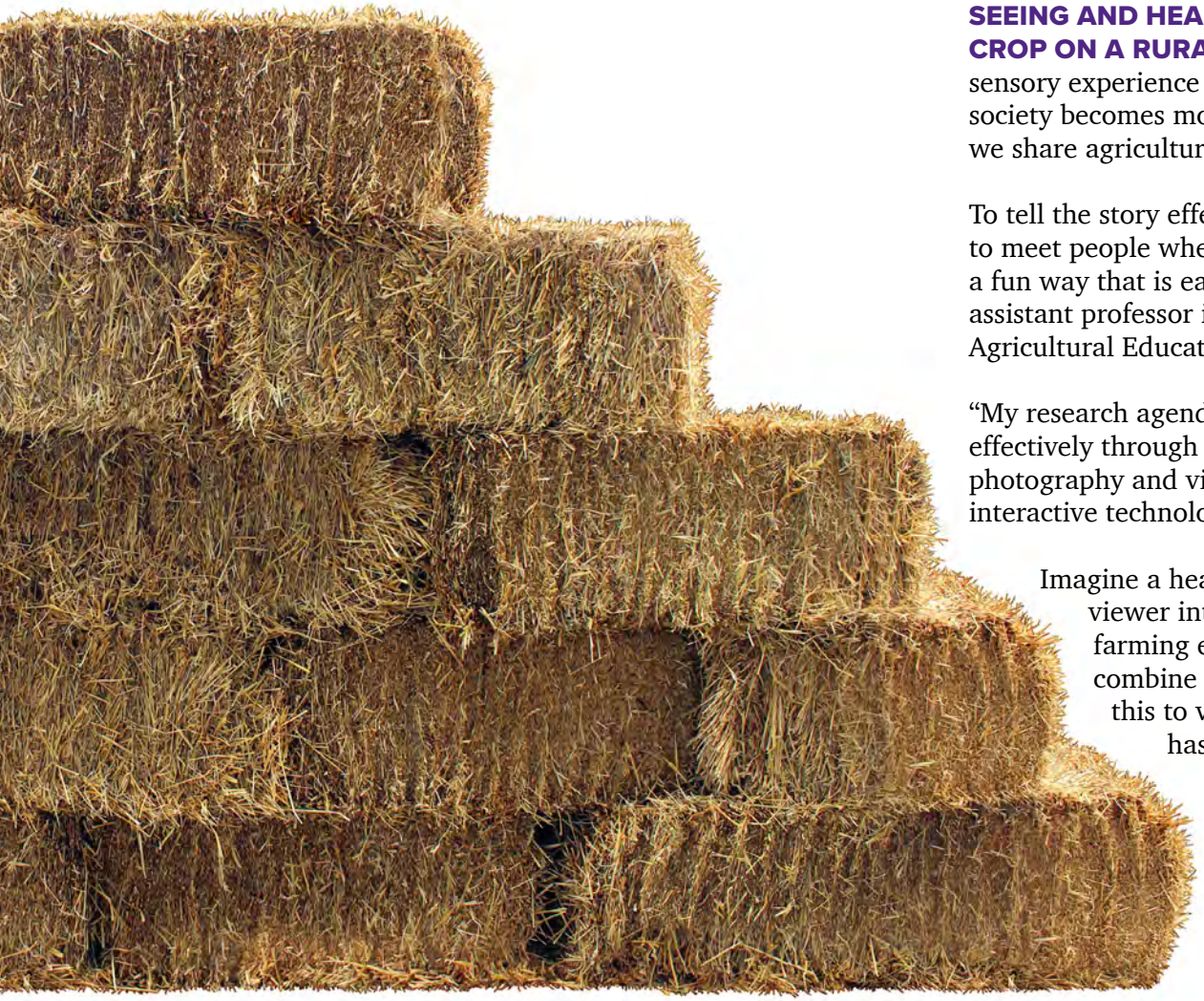
PHOTO DAN DONNERT

Bringing Agriculture *in View*

PHOTO DAN DONNERT
IN THE PHOTO LEVY RANDOLPH, PH.D., AND AG COMMUNICATIONS GRADUATE STUDENT JESSICA SHAEFFER
LOCATION UMBERGER HALL



STORY LISA MOSER

SEEING AND HEARING A COMBINE HARVESTING A CROP ON A RURAL LANDSCAPE MAY BE A COMMON sensory experience for those in production agriculture, but as society becomes more urban, it begs the question, "How will we share agriculture's story with future generations?"

To tell the story effectively, agricultural communicators need to meet people where they are by delivering information in a fun way that is easy to understand, said Levy Randolph, assistant professor in the Department of Communications and Agricultural Education.

"My research agenda is focused on how to communicate effectively through multimedia platforms to include photography and video as well as virtual reality and other interactive technology," he said.

Imagine a headset and controllers that transport a viewer into an immersive visual experience. In the farming example, the viewer virtually drives the combine to harvest the crops. Randolph compared this to video gaming experiences where a player has to advance through skill levels.

Virtual reality is a tool that makes "your reality available and accessible to those in a digital space by creating experiences that heighten the senses, immersing the viewer into a visual space," he said. "If you take them visually to a farm, the players may have to accomplish tasks that

apply their knowledge to advance. This makes learning fun but also educational."

Through a combination of a 360-degree video and other interactive components, viewers who have never visited a farm may gain a new understanding of agriculture via a virtual world.

"The 360-degree videos are immersive but not interactive, so I want to study how to use virtual reality as an effective tool to allow viewers to immerse in an environment but also interact with objects to see how things are done in the industry," Randolph said.

These types of experiences can also give the viewers an up-close look at a problem.

"Through this technology, we are able to create experiences that allow you to look at it beyond just a picture in a book," he said. For example, the creators could magnify a plant to make it possible for the viewer to see close-ups of cells to enhance their understanding.

Randolph cited research studies that show people tend to recall messages faster when they've learned them through a virtual-reality experience.

"Cognitively, research shows that information is digested faster and turned into new knowledge quicker than by just reading the words," he said.

Virtual reality training is commonplace in other industries, such as an airplane cockpit simulator used to train pilots.

Randolph is currently applying for grants to study what people enjoy about the virtual reality experiences, and how virtual experiences influence attitudes, perceptions, beliefs and ultimately purchasing decisions.

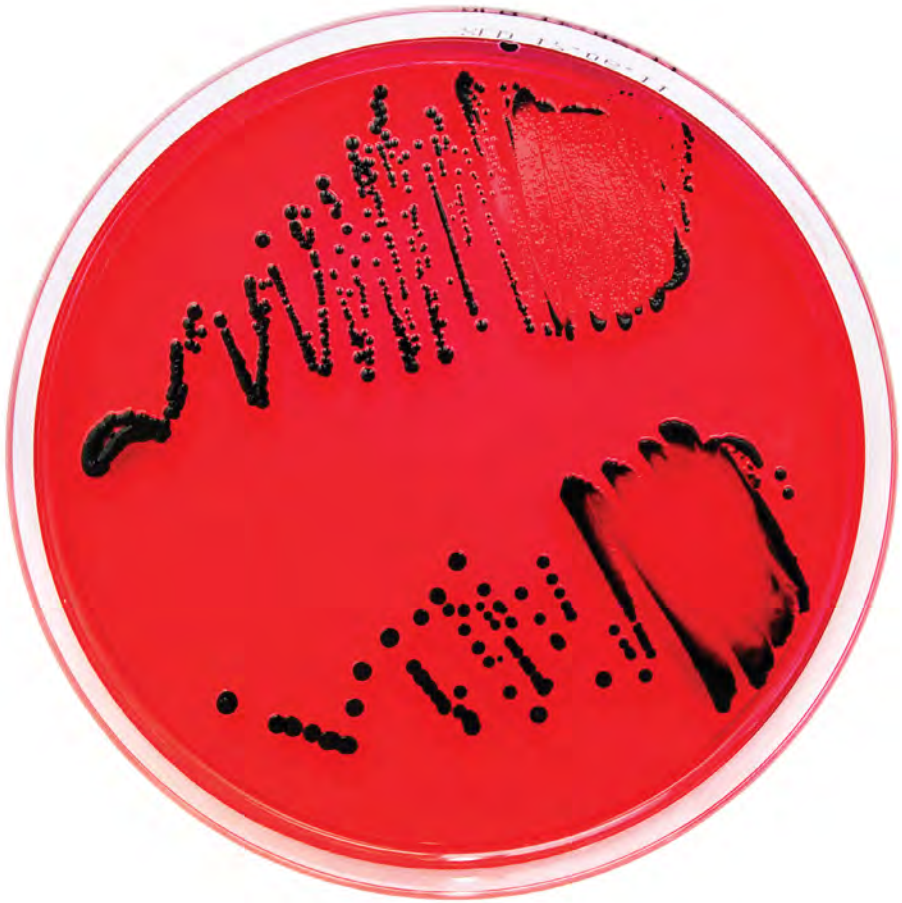
He referred to an experience he had on a college campus four years ago when an activist group used virtual reality in an attempt to persuade the viewers to align with their cause. It had a great impact on his perception of the processes used and retention of the information shared, he said.

Along with effective, consumer-facing education, he also sees future applications for these technologies in certification programs.

"I'd like to create a game that is focused around level-based education that is tied to a certification program for, say, a welder or even a food safety inspector," he said.

"I want to look at how we create experiences that allow consumers to learn about agriculture while also having fun doing it."

Building a *Line of Defense*



IT'S BEEN DESCRIBED BY SCIENTISTS AS A DIVERSE BACTERIUM, WITH MORE THAN 2,500 DISTINGUISHABLE strains, including nearly 100 that can cause disease in humans. But those who have had a bout with *Salmonella* just know that it's no fun.

The national Centers for Disease Control and Prevention estimates that in the U.S., *Salmonella* causes more than 1 million illnesses each year, typically when humans eat food or drink water contaminated with the bacteria. The symptoms can begin within hours or up to six days later, and include diarrhea, fever and abdominal cramps.

The majority of cases in the U.S. are foodborne – more often in produce, poultry and eggs, but beef has also been associated with outbreaks. And that's what has Sara Gragg's attention.

"My research is focused on reducing foodborne illness and protecting public health," said Gragg, an associate professor of food science in the Department of Animal Sciences and Industry. "(It) is not limited to a certain industry, product type or commodity. So, I have conducted research on everything from fruits and vegetables to live animals and meat and poultry products."

STORY PAT MELGARES
PHOTO DAN DONNERT
IN THE PHOTO SARA GRAGG, PH.D.
LOCATION CALL HALL

> ***"Our collective goal is to protect the consumer through our collaborative research efforts."***

Her ultimate goal is to understand the characteristics of food-safety issues and use that scientific knowledge to make it even less likely for food to make us sick.

Gragg's work has led her to study how foodborne pathogens are carried and transmitted by food animals and how to reduce their presence in the live animal, on the carcass, or in the retail products.

"A great deal of my research has been dedicated to understanding how *Salmonella* is carried in high-risk animal tissues, such as the lymph nodes of cattle and swine," she said. "Lymph nodes are present throughout the animal, many of which are embedded in the fat of a carcass that is incorporated into ground beef or ground pork. It is important that we fully characterize this issue and the risk that it poses to public health, so we can identify effective mitigation efforts."

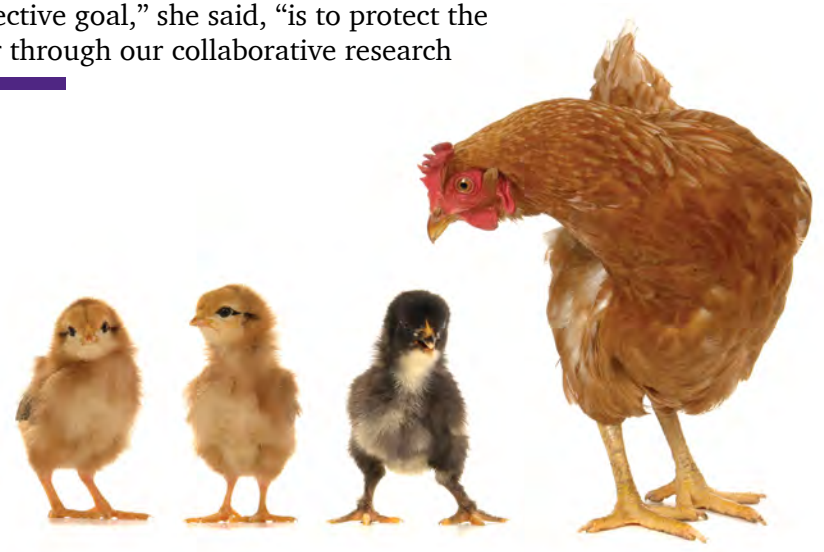
She said there is a growing body of research literature demonstrating the potential presence of *Salmonella* in lymph nodes, so much so that the beef industry is developing partnerships with scientists to find ways to reduce it. Gragg's work, for example, is supported by the National Cattlemen's Beef Association and the North American Meat Institute.

"Together, we have made progress and are actively pursuing new research to continue addressing this issue," she said, adding that her efforts recently shifted to such mitigation efforts as removing lymph nodes and preventing contamination in the live animal.

Kellen Habib, a graduate student studying under Gragg, completed a lymph node study in fall 2020 as part of his thesis research. The labor-intensive project required him to trim lymph nodes from carcasses, remove the surrounding fat tissue and evaluate the sample for the presence of *Salmonella*.

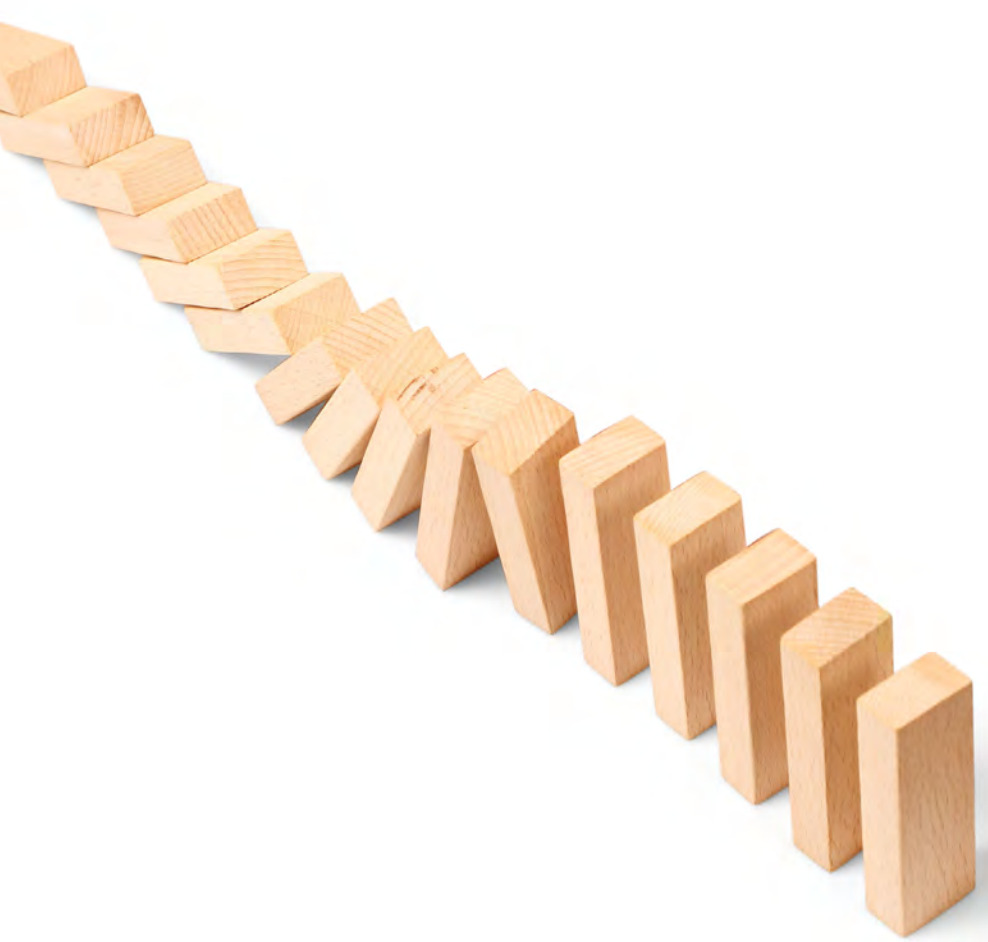
Gragg's work soon will include evaluating lymph nodes in swine. She said the pork industry, like the beef industry, also is eager to help scientists find solutions. She noted that leaders at feedyards and packing plants cooperate in her work.

"Our collective goal," she said, "is to protect the consumer through our collaborative research efforts."



Risky *Business*

PHOTO DAN DONNERT
IN THE PHOTO EMILY WARRINER
LOCATION K-STATE STUDENT UNION



WHEN TEGAN LOUW APPLIED TO A RELATIVELY NEW PROGRAM AT KANSAS STATE UNIVERSITY FOCUSED on teaching students about managing risk, she got what she expected and then some.

A 2018 graduate who earned a bachelor's degree in finance, she is now a Denver-based senior consultant at FTI Consulting. She is a member of the Power and Renewables team within the company's finance and restructuring unit. Her team works with companies addressing utility-scale power generation, including nuclear, thermal, solar, wind and biomass, among other emerging low-carbon technologies.

"The Center for Risk Management was, without a doubt, the best thing I was a part of in college," said Louw, who grew up in Johannesburg, South Africa. "The program enhanced my experience and education, both personally and professionally. Although I learned a lot about risk management and commodities while in the program, it gave me far more than that."

Now in its ninth year, the university's Center for Risk Management Education and Research, also known as CRMER, grew from conversations among industry partners, faculty members and administrators.

"In discussions with alumni who hire our graduates, we recognized K-State had an obligation to elevate student knowledge about business and societal risks they will face as they launch careers," said Ted Schroeder, agricultural

STORY MARY LOU PETER

economics professor and CRMER director. Alumni Lee Borck and Ed Prosser, plus Emilie Fink, who worked at the KSU Foundation at the time, were particularly instrumental in the center's formation.

Though based in the College of Agriculture, CRMER is a multi-college program. Students representing 40 different majors have participated and are as likely to be business, communications, engineering, mathematics or computer science students as agriculture majors.

Through CRMER, a student can earn an undergraduate certificate in Integrated Risk Management, participate in a Graduate Education Research Fellowship, or in a Student Fellowship Program.

Students in the program engage with industry partners and business executives who provide guest lectures on topics ranging from cyber and geopolitical risks; catastrophic and natural disasters; and financial, market and public relations risks.

Students have participated in site visits to such diverse workplaces as the Commodity Futures Trading Commission, ADM, Aon, CME Group and the U.S. Senate. Guest lecturers have come representing firms such as The Hershey Company, John Deere, Monsanto, Smithfield Foods and Northrop Grumman.

To help fill a need for executive education in risk management, the center also partnered with the CFTC in providing a forum for industry dialogue on important emerging-market issues.

According to Emily Warriner, the center's managing director, "Students who complete the rigorous certificate, including advanced senior-level risk management courses from each of three disciplines – finance, agricultural economics and systems engineering – possess the most robust risk-management curriculum of any undergraduate program we know of in the nation."

Louw, who serves as an alumni member of the CRMER board, said her experiences as a student fellow – taking classes outside her core business curriculum, meeting industry professionals, making friends and mentors across the university and traveling to different cities – gave her an advantage when launching her career.

"We've spent time visiting with industry executives around the country and continuously hear that K-State students are among the best in the country. Our graduates would excel regardless of whether they were part of CRMER, but we believe we are a small catalyst for some of that success," Schroeder said.

LEARN MORE ABOUT THE CENTER FOR RISK MANAGEMENT EDUCATION AND RESEARCH AT **kstate.ag/RiskManage**

Face to Cattle Face

STORY PAT MELGARES
PHOTO DAN DONNERT
IN THE PHOTO KC OLSON, PH.D.
LOCATION K-STATE STOCKER UNIT

IF YOU'VE STARED ONE COW IN THE FACE, YOU'VE SEEN THEM ALL ... RIGHT?

New technology being developed at Kansas State University is debunking that thought and capitalizing on the power of artificial intelligence to build a facial-recognition database for the cattle industry.

Human facial recognition is becoming more common in secure locations such as airports, and people can log into their computers or smartphones simply by looking at a screen.

"We thought, why can't we have something like that for beef cattle, which could then be used to create a national animal disease traceability system?" said KC Olson, who helped develop the idea. Olson, a professor in Animal Sciences and Industry and a beef cattle scientist with K-State Research and Extension, said, "The need for such a system has never been greater. We need this extra layer of protection for our industry against a foreign animal disease."

While much of the world slowed down during the COVID-19 pandemic, Olson and a group of university experts in computer engineering, veterinary medicine and animal science were busier than ever putting together the intricacies of facial recognition for cattle.

> *"We need this extra layer of protection for our industry against a foreign animal disease."*

"Initially, we made short videos of 1,000 feeder cattle that were restrained in a chute, taking a panoramic view of each calf's head," Olson said.

From the videos, computer engineers took individual images of each animal's head and uploaded each to a neural network – a form of artificial intelligence that is self-learning. Once the pictures are loaded, Olson said, the system "teaches itself which of the biometric measurements are critical."

Recently, the team tested the reliability of the network, feeding images of cattle already in the system, and some that had not yet been entered. Olson said the technology was accurate 94% of the time.

"The main challenge we are having now is growing the photo database," he said. "The artificial intelligence needs time to mature by training with a large number of photographs. We are particularly interested in relationships with cattle feeding companies that are willing to read cattle into the system when they arrive at the feedlot, and again at re-implant time or shipping for harvest."

The university worked with Kansas City-based company Black Hereford Holdings to build a smartphone app called CattleTracs, which is available to iPhone and Android users. Using CattleTracs, producers can submit pictures of their cattle directly into the app.

"For producers who don't want anything to do with a national disease traceability system, that's fine. Nobody is compelled to participate," Olson said. "An animal could be read into the database anytime, such as at the first point of sale after leaving its ranch of origin or anytime after.

"We do know that there can be economic incentives for animals with desired traits, and this system could help with that. But we would potentially get a lot more, including that all-critical element of biosecurity for our industry. The thinking is that this will eventually be applicable to most mammalian livestock species, including hogs and dairy cattle."

The Kansas Livestock Association also has supported the project from its outset. Olson said key partners also include Iowa State University bovine veterinarian Dan Thomson; and K-State computer science specialists Bill Hsu, Dan Andresen and Ray Luo.

LEARN MORE ABOUT CATTLETRACS AT **cattletracs.com**

Honoring *the Land*

PHOTO DAN DONNERT
IN THE PHOTO TY WERDEL
LOCATION WASHINGTON MARLATT
MEMORIAL PARK, MANHATTAN, KANSAS

STORY SUSAN SCHIFF

DOCTORAL CANDIDATE TY WERDEL TOOK A NON-TRADITIONAL PATH TO BECOME A RISING STAR IN THE FIELD OF WILDLIFE MANAGEMENT.

He worked as a professional-rodeo bareback rider before his path led him back to college and a field of study that reflects the values he, his family and their Sisseton-Wahpeton tribe share in honoring the land and all creatures on it.

Werdel's research is focused on helping species return to their native land after being extirpated, or wiped out completely, in a section of their natural habitat. He started by helping the South Dakota Game, Fish, and Parks Department restore the bighorn sheep population to the Black Hills by relocating a herd from Alberta, Canada, to South Dakota.

That project began while he worked on a master's degree at South Dakota State University. He continues to monitor the situation and says the new bighorn herd faces another challenge. According to Werdel, the original herd was wiped out in that part of the state because of overhunting, and now it faces a deadly form of pneumonia brought to the region by domestic sheep and goats.

Now at K-State, Werdel works with his graduate professor, Adam Ahlers, to understand how landscape changes are affecting swift fox populations in shortgrass prairies of western Kansas.

"We've learned a lot," Werdel said. "One thing that surprised us is how well the swift fox can adjust to crop fields. They burrow right in. But they aren't doing so well in the fields where the non-native grasses are higher than the surrounding prairie. The taller grass makes it difficult for the swift fox to see its prey and escape predators."

Ahlers said Werdel's research at K-State is advancing the fields of landscape ecology and wildlife ecology – and his teaching is transformative.

"Ty is also a graduate teaching assistant for my wildlife management courses, and every semester he gives an amazing lecture on traditional ecological knowledge," Ahlers said. "He encourages students to open their minds and see things from a new lens."

Werdel said he explains that western science and traditional knowledge are becoming more aligned and gave this example: "Native Americans were taught to never overhunt the largest rams or you'll hurt the herd. We were told if there are no big rams left, the lambs won't know how to grow up to be the leaders. Western science is teaching that now, too.

PHOTO SWIFT FOX

"I want students to understand that the science they learn at K-State and the traditional knowledge they learn from their parents and grandparents, who may be Native Americans or fourth- or fifth-generation farmers, is a powerful combination."

Werdel said it was his mother, LuAnn, who taught him to value education and always encouraged him to return to school. His mother is the grant coordinator of the Graduate Studies Department at Oglala Lakota College, a Tribal College located at the Pine Ridge Reservation in South Dakota, one of the most economically disadvantaged places in the United States.

"She never stops pushing her students to study hard, to go to college. She helps them understand that an education can be their ticket out of poverty," Werdel said. "I'm very proud of her."

Werdel has been recognized with many prestigious grants and awards over the years, including the Gates Millennium Scholarship, Advancing Agricultural Science Opportunities for Native Americans award, and the College of Agriculture Graduate Student Recognition of Achievement.

But now, he spends more time helping other students attain the awards and funding they need. Werdel currently serves as the program coordinator for the Native Student Professional Development Grant, an organization associated with the Native Peoples' Wildlife Management Working Group of The Wildlife Society. His job is to help ensure scholarships and other funding are available to help pay tuition and conference expenses for Native American students.

More than *Learning*

STORY MEG DRAKE
PHOTO DAN DONNERT
IN THE PHOTO EMILY GLENN
LOCATION MANHATTAN, KANSAS

TAGGING ALONG WITH HER OLDER BROTHER TO HIS 4-H EVENTS SPARKED EMILY GLENN'S LONG-TERM PASSION and commitment to 4-H, an organization she believes prepared her well for college and a future career as an agriculture educator.

"I loved getting to participate in so many different projects," she said. "I did everything from cattle and swine to leadership, citizenship, fiber arts and reading."

Today, this K-State senior studying agricultural education remembers how her 4-H projects filled her summers with fun and purpose from her elementary years through high school. But what Glenn says she values most about her 4-H experience is how it developed her sense of responsibility and accountability.

"No matter what the project, 4-H purposefully works on honing critical thinking, communication and leadership skills," she said. "4-H is so much more than learning the steps to raise an animal or learn to sew. It's about learning how to make good decisions, and that has helped me throughout my college experience, and I'm sure it will help me throughout my entire life."

According to Wade Weber, state 4-H program leader and department head, "The 4-H mission in Kansas and across the country is to give all youth equal access to this kind of opportunity. Through 4-H programs, youth are guided to be

more open to challenge and discovery, strengthen their desire to help others, and learn to set and meet goals."

Kansas 4-H has grown to be the state's largest youth-development organization, serving more than 88,000 youths. Currently, Kansas 4-H offers 30 project areas and hundreds of 4-H sponsored events and activities in areas ranging from agriculture, science and technology, to health, civic engagement and performing arts.

Historically, 4-H was embraced mainly by rural families. But the program has evolved into an organization dedicated to serving the diverse needs and interests of all young people – rural and urban – throughout the state and nation.

Glenn described the benefits of the diversity: "All of the events, like Kansas Youth Leadership Forum, bring in a different array of people and you learn so much from each other," she said. "I've seen so many attendees get out of their comfort zone at these events. Seeing them grow and develop is so exciting."

The Kansas Youth Leadership Forum is a two-day workshop aimed at helping youth ages 14 to 18 build their leadership skills. Due to the pandemic, this year's event, like many others, was conducted virtually.

"We worked to create positive engagement for those digital programs," Weber said. Being curious, asking questions, and listening well are the keys to any good learning experience, virtually or in person. 4-H youth modeled creativity and leadership in adapting and trying many new methods of virtual interaction.

Weber describes 2020 as the year when kids and families may have needed 4-H most. "Many youth weren't able to attend school in person. They needed their friends and constructive activities, and parents needed positive programs to keep their children engaged. We never lost sight of those needs."

LEARN MORE ABOUT KANSAS 4-H AND YOUTH DEVELOPMENT AT **kansas4-h.org**

By leveraging the expertise and resources of local communities and the university, Kansas 4-H learned to navigate disruption caused by COVID-19 and move forward. Overall, events hosted by K-State Research and Extension and 4-H youth development attracted more than 93,000 attendees between March and December 2020.

"This pandemic has only strengthened my belief in the 4-H values of being open to challenge and discovery and strengthening the desire to help others," Weber said.

Surrogate *Sliders*

PHOTO DAN DONNERT
IN THE PHOTO SAJID ALAVI
LOCATION MANHATTAN, KANSAS

STORY PAT MELGARES

IMAGINE GOING TO A BACKYARD BARBECUE: MUSIC IS PLAYING, FRIENDS ARE LAUGHING, THE YARD looks immaculate, the sight of all those potato salads and pies make your mouth water, and the smell of the grill makes everyone excited to eat … except for your friend who can't eat meat for medical reasons. And your young cousin who chooses to follow a vegan diet. They're left out in a way that's hard to understand for a hearty hamburger-loving carnivore.

One of the world's largest market research companies, NPD, recently reported plant-based protein alternatives are increasing in popularity in the U.S., especially among the millennial generation. Between 2017 and 2019, sales of plant-based alternative products rose from $118 million to $192 million in the U.S.

That type of growth gets the attention of American food companies – as well as the scientific community. Sajid Alavi, a professor in the Department of Grain Science and Industry, said it's a signal that some consumers are on the lookout for protein sources that address their dietary needs and preferences.

In his lab, Alavi and a group of students are studying new protein sources for use in plant-based foods, including yellow peas, chickpeas, fava beans and other legumes. This work is partly in response to the need for developing plant-based alternatives with ingredients beyond the two traditional protein sources, soy and wheat, and addressing poor quality of products based on the newer protein sources.

Their work relies on creating products in the university's extrusion lab, where specialized machines are used to push food materials through custom dies and forms to create products with specific shapes, weights and textures.

"We are studying the properties of the end products, such as texture," Alavi said, "and then comparing that to such meat products as chicken, pork and beef in their whole form, and in ground form."

Graduate student Delaney Webb, who is in the second year of her master's degree studies, is concerned with the functionality of ingredients used in making meat analogues, a term that broadly means meat-like foods made from plants. Her thesis focuses on optimizing pea protein for meat analogues.

"For example, the goal of a recent experiment was to determine if and how increasing levels of fiber in pea protein-based formulations would impact the processing and texture of low-moisture meat analogues," she said. "I am specifically looking for relationships between fiber content, processing parameters and texture."

Low-moisture extrusion is common with products made from peas, but their sponge-like texture make them a poor comparison to actual meat products.

At the 2021 annual meeting of the International Food Technologists, Webb presented results of her study, proudly declaring that K-State researchers have evidence to conclude that "balancing the protein, starch and fiber inclusions can help target the final product outcomes."

Alavi noted that Webb's work is just one of "several novel techniques developed in our lab to characterize proteins that are used in plant-based meat analogue applications." The research team continues to push findings related to such areas as gelation (the ability of proteins to create structure), viscosity (a fluid's resistance to flow), heat absorption and other areas.

"These are novel techniques in a relatively unexplored area and have contributed to a better understanding of raw materials and quality of the final product," Alavi said.

K-State's research is already appearing in peer-reviewed journals, and Alavi said it is "garnering widespread attention from the food industry and academia."

"Companies are already adopting the learning from our lab in their research and development work, and several industry sources have contacted us to assist them in their development needs related to plant-based meat analogues," he said. "We are in discussions with these potential partners for more projects that will help develop greater understanding."

Webb notes that because food companies are working overtime to simulate meat with plant-based products, she believes she's well positioned for the future.

"It's astoundingly competitive right now," she said. "But that means I am receiving training not only in the field of extrusion, but also a specific application of extrusion that is in high demand. It's exciting for me to be working in such a relevant subject area and be at the beginning of these food and technology advancements."

“Workhorses” of *Agriculture*

STORY PAT MELGARES
PHOTO DAN DONNERT
IN THE PHOTO DAN FLIPPO, PH.D., AND GRADUATE STUDENT, CHETAN BADGUJAR
LOCATION K-STATE NORTH RESEARCH FARM

IT IS POSSIBLE – AND PERHAPS VERY LIKELY – THAT AGRICULTURE OF THE NOT-TOO-DISTANT FUTURE WILL include small machines guided by computers to do some of the work, while giving farmers large volumes of information that they can use to plant, manage and harvest better crops.

In fact, Kansas State University researchers have already built the prototypes. Another tweak here or there and … well, the opportunities are tremendous.

For nearly three years, assistant professor of biological and agricultural engineering Dan Flippo and his students have been testing a robotic tractor designed to dig a small trench, plant seeds and even treat for pests.

In a test run, the machine, which measures about two feet tall and three feet wide, crawls slowly across the test site under the group's watchful eye. The blade intended to cut the trench seems a bit inefficient, and the machine fails to cut the straight path that Flippo had hoped to see.

It turns out to be a great test for the students, who will go back to the lab and work out the few hiccups they discovered on this day.

"We have two working planter prototypes, but they still need design modifications and more field testing," said Chetan Badgujar, a doctoral student in biological and agricultural engineering. "We are also planning to get access to simulation software so that we can study the interaction between the blade and soil."

Much of agriculture has already been touched by some new form of technology, whether it be sensors on tractors that precisely measure planting and fertilizing rates, or thermal

infrared cameras attached to drones that fly above farm fields and detect water or insect stress in crops. There are even robotic arms that can milk a cow.

"We are not trying to take over tractors or get rid of tractors; we are trying to make more food," Flippo said. "By 2050, we are going to have close to 10 billion people, and right now we are not close to meeting the amount of food production that will be needed."

While companies such as John Deere and Case IH are leading the way in developing autonomous (self-driving) tractors, Flippo says universities play a key part in developing smaller vehicles to aid in farm work.

Flippo said the university is building two models: the first is called a rover and is about the size of a microwave oven. Its purpose is to scout a field, which would save farmers from walking their fields all day to detect disease, pests, drought or anything else that might harm the crops.

The second category is slightly bigger than the rovers, and are called ag drones (pictured on page 26). Flippo said these are "the workhorses," such as the unit they were testing recently to plant seed. Ag drones potentially could be used to carry tanks of chemicals to an area of a field or plant seeds in areas where a larger tractor can't safely go, such as sloped hills.

Statistics indicate that farmers spray nearly $15 billion worth of chemicals annually yet still lose 37 percent of their crop yield to pest damage.

The university's group is working on a rover that has a sensor on the front of the vehicle to detect insects, such as aphids in a sorghum field. The sensor will have the ability to detect if

"Ultimately, that means smaller amounts of chemicals are being used and less money paid by the farmer."

the concentration of aphids – which measure no more than one-eighth of an inch – exceeds a critical limit.

"We are going to synchronize the system so that based on the moment that the vehicle sees the insects, it will start spraying backward, and it builds a buffer zone around the area," said Ajay Sharda, associate professor of biological and agricultural engineering. "In other words, it will spray beyond the point where the insect was sensed so that we have established a full zone of control."

Sharda notes that spraying from below the crop canopy will help to contain more of the chemical where it's needed, and reduce spray drift. Ultimately, that means smaller amounts of chemicals being used and less money paid by the farmer.

In January 2019, Flippo, Sharda (the principal investigator), agricultural engineer Ed Brokesh and entomologist Brian McCornack were awarded a grant for $883,000 from the U.S. Department of Agriculture through its National Robotics Initiative to study the use of robots to detect and defeat insects in crop fields. According to Flippo, K-State's project is at least "five to 10 years" from being implemented into the agricultural industry.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