Perspectives

Fall 2015

KANSAS STATE UNIVERSITY

Message from President Kirk Schulz and Vice President for Research Karen Burg

In academia, we're always cautious about definitively claiming something, but after more than 150 years of experience working on the topic, we at Kansas State University can reasonably state that we are one of the world's leaders in food research.

We have a proud heritage in food research and education. Kansas State University was the first operational land-grant institution under the Morrill Act in 1863. As a land-grant, our focus has been on teaching practical agriculture, science and engineering to improve lives since our inception. This entire issue is devoted to food research and a sampling of the food-related projects and ideas at Kansas State University that are focused on addressing some major food-related challenges in the world's future.

The current world population is more than 7.3 billion people. By 2050, that population is projected to be at least 9.6 billion, with most of the growth in developing regions such as China, India and Africa. By 2030, the global middle class will grow from 2 billion people to at least 4.9 billion. Most of this growth also will be in China, India and Africa. This population segment will demand a safe, higher-quality diet focused on animal protein and cereal grains.

Projections indicate humans will need to produce between 70 to 100 percent more food to meet demand. That means in the next 35 years, the world will need to produce more food than ever before in human history. Because agriculture in developed nations is already largely efficient, and we can't add to the agricultural lands that make up 40 to 50 percent of the Earth's surface, the challenge is huge. Innovation must happen in growth areas such as China and Africa.

In 2014, we introduced the Global Food Systems Initiative, the university's first presidential initiative. Initiative activities use our skills, expertise and world-class research facilities in the food system to accelerate research and solutions for our private and public food industry partners, as well as the producers who are responsible for the largest percentage of the world's food supply: farmers in developing nations with small acreages, also known as smallholder farmers. Faculty and staff in all of the university's colleges are contributing to this initiative with projects that focus on food sustainability, food bio- and agro-defense, and food accessibility and nutrition.

In addition to our heritage, what other evidence supports Kansas State University's status as a global food leader?

For starters, the U.S. Agency for International Development has invested more than $100 million in our capabilities to establish four new Feed the Future Innovation Labs at Kansas State University. These federal labs focus on reducing global hunger by helping smallholder farmers grow better crops, use improved methods for defending food crops against disease and insect pests, and establish more efficient methods of distributing the harvests — all while helping them turn a profit.

We also encourage you to read stories about our work in improving wheat genetics (Page 13), using fewer natural resources (Page 26) and reintroducing grocery stores into rural communities to feed those at home (Page 14).

The Global Food Systems Initiative will help us continue to serve as a food research leader by eliminating some food production hurdles, and it will help us maintain our trajectory toward becoming a Top 50 public research university by 2025.

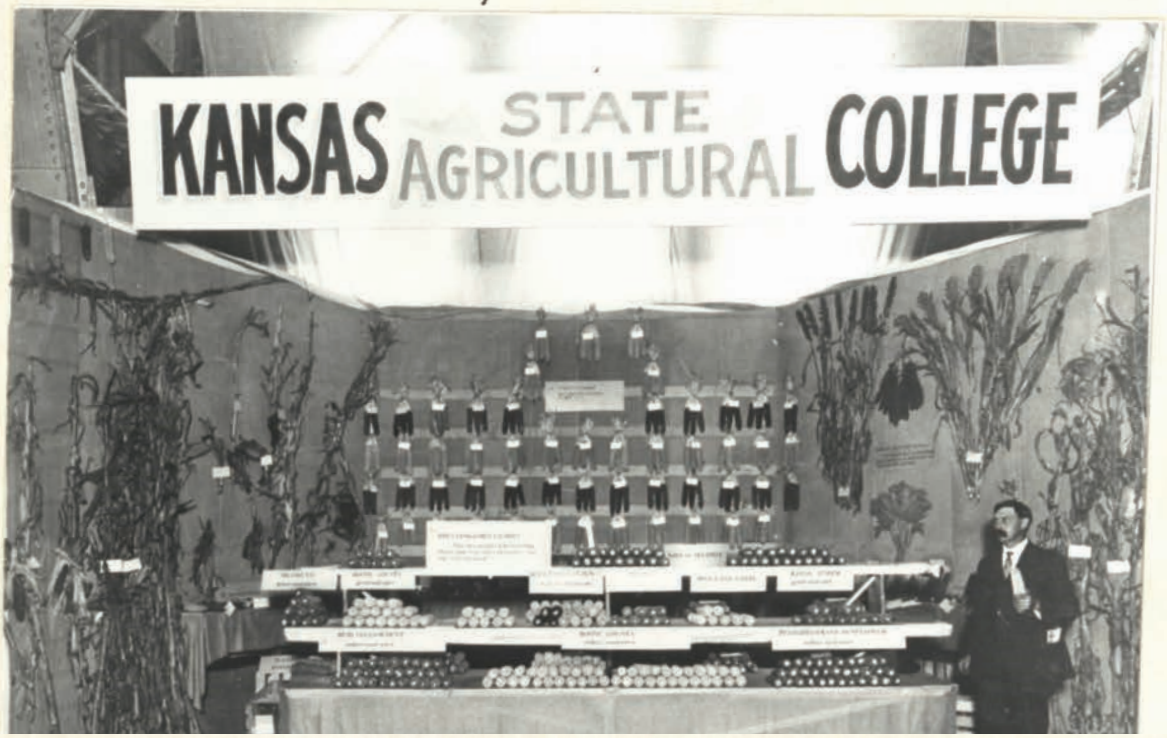
President Kirk Schulz

Vice President for Research Karen Burg

contents

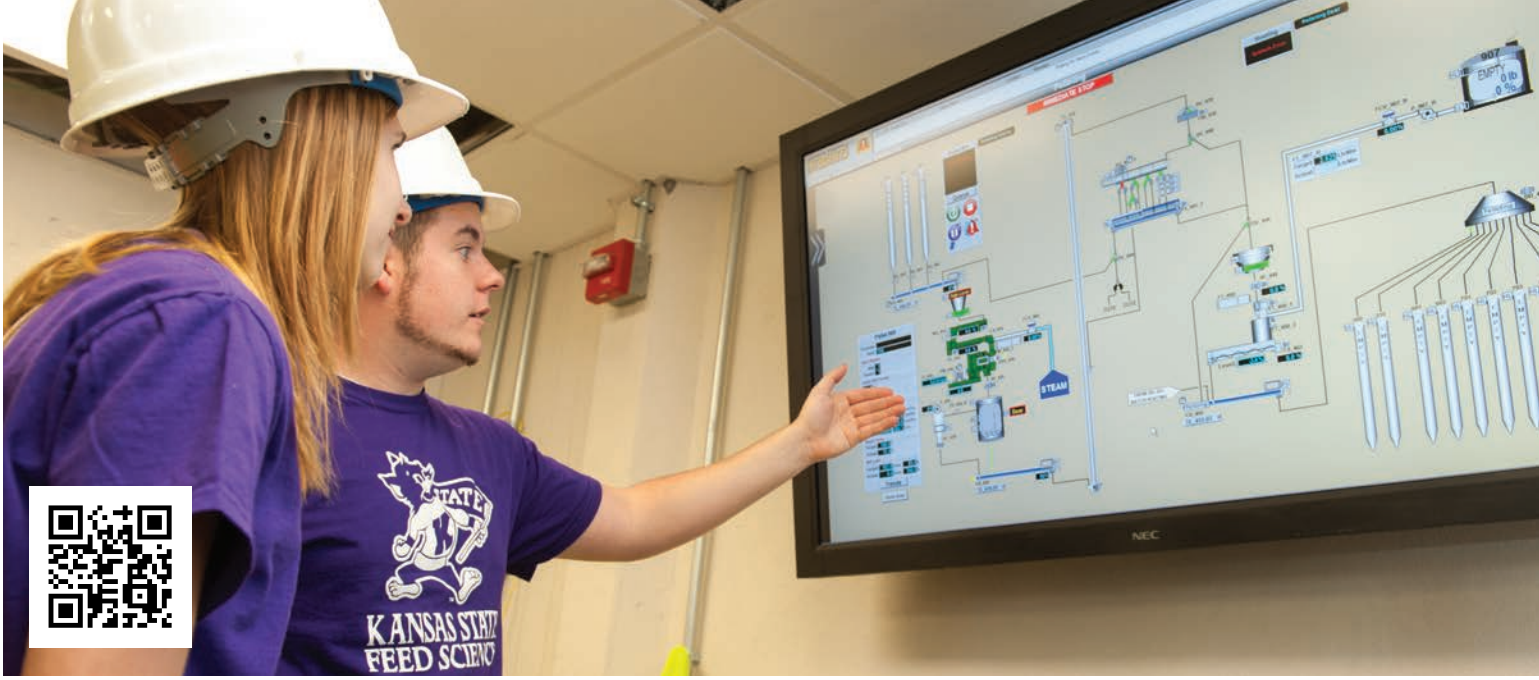
Editorial, design and photography assistance provided by Kansas State University Division of Communications and Marketing.

Photos and cover photo provided by University Archives and Special Collections.



Since its inception in 1863, Kansas State University has been developing a reputation for being home to numerous world-class food-focused research facilities and faculty experts, as well as a training ground for the next generation of researchers.

Harvesting Soy Beans w/ binder 9/29/1924



ACCELERATING EXPERIENCE IN FOOD RESEARCH, EDUCATION

Global Food Systems Initiative gains momentum

The Global Food Systems Initiative, announced by Kansas State University President Kirk Schulz in January 2014, builds on the university's legacy of leadership in food production, food safety and food security. Through a concentrated universitywide research effort, Kansas State University is developing and commercializing new food technologies and innovations, building talent-based networks with the public and private sectors, and training the next generation of researchers for the state's workforce.

"The initiative is aimed at transforming lives toward a world where people no longer face the agony of extreme poverty, malnutrition and hunger," said Dirk Maier, professor of grain science and IGP Institute senior postharvest engineer.

Manhattan is quickly becoming a powerhouse for global food research as the home to the Kansas Department of Agriculture, the U.S. Department of Agriculture's Center for Grain and Animal Health Research, the American Institute of Baking International and the current construction of the National Bio and Agro-defense Facility, or NBAF, all in or near the northern quadrant of the university's Manhattan campus.

"If we do this successfully, we can use the resources we already have on campus to meet our goals of educating others and helping industries improve their capabilities," said John Floros, dean of the College of Agriculture and director of K-State Research and Extension. "I want people to know that this is to help the public. We want to address industry problems of the global food system and make things better. This will provide an even bigger impact beyond our current goals."

The initiative covers the entirety of the food production cycle — from how food is grown, to how it is processed, transported, stored, packaged, marketed and consumed. It also involves every department at the university, including those that study family issues, nutrition, business, health, biology, the environment and more.

"This effort should lead toward Kansas State University becoming the place you go if you want to improve your food system capabilities or to learn more about the global food system," Floros said.

In spring 2015, the university awarded $500,000 in grants to faculty members for research related to the Global Food Systems Initiative. Funding was awarded to nine projects that are multidisciplinary approaches to addressing needs in the global food system and helping create jobs and wealth for the state.

"It is our job to address food system issues for Kansas producers. But when we address items for Kansas, the solution also can be applied globally," Floros said. "Ultimately, this will help Kansas today and tomorrow. This is what we have done since we began as a land-grant university, and this is what we will continue to do. Together, we will innovate the next breakthrough."

By Kelly Hannigan, senior in agricultural communications and journalism

Food for all

An update on the university's four Feed the Future Innovation Labs

In just over two years, Kansas State University has become a major player in implementing the U.S. Agency for International Development goal to reduce hunger and improve food security in the most impoverished nations of the world.

In two years, USAID has committed more than $100 million to Kansas State University under its Feed the Future initiative, creating four innovation labs.

Kansas State University is responsible for managing the funds, most of which are distributed to partner universities to conduct research in nations where hunger is prevalent. The university benefits by acquiring new resources and employees, and is at the forefront of research that can be applied in Kansas and around the U.S.

The following is a look at how the projects have helped so far.

Applied Wheat Genomics

Kansas State University's Feed the Future Innovation Lab for Applied Wheat Genomics was funded in 2013 for $5 million. The project's main goal is to develop heat-tolerant, high-yielding and farmer-accepted wheat varieties for South Asia, where approximately 20 percent of the world's wheat is grown.

University wheat geneticist Jesse Poland, the lab's director, said the project has made significant progress in the past year, including establishing field trials in India and Pakistan; generating genetic profiles for more than 25,000 wheat varieties; and implementing high-throughput phenotyping to more accurately assess plant growth and performance.

Poland said that work in India and Pakistan is complimentary to ongoing work in the Kansas State University wheat breeding programs, adding that local breeding work supported by the Kansas Wheat Commission and Kansas Wheat Alliance is very synergistic and that the same tools and new breeding technologies are being applied.

"The project is off to a great start," he said. "It is an exciting time to apply leading genomics to accelerate the breeding process, particularly with the goal of increasing food security in the places that it is most needed."

Sorghum and Millet

Kansas State University's reputation as a leading center for international sorghum and millet research got a big boost in 2013 when USAID awarded the university $13.7 million for the Innovation Lab for Collaborative Research on Sorghum and Millet.

Since then, the university has worked aggressively to improve the productivity, disease resistance, agronomy and economic value of sorghum and millet in Ethiopia, Senegal and Niger.

In 2014, Kansas State University awarded $8.5 million in funding to U.S. universities and international partners to conduct research in the focus countries. Their projects will promote food security, household resilience and private sector growth in the region.

Of that money, 57 percent is dedicated to genetic enhancement of sorghum and millet; 23 percent toward value-added uses; and 20 percent to improve production systems. Forty-two percent of the money is for projects in Ethiopia.

According to Timothy Dalton, project director and professor of agricultural economics, scientists have conducted research on one year's growing cycle, and crops are now being planted for the second year.

"Our first year of research was a resounding success with field trials conducted in more than 30 sites in Africa, and food products evaluated by urban and rural consumers in West Africa and Ethiopia," Dalton said. "Much of the seed development work will be long-term and requires patience, but we expect to launch new pest management techniques, cropping practices and new food products in the near future."

Related projects in the past year include training scientists in the focus countries; developing research methods that appropriately integrate women into production agriculture and processing; and improving crop resistance to heat, drought, insects and disease.

Preventing Loss

In 2013, Kansas State University received $8.5 million to establish the Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss. As much as one-third to one-half of the world's

Photos provided by Kira Everhart-Valentin, Feed the Future Innovation Lab for Collaborative Research on Sorghum and Millet.


Gurbachan Singh & Sons
Wedding Villa
ENTRANCE
PB10DE 5693

harvest is lost every year for a variety of reasons, from transportation to storage to consumer waste.

The project's work is focused on Bangladesh, Ethiopia, Ghana and Guatemala. Major crops being studied include wheat, maize, sesame and chickpea.

Surveys with smallholder farmers in those countries indicate the major causes of food loss are weather, termites, theft, rodents, and insects in fields and storage bins.

Kansas State University and Oklahoma State University faculty have traveled to the host countries to help lead projects that include international universities and U.S. government agencies. Some of the research planned in the next two years:

- Identifying insects causing food losses.
- Employing low-cost microchip-based sensors for measuring grain moisture.
- Drying techniques for stored grain, including greenhouse drying and solar drying.
- Proper storage techniques, including bags that help prevent infestations.
- Determining proper clothing when applying pesticides.
- Identifying farmers' trusted information sources.

Sustainable Intensification

At $50 million, the Feed the Future Innovation Lab for Sustainable Intensification is the university's biggest USAID award. The grant was received in fall 2014 for work in Cambodia, Bangladesh, Senegal, Burkina Faso, Tanzania and Ethiopia.

Sustainable intensification means producing more food and nutrition on the same land base while protecting the natural resources on which the food system depends.

Here's what Kansas State University has done since being awarded the funds:

- Renovated space in Waters Hall and hired four staff members on campus. The project also has hired three regional coordinators in Bangladesh, Senegal and Tanzania.
- Began a process to select a university to lead the Appropriate Scale Mechanization Consortium, which will identify the appropriate tools to help small landholders in the focus countries.
- Initiated the Geospatial and Farming Systems Consortium, which uses satellite images and advanced technology to map land that is targeted for research in the focus countries.
- Conducted meetings with partners in the host countries to identify their research and capacity-building needs.

Project director Vara Prasad, professor of crop ecophysiology, said the information gathered so far will help to select U.S. and international universities for research awards, which will be announced soon.

"We are closely working with all of our partner institutions and USAID to ensure that all the objectives during the first year are met," Prasad said. "The project is on track, and we are excited to complete the establishment phase and move into research and capacity-building. It is truly a collaborative effort, with multiple national and international organizations working toward common goals of improving food and nutritional security of smallholder farmers."

By Pat Melgares, Communications and Agricultural Education

Robert Fraley discusses mitigating global challenges in inaugural Henry C. Gardiner Lecture

In the next 35 years, farmers will have to produce more food than the world has produced in its history, a challenge some are calling the greatest we've ever faced. But however daunting it may seem, Robert Fraley is optimistic.

Fraley, executive vice president and chief technology officer for Monsanto Co. who was part of a team of scientists to first genetically modify plants, spoke at the inaugural Henry C. Gardiner Lecture at Kansas State University in January. Fraley addressed the challenges facing agriculture in the coming decades.

"What excites me is a world in which we are smart about our innovation and take a bold step forward and use science," Fraley told the more than 1,000 people attending at McCain Auditorium.

Farmers, who account for less than 1 percent of the population, are expected to feed more than 9 billion people by 2050 while facing limited resources and changing climate conditions. Despite the challenges, Fraley pointed out that the agricultural industry has already made advances in increasing production because of two major breakthrough areas: biology and information technology. It is advances in biology that help scientists breed crops. And increased accessibility of technology — especially for smallholder farmers — is improving the efficiency of agriculture, he said.

However, Fraley doesn't leave genetically modified organisms, or GMOs, out of the equation. Fraley said these organisms, designed to withstand factors like climate and pests, have been consumed for 20 years and that every major scientific body and regulatory agency in the world has concluded GMO products are safe.

The lecture series was established in honor of Henry C. Gardiner, a Kansas State University graduate who was a visionary leader in the U.S. cattle industry. The purpose of the lecture series is to bring leaders in global food systems from throughout the world to the university to present their views and provide a forum for open discussion.

"As the first lecture in the series, it was a spectacular success," said John Floros, dean of the College of Agriculture and director of K-State Research and Extension. "I hope to follow up next year with another speaker as compelling."

By Lindsey Elliott, Communications and Marketing

Scaling up

University and city developing the North Campus Corridor for research, education, training

Kansas State University and Manhattan, Kansas, are quickly establishing themselves as a nexus for food and bio-/agro-defense research and expertise.

The north section of the university's Manhattan campus houses the Biosecurity Research Institute, the colleges of Veterinary Medicine and Agriculture, the Grain Science Complex, the Kansas Department of Agriculture, and the upcoming National Bio and Agro-defense Facility, or NBAF — the U.S. Department of Homeland Security's foremost animal disease research facility — among several other world-class research facilities. Together, the region is a powerhouse for crop protection, animal health and food safety research.

Kansas State University and the city of Manhattan are working together to integrate the current and future development of facilities and infrastructure in this region of the campus through the North Campus Corridor Project. The corridor will serve as a hotspot of research, education and professional training. It networks the research facilities with the university's academic, intellectual property and athletic facilities as well as with future startup companies renting office and lab space in the corridor.

The North Campus Corridor is as much about research as it is about training students who will be the next generation workforce and helping grow the state's economy, said Ruth Dyer, senior vice provost for academic affairs and chair of the North Campus Corridor Task Force.

"We're looking at the future needs of the university and the region and how we can address those needs with the North Campus Corridor," Dyer said. "The collaboration between the university and the city has been instrumental in creating a plan that will maximize the opportunities in the North Campus Corridor."

In part, the traditional research park model is changing, said Dyer, who recently attended a national meeting for land-grant universities. At the meeting, representatives from several universities with research parks discussed the challenges of static infrastructure as well as the parks' distance from campus.

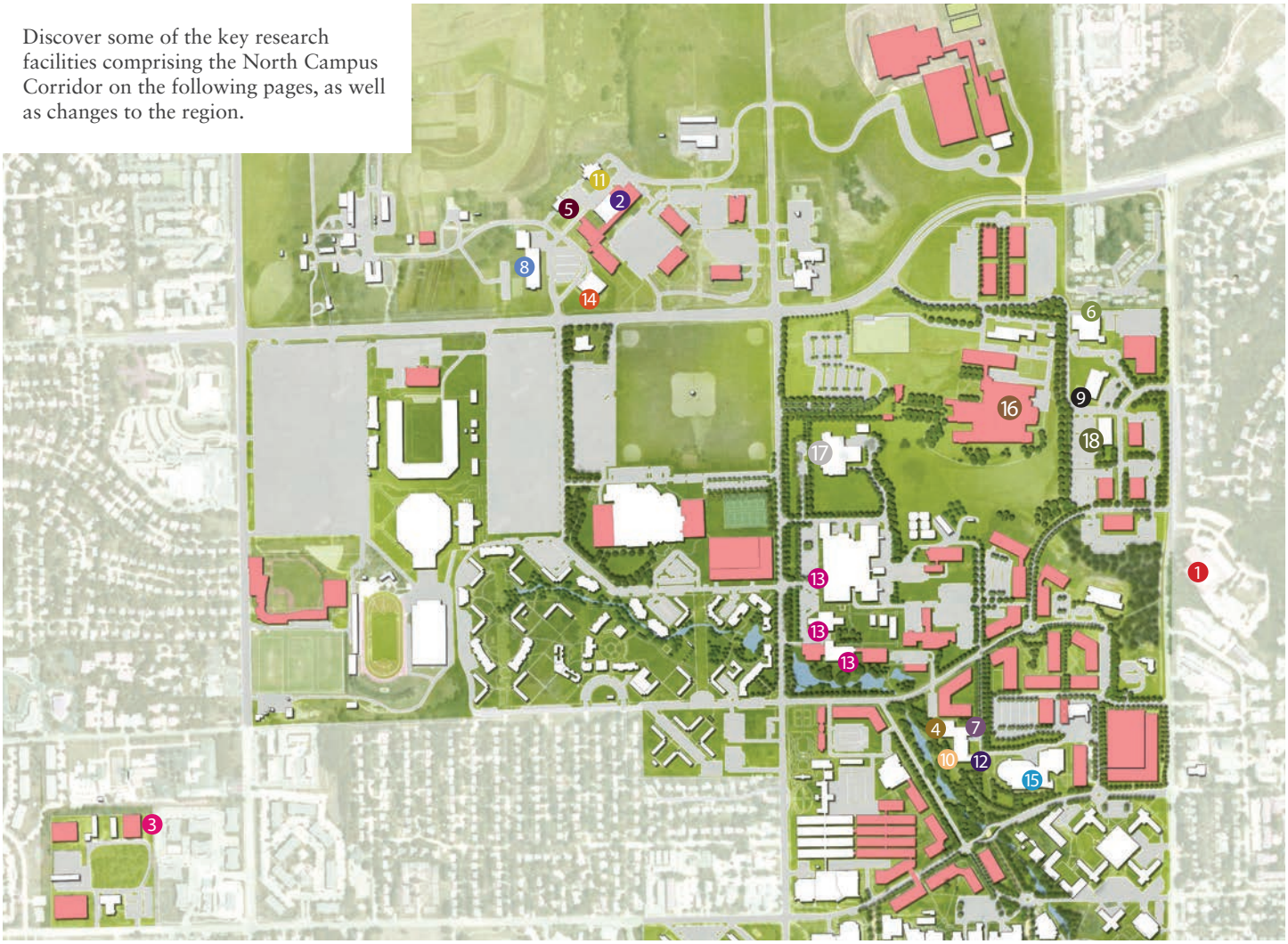
"We are pursuing a slightly different model than what has been used in the past at other universities," Dyer said. "What is being designed here is a concept that facilitates shared resources, space and knowledge across multiple colleges, disciplines, facilities and partners. It also provides rental space and labs for some of the startups and entrepreneurs that NBAF will attract and space for students to intern with companies."

One of the more unique components of the North Campus Corridor is there is more than 1,700 acres of agricultural land adjacent to the northern edge of the corridor. While this land is not what may be considered as traditional lab space, the land serves as the research space for plant sciences and livestock.

"These acres of agricultural land are the research space for many faculty members in the colleges of Agriculture and Veterinary Medicine," Dyer said. "The university sees this land as a treasure and and a piece of who we are as a land-grant institution."

A bird's-eye view of the North Campus Corridor with descriptions of the facilities is on page 10.

Discover some of the key research facilities comprising the North Campus Corridor on the following pages, as well as changes to the region.



The North Campus Corridor is a nexus of research, innovation and education for Kansas State University and the city of Manhattan. Upcoming facilities are in colored in coral while existing facilities are colored in white.

1 AIB International

AIB International is a nonprofit founded by the North American wholesale and retail baking industries as a technology transfer center for bakers and food processors.

2 Bioprocessing and Industrial Value Added Program

The lab specializes in the development of biomaterials processing technology and using agricultural-based materials to produce higher-value products for economic development. It is part of the 16-acre Grain Science and Industry Complex.

3 Center for Grain and Animal Health Research

The U.S. Department of Agriculture's Agricultural Research Service Center for Grain and Animal Health Research is the only USDA research laboratory in Kansas. Located near the Kansas State University Manhattan campus, the center conducts research and develops innovative technologies to solve soil erosion, the production and storage of grain, and arthropod-vector animal diseases. The center is comprised of five research units.

4 Dairy Processing Plant

This plant is part of the Food Science Institute and is equipped to produce a variety of dairy products as well as for pasteurization, homogenization, churning, condensing and ultrafiltration of dairy foods. The dairy facility can be used for the manufacture of new products and study new ingredient functionality.

5 Hal Ross Flour Mill

The mill is a leading pilot scale flour mill used for teaching, research and industry training. It contains the same full-scale equipment and control systems used in the commercial flour milling industry. It is part of the 16-acre Grain Science and Industry Complex.

6 Manhattan/K-State Innovation Center

The Kansas State University Institute for Commercialization, or KSU-IC, and the Kansas State University Research Foundation, or KSURF, work together to help university researchers take their ideas and inventions and make them profitable. The foundation handles researcher disclosures and the patent process, and the institute works with companies to license the new technology.

7 Kansas Valued Added Foods Lab at Call Hall

This lab offers food-related businesses, processors and entrepreneurs numerous services, including assisting in new food production; conducting shelf life tests; reviewing product labels; and generating nutritional information. The lab is part of the Food Science Institute.

8 Kansas Wheat Innovation Center

The center was built by the Kansas Wheat Commission on land owned by the university. The center houses Heartland Plant Innovations and the university's Wheat Genetics Resource Center — initiatives focused on developing new technologies for wheat farmers.

9 Mary and Carl Ice Hall

The hall is laboratory space for several of the College of Human Ecology's larger-scale research projects. These projects include the Programs for Workplace Solutions, the Personal Financial Planning Clinic and the Sensory Analysis Center — an internationally recognized research institute skilled in consulting, project management, method development, educational sensory and consumer research — among others.

10 Meat Science Facility at Call Hall

With a mission of meat science research and teaching, the facility provides educational and technical support for meat processors and entrepreneurs in areas such as product safety, meat processing regulations and quality control techniques. The lab is part of the Food Science Institute.

11 O.H. Kruse Feed Technology Innovation Center

The newly constructed feed technology innovation center is a world-class facility focused on addressing the needs of the livestock feed industry. Areas of focus include the science of feed processing, pet food development and grain handling. It is part of the 16-acre Grain Science and Industry Complex.

12 Thermal Processing Lab at Call Hall

The lab's focus is educating food processors, evaluating larger-scale food formulations, and providing training experience with processing equipment. The lab also works with processors to develop new products, test thermal processes and scale up operations to market test-size batches.

13 Veterinary Medicine Complex

The complex includes the Kansas State Veterinary Diagnostic Laboratory, the Veterinary Health Center and the Center of Excellence for Emerging and Zoonotic Animal Diseases, or CEEZAD, a U.S. Department of Homeland Security laboratory headquartered at Kansas State University, develops innovative countermeasures against high-priority foreign, emerging and zoonotic diseases that threaten human and animal health.

14 Grain Science Center/IGP Institute

The IGP Institute serves and supports Kansas and U.S. farmers in promoting the export and use of their wheat, corn, soybeans and grain sorghum with customers around the world through outreach, research and education. The building also houses several leading grain science research laboratories.

15 Weber Hall

The university's animal sciences and industry department is one of the largest in the U.S. It focuses on food and animal product safety, quality, security, production and management.

16 National Bio and Agro-defense Facility

The National Bio and Agro-defense Facility, or NBAF, is the U.S. Department of Homeland Security's foremost animal disease research facility. The $1.25 billion facility is a biosafety level-4 laboratory that will research emerging, high-consequence livestock diseases. NBAF is expected to be fully operational by 2022 or 2023.

17 Biosecurity Research Institute

The Biosercurity Research Institute, or BRI, at Pat Roberts Hall is a biosafety level-3 and biosafety level-3 agriculture facility that focuses on high-consequence animal, plant and foodborne pathogens that threaten agriculture and human health. The BRI also offers BSL-3 laboratory training and is equipped with large animal holding pens.

18 Kansas Department of Agriculture

The Kansas Department of Agriculture, or KDA, is the nation's first state department of agriculture and is dedicated to providing support for agriculture in Kansas, including farmers, ranchers, food establishments and agribusiness.

Unyielding

Researcher explores plant genomes to breed improved wheat varieties

The wheat that forms the basis of a tasty pasta dish today was domesticated nearly 10,000 years ago from wild grass. Eventually, these early cultivars, or breeding lines, spread to diverse regions around the world. These early wheat cultivars are helping researchers at Kansas State University develop new wheat varieties that are tolerant to changing climatic conditions.

Eduard Akhunov, associate professor of plant pathology at the university, has been investigating wheat genetic diversity for six years. Akhunov collaborates with a team of researchers from around the world in the search for specific wheat lines that are adapted to harsh environments.

"We analyze wheat lines that have been bred for many years around the world," Akhunov said. "People grew them in specific environments because they are very well adapted. This creates a unique opportunity to find new, useful genes that enable these wheat lines to grow in heat- or drought-prone conditions, or in the presence of pathogens."

For example, in 2013, Akhunov and his colleagues identified a gene that gives wheat resistance to a deadly race of Ug99, a wheat stem rust pathogen. Akhunov said that the goal is to find specific wheat lines that have these useful properties. Once they are pinpointed, researchers can begin crossing these lines with modern cultivars that currently grow in Kansas or in other regions.

Akhunov finds these genes by studying the sequences of multiple wheat genomes received from germplasm repositories around the world. This sequence-based approach leads to useful information without having to interbreed these wheat lines with local Kansas cultivars. For some traits — like drought and heat tolerance — it is impossible to simply bring in the wheat varieties from other parts of the world, plant them in Kansas, and deduce if these lines will be useful for breeding.

"If you bring wheat from the Middle East and try to grow it here, you would get a very poor product because it isn't adapted to the Kansas environment," Akhunov said. "Even if you plant a Kansas cultivar in Nebraska or Texas, it will develop completely differently. Instead, we study genetic diversity using technology that allows us to sequence all genes in the wheat genome."

The samples Akhunov studies all have a known geographic origin and are connected to the location's historic climate data. Researchers take isolated DNA from these samples and compare them against each other.

"When you compare genomic sequences, you're actually looking at genetic mutations in the genetic code that are enriched in the regions that show extreme climatic conditions," Akhunov said.

For example, if a group of lines grows successfully in a heat-stressed environment, the researchers can look at the mutations within that genome. If mutations are found frequently in these adapted lines, it could be deduced that these mutations make the wheat lines better adapted to this heat-stressed environment.

Akhunov said they create a catalog of mutations for a large number of wheat lines across the world. The project currently involves approximately hundreds of wheat lines from around the world and millions of mutations. To analyze these vast amounts of data, Akhunov uses the university's Beocat computer cluster.

"All our work is done on campus," he said. "In addition to computing resources, we're also lucky to have the Integrated Genome Facility just down the hall that has equipment for DNA sequencing. Just being able to process and analyze this data is a great success. The amount of DNA in a wheat genome is nearly six times greater than in the human genome. It takes a lot of time to analyze."

In spite of the seemingly never-ending job of data analysis, Akhunov and his team are continuing to expand their work. The next step is utilizing a technology that Akhunov, fellow Kansas State University researchers and industry developed that allows them to analyze genetic variations from grass species that are related to wheat. They collaborate on this project with the university's Wheat Genetic Resource Center.

"Species of certain grasses are related closely to wheat," he said. "We can crossbreed them with wheat and bring this exotic diversity into breeding programs. Many useful genes, including drought- and disease-resistance genes, are found in these grasses, so this could be an effective way of controlling wheat-killing diseases or yield losses."

Akhunov's wheat genetics projects are funded by the Kansas Wheat Commission, the U.S. Department of Agriculture, the National Science Foundation and the university. All support contributes to the project's overall goal of learning how plants adapt to their environments.

"When we understand the mechanisms, we can learn to predict if a wheat variety will be able to adapt or not," Akhunov said. "There will always be screening involved, but it will become a more precise science."

By Megan Saunders, Communications and Marketing

"People have to eat, and the grocery store is the cornerstone of a community," said Pam Budenbender, store owner. "Statistically, when rural grocery stores fail or close, the town dies."

Talk of the town

Rural Grocery Initiative feeds small communities

When the sole grocery store in Onaga, Kansas, burned down in 2010, the town lost more than a community hub. The 800 residents also lost their local source of food: The nearest grocery store was a 50-mile round trip.

Pam Budenbender and her husband, Paul, took action. They gathered funds, partnered with food distributors and built Onaga Country Market, an invaluable source of fresh food for the local community.

"People have to eat, and the grocery store is the cornerstone of a community," said Pam Budenbender, store owner. "Statistically, when rural grocery stores fail or close, the town dies."

People like Budenbender — along with Kansas State University's Rural Grocery Initiative — are keeping small towns alive by investing in rural grocery stores.

The Rural Grocery Initiative, part of the university's Center for Engagement and Community Development, aims to create new models for rural business development and sustainability.

"These small food businesses are anchor institutions," said David Procter, director of the Center for Engagement and Community Development. "They are important sources of jobs and local taxes as well as the primary place for healthy food in the community."

Since 2007, the initiative has worked with rural communities — those with populations less than 2,500 people — to help current grocery stores stay open or to help build new stores. The initiative has helped launch or sustain multiple stores in the Kansas towns of Plains, Morland, Minneola and Protection.

The initiative also has aided rural communities in more than 25 states as they improve access to healthy foods.

"We're now talking about grocery stores in terms of their connection to farmers markets and local growers," Procter said. "The initiative has changed from a focus strictly on grocery stores to the bigger issue of getting more healthy food into small towns."

The Rural Grocery Initiative continues to support small communities through several new resources and research projects.

- The Rural Grocery Store Summit is a biennial meeting where store owners can network and discuss issues, challenges and solutions. The 2014 summit included Kansas rural grocery store owners like Budenbender as well as owners from more than 15 states.
- The initiative provides a rural grocery toolkit, which is a resource for current grocery store owners as well as people considering establishing a grocery store. The toolkit contains a variety of links with information on assessing the market, funding, legal licensing and regulations.
- Several U.S. Department of Agriculture, or USDA, grants are helping the Rural Grocery Initiative identify the challenges that store owners face as well as identify different ownership models, including cooperative stores, community-owned stores, nonprofit stores or sole proprietorships.
- A collaborative $500,000 USDA grant focuses on two interventions — a nutrition education program and a new food labeling system — to help customers fill their shopping carts with healthier foods. The food labeling system adds nutritional value, or NuVal, scores to shelf labels. The NuVal scores range from one to 100, with more nutritional food containing labels closer to 100.

  "We want to increase the purchase of healthy food by customers," Procter said. "Ultimately, we hope that the grocery store will purchase more healthy foods, which can improve the overall health profile of the store and the community."

  The grant also involves the university's agricultural economics and human nutrition departments as well as K-State Research and Extension and the University of Minnesota Extension Service.

By Jennifer Tidball, Communications and Marketing

Photo provided by Justin Kastner, Frontier program.

Experiential learning takes students to a new Frontier

Ensuring a safe and healthy food supply for the world's growing population requires preparing highly skilled leaders ready to meet this challenge.

That need is the focus of Kansas State University's Frontier program, which provides multidisciplinary training and experiential learning to students interested in becoming scholarly, thoughtful global food systems leaders. Program alumni have gone on to work in government — including the U.S. Food and Drug Administration and Kansas Department of Agriculture — and in agri-industry at companies such as Cargill.

"From Los Angeles to Boston, the Frontier program increased my multidisciplinary breadth over facets encompassing the food industry and beyond by providing a unique educational atmosphere. This atmosphere developed my scholarly and occupational identities through experiential learning, networking with other students, and skill-development workshops. I discovered the vastness of the food industry through experiential learning."

— Megan Kulas, Frontier alumna who now works at the U.S. Food and Drug Administration

Now, with a Global Foods System Innovation Grant from the university, the Frontier program will focus on a Kansas pipeline of global food systems leaders with the education and outreach project "Experiential, Multidisciplinary Career-Development Investment for Kansas."

"This project will innovatively cultivate multidisciplinary breadth in current and future Kansas-based members of the global food systems workforce," said Justin Kastner, program director and an associate professor of food safety and security at Kansas State University. "Global food system employers want skilled graduates and career-development pipelines and job preparation — and that's what we're doing at the Frontier program."

Kastner and Jason Ackelson, a political scientist and an adjunct faculty member in diagnostic medicine and pathobiology at Kansas State University, created the Frontier program in 2004. Ackelson is the program's co-director.

Frontier's successful field trips and experiential learning components will be part of the new Kansas initiative. To date, more than 200 students have gone on Frontier field trips to meet with governmental and nongovernmental policy-making and policy-analysis groups in Washington, D.C., and to explore key ports of food entry across the nation. Also to be offered will be weeklong courses on a wide and multidisciplinary range of topics relevant to global food systems.

By Beth Bohn, Communications and Marketing

Beefing up the beef transport system

Electrical and computer engineering, psychological sciences, agricultural economics and veterinary epidemiology. These may not be the first disciplines you think of when it comes to solving issues in the beef industry, but a team of Kansas State University researchers believes the complex beef transportation system can be improved by using tools from their fields.

"The beef cattle industry and the transportation system are interdependent infrastructures," said Faryad Darabi Sahneh, research assistant professor of electrical and computer engineering. "When you add in the element of human behavior and decision-making, predicting what can happen becomes a very complex issue. This is why it's important to have a multidisciplinary approach to help cover all the angles.

Sahneh, along with Caterina Scoglio, professor of electrical and computer engineering; Gary Brase, professor of psychological sciences; Ted Schroeder, distinguished professor of agricultural economics; and Mike Sanderson, professor of diagnostic medicine and pathobiology, have been awarded a $60,000 Global Food Systems Innovation Grant to develop computational models to help mitigate potential threats to the beef transport system.

The researchers are collecting data on the movement of cattle and trucks and plan to use this information to create models that will predict potential vulnerabilities and ways to protect against them. One of the threats that will be evaluated is the possibility of an epidemic.

"An infected animal being transported to another area can spread the disease to other cattle without the producers knowing. And there are other ways of spreading disease, too," Scoglio said. "If a truck is going to pick up feed and the truck driver gets some mud containing a pathogen on his or her boots, clothing or truck wheels, the driver can unknowingly transport the pathogens to other locations and spread the disease."

The transportation of cattle from ranchers to feedlots to slaughterhouses has made the industry more efficient, but also has left the industry vulnerable. The researchers hope to find ways to reduce the infrastructures' susceptibilities, especially because of the effects it could have on the state.

"Agriculture and the cattle industry are a huge part of the Kansas economy, so if something negative happens to it, that's going to be bad for the entire state," Brase said. "It will hurt more than just the producers; it will raise the prices of beef at the grocery story and have an overall effect on the state economy."

It also will take more than just a model, Scoglio said. It will involve understanding the industry and the attitudes of producers and empowering them to make informed decisions. It's a job that will take more than just one expert.

"Kansas State University is a unique place for this kind of research," Brase said. "As a land-grant university, there's a lot of emphasis on actually getting your hands on real-world problems. We are always looking for ways to translate research into practical issues."

By Lindsey Elliott, Communications and Marketing




Budding opportunities

University tapping public, private industry to help meet increasing food demands

Kansas State University's Global Food Systems Initiative is leveraging the university's more than 150-year food and agriculture heritage, expertise and world-class research facilities to help meet the challenge of sustainably feeding a growing population that will reach 9.6 billion people by 2050 and double the global food demand.

The initiative, introduced by Kansas State University President Kirk Schulz in January 2014, creates future opportunities for the university and the state by building on the university's land-grant heritage in crop production and protection, animal health, food safety and food security, and leveraging that research and expertise to industry partners and entrepreneurs. These partners can quickly move new food-based technologies that address emerging food challenges to the marketplace.

"The great thing about the agricultural industry is that it has been around for centuries and a lot of the companies that are ingrained in the global food system itself have excellent pathways to the market," said Ken Williams, director of licensing at the Kansas State University Institute for Commercialization. "They have brand loyalty and they have a lot of different things that allow them to be successful. Trying to replicate that on your own as an entrepreneur can be tough; it's not impossible, but it can be tough."

Two initiatives in particular are helping develop public partnerships.

Launch a Business

Launch a Business is a program that provides entrepreneurs with access to university faculty and to alumni mentors who are operating successful businesses.

Chad Jackson, director of the Center for the Advancement of Entrepreneurship at the university's College of Business Administration, said that the program has doubled the number of entrepreneurs it is accepting into its five-week summer course, including 10 spots for those focusing on advancements in food and agriculture.

"In its first year, our program had a broad reach of entrepreneurs, and we'll continue that," Jackson said. "But the exciting thing is when you start to develop expertise for specific industries, the effect you can have goes up a notch."

Partnership with General Mills

Food giant General Mills Inc. recently formed a research agreement with Kansas State University to develop wheat varieties with improved nutritional

Estimated Total Spending by the Global Middle Class, 2030

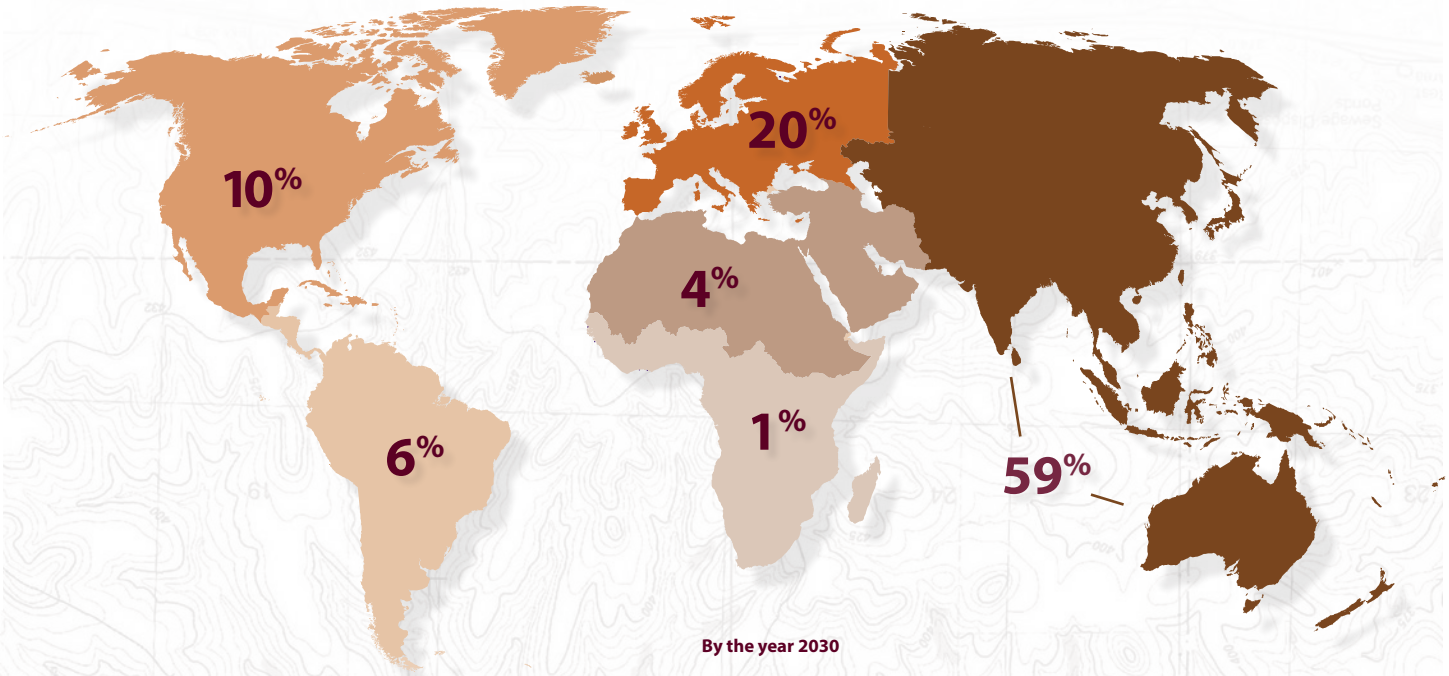
The percentages on the adjacent map indicate the estimated increase of each region's share of the world's food spending in 2030. It equates to $56 trillion in purchasing power.

Source: Organization for Economic Co-operation and Development Centre (2010).

milling and baking qualities. The project directs more than $400,000 toward wheat development projects at the university.

"The expectation is that Kansas wheat farmers will benefit directly from this research," said Jesse Poland, assistant professor of plant pathology and director of the Feed the Future Innovation Lab for Applied Wheat Genomics. "Through these projects, we are focused on developing and delivering wheat varieties with superior quality that may be grown in high-value, contract acres."

By Kelly Hannigan, senior in agricultural communications and journalism



By the year 2030

FOOD TECHNOLOGIES REQUIRE CONSUMER ACCEPTANCE

RESEARCHERS STUDY RNA INTERFERENCE IN PLANTS AND ANIMALS TO IMPROVE FOOD EFFICIENCY WHILE UNLOCKING PUBLIC PERCEPTION

The unpredictability of Mother Nature often requires crops to deal with changing weather patterns, such as excessive moisture one month and drought the next. Scientists develop new varieties that can adapt well to a particular weather extreme, but creating a variety that acclimates to all becomes a greater challenge.

Consider the numerous metabolic disorders or even viruses that plague living things. Because antibiotics only help combat bacterial infections, livestock and humans typically rely on a strong immune system to feel better.

A technology developed in the last two decades called ribonucleic acid interference, or RNAi, could help overcome these and many other challenges. Scientists from multiple disciplines at Kansas State University are working together to determine how to use RNAi to more efficiently produce food from plants and livestock.

Barry Bradford is an associate professor of animal sciences and industry and primary investigator on the project. He said as an example in animals, the complex process would first require identifying a protein encoded by a gene that is causing a problem, with the goal to suppress that protein in a certain organ, such as the liver.

Fatty liver syndrome in cattle could be one such problem addressed by RNAi. It occurs when a cow breaks down too much fat for the liver to process and the leftover fat in the liver becomes toxic.

Computer software determines what RNA molecule to build that will bind to the problem protein and eventually silence it. Bradford said the computer algorithms are precise and provide a sequence that will only knock down one of the 25,000 or more proteins produced in an organism.

A nanoparticle is formed when a protective shell is built around and bound to the double-stranded RNA. Scientists would then place the nanoparticle in the animal's bloodstream, where it would go to the targeted organ and complete its task of silencing the protein.

Bradford, who has been working on RNAi as a Fulbright senior scholar in Australia, said the process is not any more invasive than giving the animal a traditional drug and is more targeted. It also does not involve genetic modification.

"A benefit would be you don't have to worry about a drug their body has to get rid of," Bradford said. "You have a nanoparticle, but RNA is always in the body in billions of copies. You are introducing a different code to a natural compound already in the body."

Because the technology is new and is still being developed, consumers might have questions and concerns. Scientific feasibility alone does not mean the technology will work, which is why Glynn Tonsor, associate professor of agricultural economics at Kansas State University, is on the study to analyze the consumer aspect.

"There is benchmark science at the front of this, but we also have to understand if the public is going to accept this technology," Tonsor said.

Tonsor plans to analyze consumer perceptions of RNAi in the form of meat products that might come from it. For example, he wants to know if a consumer would purchase a steak or ground beef from an animal that experienced RNAi.

The RNAi project was funded through the university's Global Food Systems initiative and includes nine faculty from the College of Agriculture, College of Veterinary Medicine and College of Arts & Sciences.

By Katie Allen, K-State Research and Extension

Early detection

Researchers develop detection test for subclinical mastitis in dairy cows

Each day Mike Scheffel's 608 Holstein cattle produce about 24,000 gallons of milk. Scheffel, manager of Kansas State University's Dairy Unit, has been working on dairies since age 12. Throughout the years, he's seen one of the constant challenges facing dairy producers: mastitis in the dairy cows.

"Every dairy deals with mastitis," said Scheffel, who also is a research assistant in animal sciences and industry. "That's the nature of the operation. We've been very fortunate here and have preventative steps to recognize the early symptoms, but it's a problem that's always present at a dairy."

Mastitis is a disease that inflames and eventually scars the udder tissue of dairy cows. This reduces a cow's milk production and alters the milk composition. Mastitis costs the U.S. dairy industry more than $2 billion annually. Fast and early detection could help dairy producers reduce transmission to other cows in the dairy operation.

Kansas State University researchers Deryl Troyer, professor of anatomy and physiology, and Stefan Bossmann, professor of chemistry, developed a test that can positively identify mastitis in dairy cattle earlier and for less cost than current technologies on the market.

"The classical mastitis tests estimate the numbers, not the activity, of neutrophil cells, which are the dominant cells that travel to the inflamed udder during mastitis," Troyer said. "Many times early and emerging cases of mastitis are not caught by the tests because they count the numbers rather than the activity. These are often the most important cases to catch."

The test uses the duo's nanoplatform technology that can quickly detect cancer cells and tumors before physical symptoms ever appear. Several enzymes that cause inflammation in human cancers also cause inflammation in the udder of the dairy cows.

"We looked at about 30 enzymes and identified three that are highly indicative of mastitis," Bossmann said. "These three enzymes and this nanoplatform make it possible to detect preclinical mastitis cases that have high enzymatic activity but a low somatic cell count. These cases were previously undetectable, so there was not a test on the market for this combination."

To test for mastitis, a sample of pasteurized milk is put into a buffer solution containing the enzyme-detecting nanoplatform. The nanoplatform consists of iron nanoparticles coated with amino acids and a fluorescent dye. The amino acids and dye interact with enzymes in the milk. The sample is incubated for up to 30 minutes and then examined for three enzymes that cause mastitis.

Recent tests in the Troyer and Bossmann laboratories have detected subclinical mastitis in less than five minutes.

Researchers say their mastitis test could be used today by large-scale dairies and eventually by robotic dairy facilities.

Additional collaborators include Scheffel; Gregg Hanzlicek, assistant professor of diagnostic medicine and pathobiology and program director for the Kansas State University Veterinary Diagnostic Laboratory; Luis Mendonca, assistant professor of animal sciences and industry; Tej Shrestha, senior scientist of anatomy and physiology; Madumali Kalubowilage, chemistry doctoral student, Sri Lanka; Thilani Samarakoon, former postdoctoral researcher; and Samie Milligan, Heart of America Dairy Herd Improvement Association.

Kansas ranks 16th in the U.S. for milk production. It produces nearly 3 billion pounds of milk annually. Dairy is a more than $5.4 million industry in Kansas.

By Greg Tammen, Communications and Marketing

Good to the LAST DRIP

Researchers are evaluating irrigation technologies to help farmers

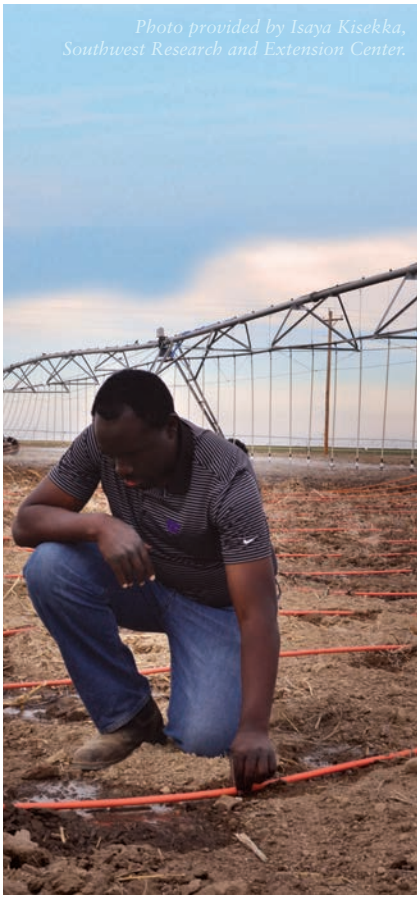


Photo provided by Isaya Kisekka, Southwest Research and Extension Center.

Kansas State University researchers are evaluating different irrigation technologies to help farmers determine the best method for irrigating their cropland under water-limited conditions.

Isaya Kisekka, assistant professor of irrigation and agricultural water management, and her colleagues at the university's Southwest Research and Extension Center in Garden City, Kansas, are researching mobile drip irrigation, or MDI.

Initial work on mobile drip irrigation technology can be traced back to the early 1980s, but it has not gained much in popularity. Continued drought and groundwater depletion along with technological advances in drip line emitters, water filtration and planting equipment — such as tractors with GPS and autosteer for planting crops in circles, which is critical to using mobile drip irrigation — might increase acceptance of the irrigation method among producers.

"Lately there has been a renewed interest in MDI," Kisekka said. "The combination of declining groundwater levels coupled with frequent droughts has many farmers concerned in the south and central High Plains."

The researchers, in collaboration with private industry, the Kansas Water Office and Kansas State University's Global Food System Initiative, are looking at the viability of mobile drip irrigation in comparison to another commonly used technology called low elevation

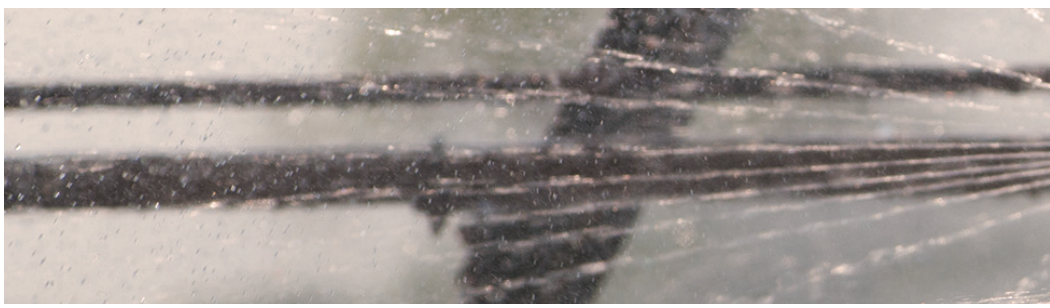


Photo provided by Isaya Kisekka, Southwest Research and Extension Center.

spray application, or LESA. Both may help farmers save money and conserve water.

"We hope that technologies such as MDI will slow the transition from irrigated agriculture to dryland farming, which would have a significant socio-economic influence on many rural communities and the state as a whole," Kisekka said. "The new version of the technology involves accessories that let the spray and drip line be connected to the same drop hoses, which allows the flexibility to use sprays for enhancing germination and for herbicide incorporation."

Mobile drip irrigation combines the mobility and economic benefits of center pivot irrigation — a large sprinkler system on wheels — and the water conservation benefits of drip irrigation. Low elevation spray application uses a center pivot system with spray nozzles a few feet from the ground.

According to Kisekka, sprays are needed to ensure germination in dry years and for incorporating herbicides and fertilizers. In addition, the drip irrigation can reduce evaporative losses to center sprinklers and is relatively inexpensive to retrofit an old sprinkler system to mobile drip irrigation.

The researchers planted corn in May at the university's Southwest Research and Extension Center. They will be collecting data to compare mobile drip irrigation to low elevation spray application in summer 2015. They will compare yields, water productivity, biomass, evaporation losses and application efficiency, and do an economic analysis.

"The lack of data on the MDI technology is the reason we are conducting this research," Kisekka said. "We can scientifically quantify yield benefits, if any, and potential water saving of this technology compared to LESA."

In addition to Kisekka, the team of researchers includes Jonathan Aguilar, assistant professor and extension water specialist; John Holman, associate professor and cropping systems agronomist; Randall Currie, associate professor of weed science; Bill Golden, research assistant professor of agricultural economics; and Sarah Zukoff, assistant professor of entomology.

By Stephanie Jacques, Communications and Marketing

Photo provided by Dan Donnert, K-State Research and Extension.

Have your cake and eat it, too

Novel starch makes processed foods healthier

The old saying is confusing, because why would anyone who has cake elect not to eat it? Some have argued that the order should be reversed to clarify the relationship: After you eat your cake, you can no longer have it, because it's gone.

But regardless of order, afterward, the real problem begins: Your blood sugar rises rapidly because of the easily digestible starches that cake and other processed foods contain. These starches contribute to obesity, diabetes and colon cancer.

Kansas State University researchers have found a way to make processed foods healthier by producing resistant starch, or starch that can't be digested by the stomach and small intestine.

> If people are going to make the less healthy decision, why not make those things healthier?

"We are trying to understand the structure of starch and how it's related to digestibility, and then use technology to manipulate the structure and change digestibility," said Yong-Cheng Shi, professor of grain science and industry.

Postdoctoral researcher Michael Sweedman said the starches have many applications in foods like white bread and cookies and "anything where you want functional fiber in products, but you don't want the textural properties that come with more traditional forms of fiber."

A patent is pending on the process that creates resistant starches. Commercial food ingredient companies are interested in licensing the technology, which requires no nonfood chemical additives and meets niche dietary requirements, such as vegan, vegetarian, kosher and halal.

"We are carefully controlling crystallization conditions," Shi said.

Water, enzymes, and heating and cooling are all that's required to manipulate the starches, and the process is high-yielding. Increasing the proportion of resistant starches results in foods with a lower glycemic index. An additional benefit is that because resistant starch escapes digestion in the small intestine, it is fermented in large intestine.

"The colon is like a large fermentation tank," Sweedman said, "and bacteria need to be fed."

When we eat high glycemic index food, it is digested and absorbed in the bloodstream before it gets to the large intestine, and bacteria don't get the food they need. That means bad bacteria proliferate.

"Fermentable material needs to get through," Sweedman said.

Human clinical trials demonstrated a positive glycemic response, and results raised questions about measuring the glycemic index that will ripple through the human nutrition community. An additional application for the product may be as a coating on pills that ensures ingredients survive long enough to be absorbed. Shi and Sweedman are also working on ways to scale up production to make it suitable for a commercial environment, which may entail another patent.

So should we be encouraged to eat the cake?

"People should eat better food, but the fact remains that many of us still choose for whatever reason — price, shelf life or just texture-flavor profile — processed foods over the more fresh traditionally healthy foods," Sweedman said. "If people are going to make the less healthy decision, why not make those things healthier? You can make those sweet, processed foods healthier for people, and you get the best of both worlds."

By Sarah Caldwell Hancock, Office of the Vice President for Research

KANSAS STATE UNIVERSITY
Office of Vice President for Research

105 Anderson Hall
919 Mid-Campus Drive North
Manhattan, KS 66506
223-001

- As the nation's first operational land-grant university, Kansas State University has more than 150 years of expertise in animal health, plant science, food safety and food security.
- More than $192 million in active funding has been awarded to Kansas State University for research related to global food systems since 2012.
- Kansas State University is home to the four newest Feed the Future Innovation Labs from USAID.
- In 2014, Kansas State University helped produce 15 wheat varieties for Kansas' more than 9 million acres of wheat fields.
- Kansas State University is the only U.S. university invited to join the Plant Biosecurity Cooperative Research Center. The center is a consortium of several of Australia and New Zealand's leading governmental research institutions and universities. Kansas State University and Australia share similar agricultural systems and concerns about emerging diseases and insect pests.
- The U.S. National Research Council ranks Kansas State University's department of plant pathology and its program as No. 1 in the nation among 162 plant pathology departments.