# Building for the Future

## 2017 Annual Report

Kansas State University | College of Agriculture

K-State Research and Extension

# Introduction

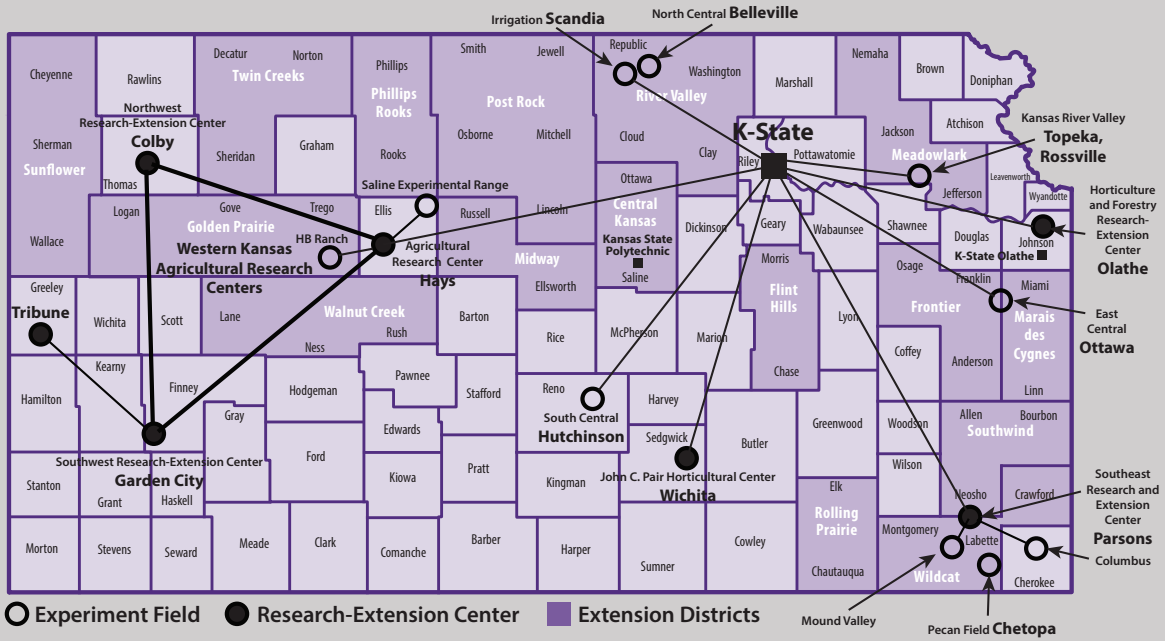
## How we benefit Kansas

K-State Research and Extension serves as the front door to Kansas State University, the state's land-grant university. We provide trusted, practical education to help individuals, businesses and communities solve problems, develop skills and build a better future.

The College of Agriculture prepares students for productive lives that contribute to agriculture, society and the economic competitiveness of Kansas.

Our statewide network encompasses faculty at three campuses, extension professionals in every county through our 16 districts and 60 county offices, and five research-extension centers. These educators share research-based information related to agriculture, youth development, family life, healthy living, business, economics and much more. We partner with local, state and federal agencies to help the agencies accomplish their goals. Our vision is to be a top-five college of agriculture and a global destination for education, research and extension.

This report highlights the work we are doing in research and extension to develop healthy communities, families and youth, as well as a sustainable, competitive agricultural system.




Agricultural research facilities are located throughout the state to accommodate climate and soil variability.

## KANSAS AGRICULTURE STATISTICS

*Largest employer*

**234,726**

*Largest exporter*

**$3.3 billion**

*Contribution to Kansas economy*

**43%**

Provided by Kansas Department of Agriculture

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## Grand challenges

During a strategic planning process with our stakeholders, K-State Research and Extension identified five grand challenges facing every Kansan: global food systems, water, health, community vitality and developing tomorrow's leaders. Our efforts in research and extension focus on addressing these challenges to help better our state, country and world.

# Global Food Systems

**The world's population is expected to reach 9.6 billion by 2050. To feed and sustain a growing population, we develop innovative practices that benefit Kansas, our nation and the world. Through cutting-edge research in areas such as genetics, disease prevention and food security, we help agriculture — Kansas' largest employer — be more profitable, sustainable and efficient.**

**10 million**

*bushels of certified Jagger wheat sold in Kansas since its release*

**30,000**

*fungi strains in Fungal Genetics Stock Center*

## *Wheat-breeding expertise assures quality year after year*

With a name befitting its place at the summit of Kansas agriculture, the K-State-produced wheat variety called Everest just completed its fourth year as the top variety planted across the state — and the fifth time out of the last six years that a K-State variety has held the top spot. Everest was first released in 2009, and to have so many years of successful use is almost unheard of, according to Gary Pierzynski, head of the agronomy department.

"Wheat varieties don't last that long as their resistance to disease breaks down, and they have to be replaced continually," Pierzynski said. "We wouldn't expect Everest to remain the top variety for an extended period, but we're confident what we've released recently will be tops in a couple years' time."

In fact, Pierzynski says two new varieties of hard red winter wheat released in 2016, Larry and Zenda, have the potential to replace Everest.

K-State partners with the Kansas Wheat Alliance to continually ensure producers have access to seed that gives them the best yields and quality while keeping resources and research capacity within the state.

The long continuum of successful wheat breeding comes from K-State's decades of commitment to research and development. Guarong Zhang, wheat breeder at the K-State Agricultural Research Center in Hays, says each successful variety is released to the public only after years of proving its quality.

"Every year we develop and test about 1,000 new breeding lines," Zhang said. "Before releasing a line, it would have been tested for about 6 to 7 years. A breeding cycle, from start to end, takes 10 to 12 years."

Larry and Zenda are not the only varieties likely to win favor among producers over the next few years. Zhang expects the new hard red variety, Tatanka, to take the place of Joe, which won the 2016 wheat yield competition in western Kansas and set a record for state yield completion. Zenda is a descendent of Everest.

Tatanka and Larry are derived from Jagger, one of the most successful wheat breeds in the state's history. Though it is not seen much in Kansas fields anymore, Jagger marked 22 years of productivity in 2016.

The Kansas Wheat Alliance noted that at one point, Jagger was planted on virtually every acre in south-central Kansas and has gone on to be productive in 12 countries. Meanwhile, Jagger continues to have an impact as new varieties are developed from it.

Larry and Joe were named for longtime members of the K-State breeding team Larry Patton and T. Joe Martin. Everest was developed by Martin and Allan Fritz, a K-State alumnus who leads the wheat breeding team.

With a system of experts that spans the state, the breeding team carries forward the legacy of developing the right combinations of yield, drought tolerance, disease resistance and processing qualities.

**$2.4 billion**

*lost crop yield if weeds are uncontrolled*

**10 years**

*average wheat breeding cycle*

**622,530**

*seeds in Wheat Genetics Resource Center*

**80**

*wheat field days hosted*

# Global Food Systems

**77,450**

*dairy cows tracked monthly through Dairy Records Intelligence Network*

**$1.93 million**

*grants to do research and develop training to improve feed safety*

**92**

*countries downloaded K-State beef cattle research information*

## *USDA grant advances food safety, education*

An estimated 265,000 Shiga toxin-producing *Escherichia coli* (STEC) infections occur in the United States each year. Eating contaminated food or having direct contact with fecal matter from infected cattle causes most of these illnesses.

In 2012, the USDA National Institute of Food and Agriculture awarded a five-year, $25 million coordinated agricultural program grant to the University of Nebraska-Lincoln. More than 50 researchers from 11 institutions and the USDA Agricultural Research Service are collaborating on interrelated grant projects.

Kansas State University received $8.3 million of the total to support projects in multiple departments and colleges.

Randy Phebus, professor of animal sciences and industry, serves on the grant's executive management team and is the principal investigator for the K-State component. He also leads multi-institutional efforts toward the development and validation of antimicrobial technologies applied during beef processing to reduce STEC risks in raw and processed beef products.

Specific research projects that involve STEC-inoculated carcasses and mimic commercial-scale processing can only be conducted in K-State's Biosecurity Research Institute in Pat Roberts Hall.

Project goals include: reducing public health risks related to STECs in the beef system; providing scientific guidance to producers, processors, regulators and consumers to lower incidences of STEC in beef products; and recruiting and energizing the next generation of food safety professionals through degrees and training.

An advisory council offers industry and producer input for the multiple projects.

K-State's Office of Educational Innovation and Evaluation (OEIE) serves as an external evaluator for the project. OEIE tracks publications and presentations, surveys collaborators and collects data, which can be used by the management team to shift the project's focus if necessary. They also help gauge the impact of grant-generated research and educational programs.

Approximately 100 student interns from across the country are benefiting from STEC research, including several K-Staters. Amanda Wilder, food science master's student, earned at least $11,500 in scholarships related to her work with the STEC grant.

K-State alumnus Danny Unruh began his involvement in the STEC grant in fall 2012 as a master's student at the University of Nebraska-Lincoln, where he worked on characterizing destruction of different STECs by heat and high-pressure technologies.

"I wanted to return to K-State for my Ph.D., so I accepted an offer to work with Dr. Sara Gragg at the Olathe campus," Unruh said.

"The STEC project has shown me there are opportunities to make an impact anywhere — in industry, academia or government. I have learned the value of asking questions, networking and collaboration. I have seen firsthand that big-picture thinking and attention-to-detail are both important skills moving forward as a scientist in this field."

Phebus said there is still a lot of work to do. "The grant was recently extended through November 2017 to complete our research, education and outreach activities across all of our participating institutions.

"It will be a busy 2017 for our K-State team to conduct this research; prepare educational materials and courses derived from this grant; finish off the last batch of student interns; and meet our outreach goals to industry, consumers and youth audiences."

**9**

*regional meetings on Food and Drug Administration veterinary feed directives*

**407**

*individuals trained using FDA-certified curriculum developed by K-State team*

**100,454**

*average monthly visits to AgManager.info*

# Global Food Systems

**$38 million**

*saved following K-State pest recommendations on grain sorghum*

**37,194**

*soil and plant samples analyzed*

**982**

*people trained on pesticide safety and application techniques*

## *Agent's vigilance averts sorghum losses*

Monitoring crops and mobilizing experts saved southern Kansas sorghum producers millions of dollars in potential crop losses. Zach Simon, K-State Research and Extension agriculture and natural resources agent based in Sedgwick County, knew the sugarcane aphid was making its way toward Kansas from Texas and Oklahoma and that it would threaten sorghum crops once it arrived.

His vigilance paid off in 2015 when he identified the aphid in the field, confirmed its identity with an entomologist on the Manhattan campus and, "knew right away that we needed to inform producers of what was going on and how to try to manage this pest."

Simon, a recent K-State alumnus, immediately used every communication channel at his disposal — email, Facebook, Twitter and good, old-fashioned phone calls — to reach out to sorghum producers. Within 20 hours, 86 people from around the state gathered in a farmer's shed to learn how they could protect their crops.

Producers were able to speak with K-State entomologists who were on hand to share every bit of information they could about the pest. The experts wanted to ensure no one panicked and tried treating the pest too early, which could have caused more problems and compounded the economic damage.

The timely sharing of information led many producers to treat their crops effectively for the sugarcane aphid and benefit from a great growing season. Those who did not heed the warnings ended up with major crop losses.

Kent Winter, president of the Kansas Grain Sorghum Producers Association, said the number of bushels protected because of Simon's quick efforts was valued at $38 million.

## *Sorghum interests cooperate to promote growth*

As a global leader in sorghum research and promotion, K-State co-founded a unique coalition with industry leaders and producers. In early 2016, the Kansas Grain Sorghum Commission, United Sorghum Checkoff Program, Kansas Department of Agriculture and K-State formed the Collaborative Sorghum Investment Program.

The program focuses on expanding markets for sorghum and increasing the average national sorghum yield from 62 bushels per acre to 100 bushels per acre by 2025 by funding research in such areas as plant breeding, genetics and field-level management.

In terms of national rankings, Kansas is the No. 1 producer of sorghum, but in terms of statewide acreage and return, it ranks behind wheat, corn and soybeans.

K-State coordinates these efforts through the Center for Sorghum Improvement, which aims to achieve major advances because farmers have not seen private technology investments in sorghum for the last couple decades. Those advances will come from work currently being done in labs at K-State and in test fields across Kansas.

Along with seeking improvements on the front end of production, the center is also working on the back end: growing and opening markets for sorghum.

This includes building the case for more sorghum use in livestock feed, entering the $24 billion pet food industry and creating products for people that capitalize on food-grade sorghum as a gluten-free, low-glycemic index product high in antioxidants.

***Collaborative Sorghum Investment Program 2025 objectives:***

- **Develop an annual 1.25 billion bushel annual consumptive sorghum demand.**
- **Decrease value discount of sorghum relative to corn from today's 4.6 percent discount to no greater than a 2 percent discount.**
- **Increase national annual yield to 100 bushels per acre.**

**4**

***U.S. Agency for International Development Feed the Future Innovation Labs***

**$102 million**

***5-year total investment for USAID labs***

### Why Innovation Labs Matter

- **Research pest and disease resistance.**
- **Stimulate demand and open trade.**
- **Develop technologies, varieties and methodologies.**
- **Provide feedback on potential new markets.**

# Water

**Future generations of Kansans will need a reliable source of clean water. We develop and implement programs to help Kansans maintain and improve water quality and quantity. These include pioneering new practices and techniques; researching high-priority water issues; facilitating meetings among local, state and federal officials; and effectively communicating research results.**

**56**

***Mesonet weather data stations available throughout the state***

**22**

***Watershed Restoration and Protection Strategy (WRAPS) plans developed and implemented (2010-2016)***

## *Drop by precious drop: Researchers and farmers work together*

From Kansas City to Liberal, we're reliant on farmers to help grow the world's food supply and contribute to the $62 billion that agriculture brings to the state's economy. But growing crops requires water, which is in short supply and growing scarcer in parts of the state.

Kansas State University researchers and Kansas farmers are collaborating to determine if a new technology, mobile drip irrigation (MDI), works well enough to merit the upfront purchase and maintenance costs of installation on farms on a broad scale.

Mobile drip irrigation brings together existing technology — center pivot systems that are highly visible in some parts of the state — with new hose-like products called drip irrigation lines, said Danny Rogers, K-State Research and Extension irrigation engineer.

With the widely used center-pivot systems, water is sprayed either above or within the canopy of the crop that's being irrigated. Some of the water stays on leaves or is lost to evaporation before it reaches the ground, possibly as much as 20 percent. By adding drip lines, which drag along the soil surface, less water is lost to evaporation and more is available for plants' roots.

"It started with a question," extension water resource engineer Jonathan Aguilar said of how K-State scientists and farmers began working together to test the new irrigation method. He and other K-State researchers were already studying the new technology on a limited scale on university property near Garden City. But first one farmer, then another asked the researchers if the technology worked as well as manufacturers claimed — especially for large-scale farming.

Ensuing discussions, which included the Kansas Water Office and Kansas Department of Agriculture, led to establishing three water-technology demonstration farms in 2016 — all on privately owned farmland. K-State is now conducting multiyear MDI equipment studies with various crops and soil types on two farms near Garden City and one near Larned.

Garden City overlies the Ogallala Aquifer, a massive underground water source that is increasingly being depleted, and Larned is over the Big Bend Prairie Aquifer.

"Part of the work is focused on education," Aguilar said. To help show farmers and others how the technology may be used and shed light on the research that's underway, K-State Research and Extension and the Kansas Water Office hosted field days on the three farms in 2016. The events drew more than 350 people, about twice as many at each site than a normal educational event. More such events are planned in upcoming years.

Larned farmer Richard Wenstrom stressed the importance of K-State's mobile drip irrigation research:

*"With this drip technology — if you can capture the 20 percent lost to evaporation — the plant roots receive the entire water application instead of 80 percent."*

**K-State Research and Extension watershed specialists' 2010–2016 accomplishments include:**

**1,800**
*one-on-one consultations*

**2,499**
*educational events, reaching 105,600 people*

**1,065**
*cropland best management practices implemented, affecting 184,398 acres*

**12,883**
*fields assessed for tillage practices*

**2,932**
*water samples collected and analyzed*

# Developing Tomorrow's Leaders

**The next generation of leaders will shape the future of our state, country and world. To prepare our youth, we equip them with the strengths and skills to lead for a lifetime. Through 4-H, we empower young people to be true leaders — to have confidence, know how to work well with others, endure challenges, stick with a job until it is done and give back to their community.**

**77,620**
*participants in Kansas 4-H*

**10,999**
*adult and youth volunteers*

## 4-H grows here

4-H learning experiences enhance young people's abilities to grow into tomorrow's leaders and communicators. The structured learning environment, combined with encouragement and mentoring, allows 4-H programs to play a vital role in helping our youth achieve future success.

This year, 2,600-plus Kansas youths — from rural areas and cities — participated in a study to determine 4-H's effectiveness in fostering positive connections, encouraging responsible decisions, and developing communication and citizenship skills.

Gaining skills and self-confidence through community service, as well as a desire to help others, were reported by well over 90 percent of the survey respondents.

**95%**
of youths reported an increased effort to allow everyone to have a voice

**95%**
treat everyone fairly and equally when they are in charge of a group

**95%**
reported being comfortable with making their own decisions

**91%**
have a plan for reaching their goals

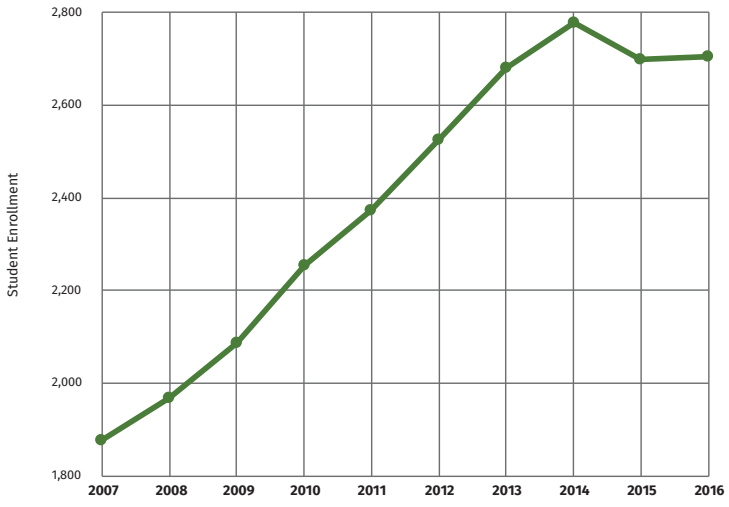

## K-State students excel on multiple levels

Students in the College of Agriculture are preparing to be the next generation of agricultural leaders through engagement in the classroom, hands-on learning and student leadership. Our highly ranked programs go hand-in-hand with excellent advising — on average each advisor works with about 25 students.

Our students succeed:

- Crops judging team won seven consecutive national titles, the collegiate crops championship in 14 of 17 years, and two consecutive international championships.
- Forage judging team competed in its second national contest and won both years.
- Meat animal evaluation team won the national championship, and the livestock judging team earned the reserve national title.
- Food science product development team was first among all U.S. teams at the 2016 Research Chefs Association Student Culinology competition.

*Undergraduate Enrollment*




**$1.4 million**
*awarded in academic scholarships*

**97%**
*graduation placement*

**500**
*students annually gain leadership experience with an officer or leadership role in college clubs and organizations*

# Community Vitality

**We help residents and all communities — rural, suburban and urban — grow and prosper. We energize community groups and aid local businesses by providing leadership, research-based expertise and technical assistance to make communities better places to live and work.**

**70**
*communities with active PRIDE projects*

**3,000**
*individuals serve on advisory councils*

**$2 million**
*— value of hours donated by 1,203 Extension Master Gardeners*

## *Local food hub benefits farmers, consumers*

Five years ago, it seemed like a simple idea: find a way to help smallholder farmers in Kansas sell the food they grow to more people.

K-State Research and Extension helps farmers become more efficient, more profitable and more self-sustaining. We also assist consumers and communities. Local food-system development is community vitality.

The food hub is a producer cooperative that goes beyond selling food at local farmers markets. The food hub helps farmers sell their products to larger buyers, such as restaurants, hospitals, schools and food companies.

"For the most part, farmers are really good at retail and direct sales, and we are kind of good at what I call the 'easy wholesale' — such as chefs and grocery stores," said Jill Elmers, owner of Moon on the Meadow Farm in Lawrence. "But there is a whole new, larger world that farmers have not even begun to tap into."

In 2011, an ad hoc group in Kansas City, Missouri, began talking about developing a food hub for the region. The Douglas County Food Policy Council joined the effort and in 2014 asked K-State Research and Extension to help pursue the next steps.

Today, smallholder farmers in Kansas have numerous options for providing their goods through the food hub.

This food hub allows K-State Research and Extension to think critically about how to grow the local food system in a way that invests back into Kansas farmers and also benefits Kansas communities and consumers.

# Health


## Program helps seniors retain independence

Children and teenagers are often in a hurry to grow up. Young adults can't wait to start their careers and families. And when their children grow up, many look forward to becoming grandparents. But at some point past middle age, the enthusiasm for tomorrow wanes, and people begin to view aging negatively.

Our Keys to Embracing Aging program promotes lifelong independence and helps adults embrace their age. Based on lifestyle habits of centenarians, the program highlights 12 activities to help Kansans live longer, healthier lives and prevent early admission to long-term care facilities. Helping citizens remain in their homes longer saves families and the state millions of dollars in health-care costs.

The program brings individuals and family members together and reinforces the necessary "keys" to increase longevity and overall well-being. Tools and tips are delivered in a fun, interactive format. Participants can immediately implement enjoyable activities into their daily lives.

During the last year, Keys to Embracing Aging has reached more than 4,000 individuals across three states. Program evaluations show 96 percent of participants intend to immediately make behavioral changes to improve their overall health, promote independence and increase longevity.

Keys to Embracing Aging is a true example of what K-State Research and Extension offers to Kansas communities: programs founded on research that address real community needs and provide workable solutions for Kansans. It helps elevate the health and well-being of our neighbors and positively affects our economy.

**A vibrant economy starts with a healthy population. We define health as a person's physical, mental and emotional well-being. Our programs promote behaviors that improve quality of life, healthy development and active behaviors across life stages for all socioeconomic groups.**

**$3.7 million**

*savings through Senior Health Insurance Counseling for Kansans*

**$27 million**

*savings through Kansas SNAP-Ed nutrition education program*

**14,000**

*participants in the annual 8-week Walk Kansas health initiative*

# Facilities

## Building for our future

The Kansas State University College of Agriculture is one of the leading agriculture colleges in the nation. Our Department of Plant Pathology and its doctoral program rank first in the nation. Our Department of Grain Science and Industry is the only program that offers bachelor of science degrees in bakery, milling and feed science. We are also a leader in research and rank fifth in the nation for National Institute of Food and Agriculture Competitive Grant funding among 106 land-grant institutions.

Companies that remain stagnant and do not plan for the future do not survive. The same is true for our university and our college. To remain competitive — while continuing to attract top faculty and students and to lead the nation in research — we must continue to improve our facilities.

The reality: We are losing research dollars because we do not have the space and equipment to conduct certain studies. We are conducting 21st century research in aging facilities and have reached the threshold of our capabilities. We are losing existing faculty to other universities because we cannot offer them space and funding. We are losing students to programs that may lack the expertise we offer, but recruit using new facilities and technology. Just as K-State's football program has updated its space to recruit top athletes, we must also update our facilities to recruit the best minds and the next generation of agriculturists.

## Moving into the 21st century

The College of Agriculture hired two firms, one architectural and one engineering, to identify the quantity and quality of the existing space and what we need in the future.

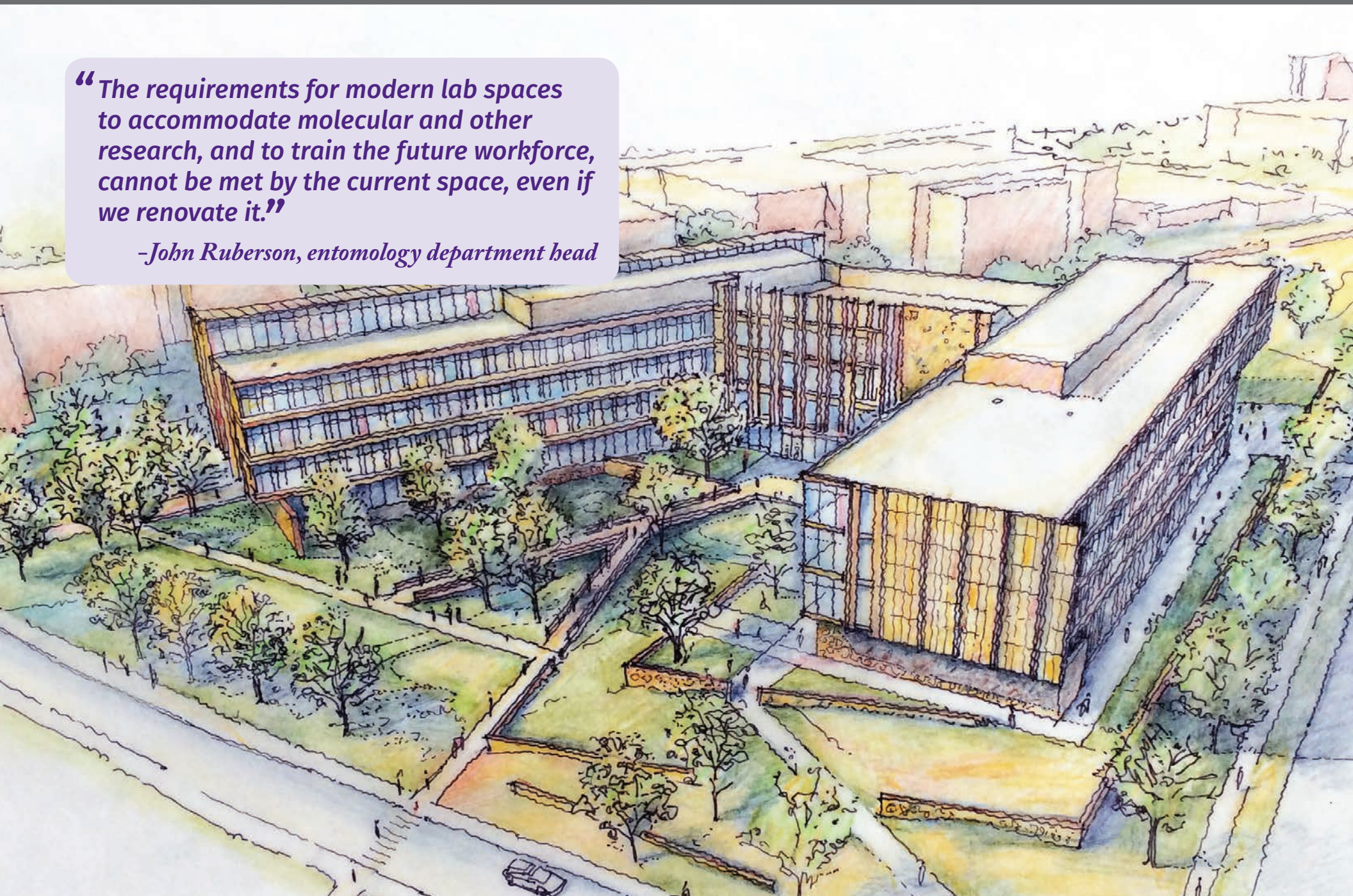
A four-phase master plan for the college was developed and will eventually include at least two new buildings, new greenhouses and remodeling much of our remaining space.

### CURRENT FACILITY CONDITIONS

**21%**
*acceptable*

**68%**
*needs renovation*

**11%**
*does not support renovation*



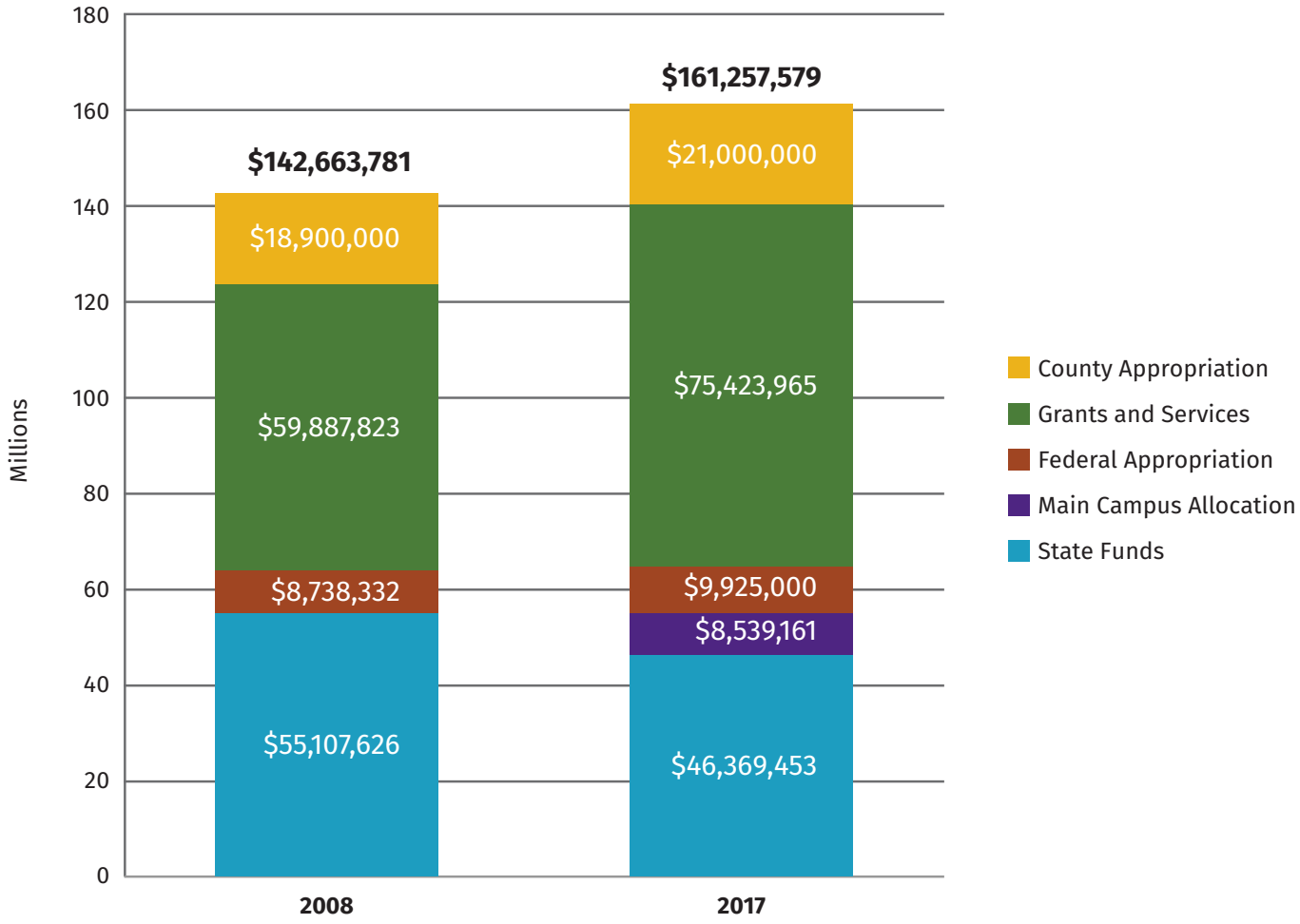
*"The requirements for modern lab spaces to accommodate molecular and other research, and to train the future workforce, cannot be met by the current space, even if we renovate it."*

*–John Ruberson, entomology department head*

# Financial

## K-State Research and Extension budget (in millions)

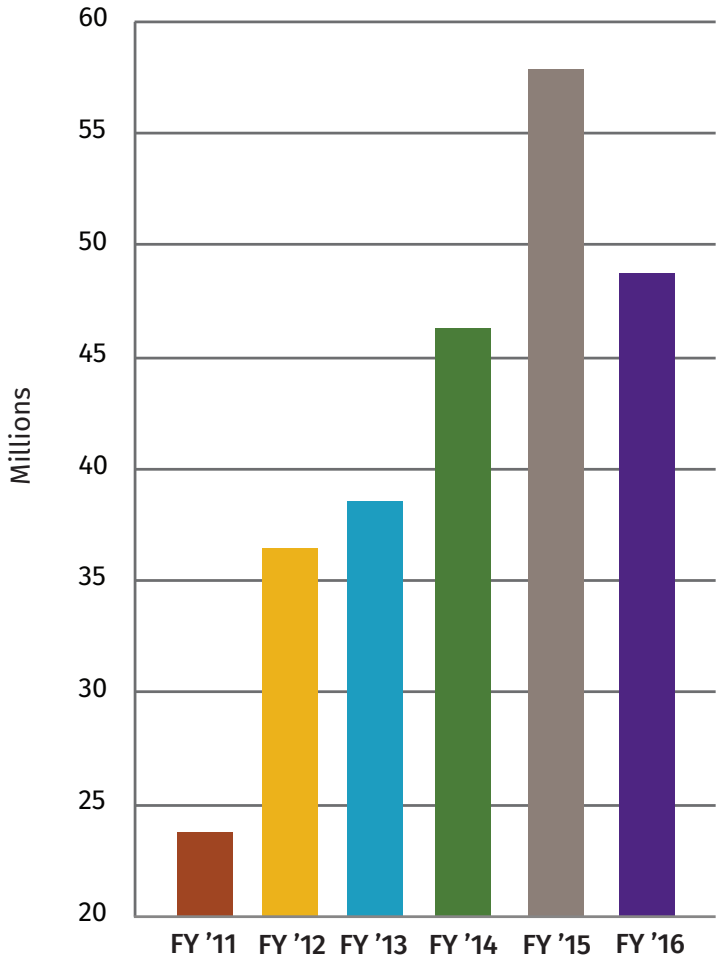
Although state support has been reduced by 16 percent, from $55.1 million in 2008 down to $46.4 million in 2017, we have found alternative sources to increase our overall budget by 13 percent, from $142.6 million in 2008 to $161.2 million in 2017. If our base of state funds continues to erode, we will lose our ability to compete at the national and international levels for grants, contracts and other funds.



## College of Agriculture extramural awards

(in millions)

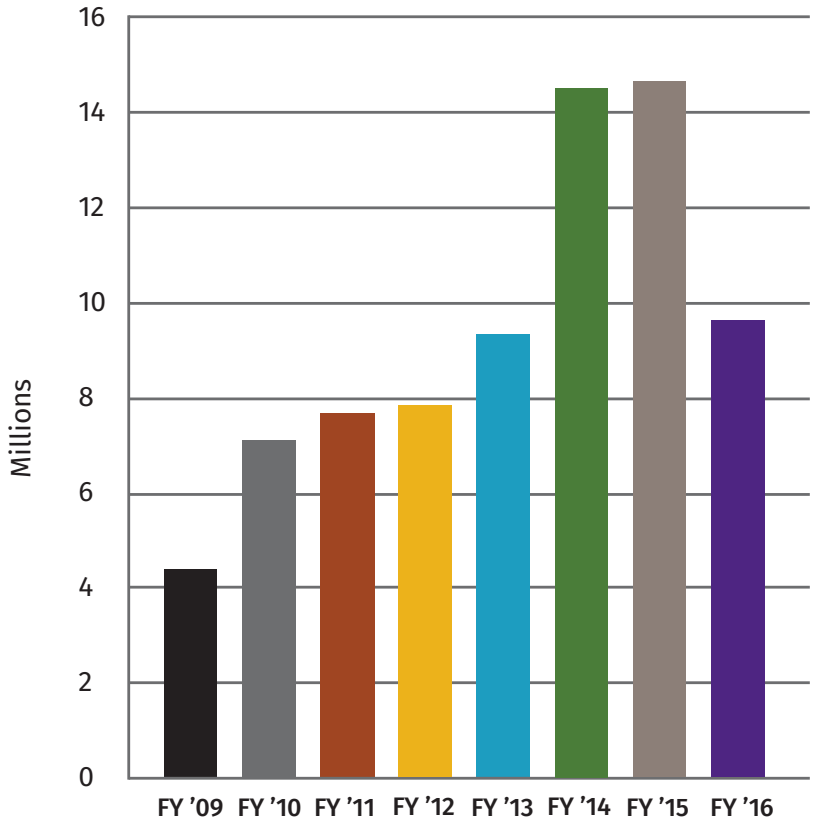
Our faculty and staff have attracted increased funding into their programs (from $23.8 million in 2011 to $57.8 million in 2015) to conduct research, train students, and deliver outreach and extension programs. Our competitiveness and ability to attract and retain the best faculty will be diminished if state funding continues to erode.




## College of Agriculture private fundraising

(in millions)

Private fundraising from philanthropic sources has increased significantly — more than three times — from $4.4 million in 2009 to $14.6 million in 2015. This supplements student scholarships, faculty support and programs.



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