Expression of University Strengths

February 2019

KANSAS STATE
UNIVERSITY

Expression of University Strengths

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KANSAS STATE UNIVERSITY

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KANSAS STATE UNIVERSITY | Office of the President

Memorandum

DATE: February 6, 2019

TO: Members and Staff of the Kansas Congressional Delegation

FROM: Richard B. Myers, President Kansas State University

RE: Kansas State University Expression of University Strengths Document

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On behalf of Kansas State University, I would like to thank each of you for your work for the citizens of Kansas. Your guidance and support have assisted the university in launching and enhancing programs and research efforts. We particularly appreciate the support you have shown the university in the past.

This document is presented to you as the Expression of University Strengths. The university faculty and staff believe these initiatives represent the strengths of the university and match federal initiatives and programs. In addition, these initiatives are in step with K-State 2025, the university's strategic plan with the goal to be recognized nationally as a Top 50 research university by 2025.

If you have questions about any of these requests, please contact Sue Peterson, chief government relations officer, at 785-532-6221 or skp@k-state.edu. She will provide you with whatever information you may require. You may access this document on the K-State Government Relations website at k-state.edu/govrelations/federal.

Agriculture Research, Teaching, and Extension Facilities

Background

Kansas State University has directly impacted the Kansas economy for more than 150 years. Multiple generations have benefited and their lives directly influenced by K-State's College of Agriculture. World-class research technologies such as breeding seeds that allow crops to flourish, research that ensures the health of livestock, the creation of unique value-added products — and markets to sell them — or the development of new ways to protect our dwindling natural resources directly impacted Kansans and the world.

The Kansas State University College of Agriculture has very few modern laboratories, greenhouses and other research- or teaching-intensive facilities. The last building constructed for plant-related research was Throckmorton Hall, completed in two phases in 1981 and 1994. Other buildings housing animal, meat, food, grain and entomology range from 62 to 105 years old.

Even though research done here directly affects farm production and the food that ends up on our plates, most K-State students can say they used more modern, well-designed and well-equipped lab facilities learning the basics of chemistry and biology in middle school.

Description

Researchers and educators at K-State are internationally recognized in food and agriculture. The National Academies of Sciences' National Research Council publishes rankings of doctoral programs in the United States. Many of the K-State College of Agriculture's programs are in the top 10. For the past several years, K-State's Agricultural Experiment Station expended more than $100 million annually in research, which is more than 53 percent of the university's total research expenditures.

K-State is the only school in the United States that offers four-year Bachelor of Science degrees in milling science, bakery science and feed science, and our influence is felt worldwide. These graduates are guaranteed a variety of high-salary careers, with 100 percent job placement in recent years. Additionally, K-State develops new technologies and practices that are used throughout the industry. Shellenberger Hall, constructed in 1961 and home to these degree programs, has significant structural and safety issues that must be addressed.

Relevance

During the past 10 years, the number of students in the college has increased more than 1,000. In addition, nearly 100 percent of the college's graduates find excellent jobs — nearly 60 percent of them in Kansas. The U.S. Department of Agriculture expects the demand for future agricultural graduates will continue to grow.

For K-State to reach its 2025 goal of becoming one of the nation's Top 50 public research universities, the College of Agriculture and K-State Research and Extension must continue to increase research, teaching, and outreach activities.

To capitalize upon our existing strengths in food and agricultural research, and to address critical infrastructure needs, we propose the renovation and construction of agricultural research facilities at K-State.

A space-needs analysis for the college identified a serious need for an additional 231,572 square feet of usable research laboratory space. The new PRIDE facility will only partially meet this need.

The PRIDE project seeks to make significant improvements to about 141,000 square feet of existing space and add approximately 73,000 net square feet of state-of-the-art research laboratory space and some, as yet to be determined, space for teaching, extension and distance education. The project would also add additional square feet of modern roof-top greenhouse space to supplement the existing and aging greenhouse facilities.

The new building will include an appropriate number of offices and conference rooms, as well as, adequate space for our industry and federal research partners. This will continue our great research collaboration and synergy.

K-State is the only place that provides cutting-edge agricultural resources, support and opportunities to Kansans. We must discover, develop and deploy new solutions by maintaining and improving a robust research enterprise. To ensure we meet the needs of the Kansas agriculture industry and prepare for increasing demands for innovation, K-State's scientific workspaces — its working labs, classroom labs and greenhouses — must be modernized to 21st-century standards.

Agency Contact Information

U.S. Department of Agriculture

Addressing the Antimicrobial Resistance Challenge

Background

Infectious diseases have been a scourge throughout human history, causing much death and suffering. The first major intervention (1796) was Jenner's smallpox vaccine, saving an estimated 5 million people annually. The next significant advance was the discovery of penicillin and birth of the modern antibiotic era in 1928. Since then, researchers in industry and academia have developed scores of antibiotics in over 35 different major groups. These antibiotics have revolutionized both human and animal health. Pneumonia is now routinely treated on an outpatient basis, but once killed 30 percent of those infected. Organ transplantation, joint replacement, cardiac surgery and most cancer treatments could not take place today without antibiotics.

Antibiotics are equally transformational in animal health. The U.S. currently has over 200,000 concentrated animal feeding operations (CAFOs). Individual livestock CAFOs can have more than 1,000 head of cattle, while a single poultry CAFO can have in excess of 100,000 birds. This density and the associated economies of scale have dramatically lowered food prices and made the U.S. a major food exporter around the world. It is only possible because of antibiotics; without them, a single infected animal could quickly wipe out an entire CAFO operation.

Over time, pathogens can develop complete resistance to a given antibiotic. Unfortunately, multidrug resistance in bacteria is becoming widespread, especially due to extensive use in agriculture. Resistance threatens to abolish all of the gains antibiotics have brought.

Microbial resistance to control agents is not limited to antibiotics; it extends to drugs used to combat diseases caused by viruses (e.g. HIV/AIDS) and parasites (e.g. malaria). Increasing populations, global travel, global trade, the spread of urbanization and widespread use of technology present additional challenges. They combine to drive the fastest pace of emergence of novel pathogens in recorded human history. Many of these pathogens are zoonotic, previously limited to domestic or wild animals, but now infecting people. A particular challenge of emerging infectious agents is the lack of tools for detection, control, and prevention.

Description

In September 2017, the Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria (PACCARB) issued a *report, Recommendations for Incentivizing the Development of Vaccines, Diagnostics, and Therapeutics to Combat Antibiotic-Resistance*. The council noted that a variety of economic, research and development, regulatory, and behavioral hurdles must be addressed to accelerate the pace of new tool discovery to fight antimicrobial resistance. A key recommendation was establishment of a formal entity, or coordination hub, to accelerate vaccine development, therapeutics, and animal health diagnostics.

This entity, which PACCARB proposed to be administratively housed within USDA, would serve as a "one-stop shop" for researchers, companies and universities to advance their technologies from discovery to commercialization. The new unit would establish connections to accelerate research, development and tech transfer for new vaccines, diagnostics, and alternatives to antibiotics.

Kansas State University is the ideal location for this coordination hub. It has collaborations with companies in the Animal Health Corridor and close proximity to the National Bio-and Agro-defense Facility now under construction. K-State has existing relationships with national labs and ag and animal health companies and is developing a partnership with other land-grant universities having complementary research strengths in human/animal/plant infectious diseases.

Relevance

The proposed concept is in keeping the five goals articulated in the 2018 National Biodefense Strategy (NBS) for strengthening the biodefense enterprise, including to "Strengthen biosafety and biosecurity practices and oversight to mitigate the risk of bioincidents" (2.1.2), and "Ensure a vibrant and innovative national science and technology base to support biodefense" (3.1). The NBS also specifically identifies the need to "reduce the emergence and spread of antimicrobial-resistance pathogens domestically and internationally," including activities to "promote the use of preventative and therapeutic options other than antimicrobial drugs; [and] accelerate basic and applied research and development of new antimicrobials, novel preventatives and therapeutics, vaccines, and diagnostic tests."

Kansas State University and its land-grant partners Colorado State, Iowa State, Oklahoma State, Texas A&M, UC-Davis, Missouri and Nebraska are well-poised to lead a coordination and collaboration effort to accelerate progress in this arena.

Agency Contact Information

USDA NIFA Office of the Director
J. Scott Angle, Ph. D., Director; 202-720-4423

Preparing the Bio/Agro-defense Workforce

Background

Protecting American agriculture — crops, livestock — and food from global biothreats while safeguarding people from zoonotic animal diseases and foodborne pathogens is vital to U.S. homeland security as called out in the 2004 Homeland Security Presidential Directive-9 (HSPD-9). The 2018 National Biodefense Strategy reiterates this crucial mission.

Kansas State University stands ready to deliver tailored education and training programs to prepare and maintain the bio/agro-defense workforce needed for our nation's biodefense strategy, specifically for USDA and the National Bio- and Agro-defense Facility (NBAF) being built in Manhattan, Kansas.

Description

Based on the needs assessment developed during the pre-NBAF OPTIC process led by DHS, expectations for the management and operations of NBAF focused on the necessity for training programs for NBAF employees. Personnel needs of NBAF, however, extend beyond the education and training of Ph.D.-level scientists. Specifically, NBAF needs fully trained, competent staff capable of conducting research with select agents (SAs) and working in BSL-2 through 4 laboratory settings with large livestock models.

The K-State Biosecurity Research Institute (BRI) is one of fewer than six high containment facilities in the U.S. that can conduct research on livestock experimentally infected with a broad range of highly pathogenic organisms. The BRI is the designated facility at K-State for work on organisms classified as SAs, and has been a partner with the Plum Island Animal Disease Center in the transition of science to NBAF. BRI faculty and staff have developed world-renowned hands-on training for students and staff at all levels for operating in and managing very specialized facilities. These programs have trained and approved personnel to ensure accountability, safety and security.

The BRI has over 10,000 square feet dedicated to education, including a tiered classroom seating for 25 that adjoins a fully-equipped biocontainment training laboratory. The lab provides hands-on training activities in a pathogen-free area. Students gain foundational skills in a realistic work environment without the risk of biosafety concerns or biocontainment breaches. The training suite also includes world-class high-definition video capture and streaming technology allowing the training and research areas to serve as filming studios for online distance-education courses.

To date, almost 300 individuals have been trained to work with SA pathogens in biocontainment. The BRI trains or retrains an average of 130 people each year. Based on the anticipated workforce needs for NBAF, DHS, USDA-APHIS and the state of Kansas have invested in training programs at the BRI. DHS has supported 11 doctoral researchers and APHIS has committed to five M.S., Ph.D. and D.V.M. students with guaranteed employment at NBAF.

With investments from USDA, K-State and the BRI will be able to expand current capacities in education and training to deliver a comprehensive program to meet future needs. Specifically, APHIS requires foreign animal disease -related technical education along with training and proficiency testing associated with the NAHLN. The ARS has recognized that the partnership between the Arthropod-Borne Disease Laboratory and the BRI will continue to provide trained personnel to address emerging zoonotic diseases and an integrated animal and microbial genomics program. NBAF success will require training with a focus on relevant pathogens, experience working at a particular biocontainment level, and use of both agricultural and wildlife animal species.

Relevance

The proposed training program is in keeping with the five goals articulated in the 2018 National Biodefense Strategy for strengthening the biodefense enterprise, including to "Strengthen biosafety and biosecurity practices and oversight to mitigate the risk of bio-incidents" and "Ensure a vibrant and innovative national science and technology base to support biodefense."

Agency Contact Information

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The Wheat Genetics Resource Center Industry/ University Cooperative Research Center (WGRC I/UCRC)

Background

Established in 2013, the Wheat Genetics Resource Center Industry/University Cooperative Research Center (WGRC I/UCRC) at Kansas State University joins public and private partners to mobilize genetic diversity to enhance wheat yield and meet food security needs. Researchers at the WGRC I/UCRC deliver novel genes, derived from wild wheats, to public and private breeding programs. These genes combat challenges facing wheat farmers, such as hot and dry climate conditions, pests, and disease, to ensure a stable and profitable wheat supply that keeps up with global demand. The WGRC I/UCRC also targets genes related to consumer-demanded nutritional, flavor and textural profiles. Beyond scientific deliverables, the WGRC I/UCRC provides a transdisciplinary, applied and fundamental research environment to train the future leaders of crop improvement research.

Description

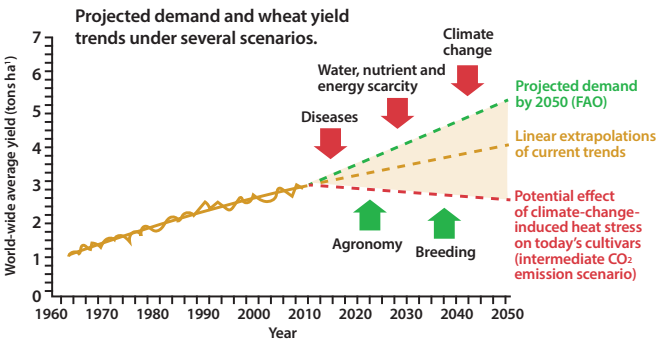
Kansas State University requests $750,000 per year for five years to be matched by industry investors and the National Science Foundation. The funding will go toward the core research program of the WGRC I/UCRC:

- Managing wheat germplasm
- Mining the wheat gene pool
- Wheat phenotyping for drought
- Wheat genetic stocks and introgression platform, and
- Graduate student training.

This core research program enhances the value of the WGRC wild wheat collection to the user community, leading to rapid development of new, high-yielding wheat varieties and value-added food products.

Relevance

- Temperature increases are projected to decrease wheat yields by 20-30 percent.
- Demand for wheat is expected to increase by 60 percent over the coming decades.
- The current trend of wheat yield cannot meet the projected global demand in 2050.



— CGIAR WHEAT, 2014

The WGRC I/UCRC provides novel genes to breeders to develop wheat varieties for farmers that can resist pressures such as disease, water, nutrient, energy scarcity and climate change.

The core research program of the WGRC I/UCRC has three main missions to address challenges facing the global wheat supply:

1. Collect, conserve and utilize germplasm in crop improvement, current stock includes:

2. Create and promote the free exchange of materials, technology and new knowledge in genetics and biotechnology: In the first three years of operations, center researchers have produced 25 publications and 14 presentations.
3. Train undergraduate, graduate, and postgraduate students and visiting scientists: WGRC has mentored 13 master's students, 25 doctoral students and 20 postdoctoral fellows, in addition to hosting more than 60 visiting scientists from all over the globe.

Agency Contact Information

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Members and Partners

Center for Sorghum Improvement

Background

The Collaborative Sorghum Investment Program, or CSIP, is a farmer-university partnership designed to leverage partner resources and build high-performing research teams with field deliverables. The program links research capacity to farmer-driven results with the following objectives:

- **Yield** — Increase the U.S. national yield average from 62 to 100 bushels per acre by 2025.
- **Demand** — Build an annual, consumptive 1.25-billion bushel demand market.
- **Value** — Decrease the market trade discount of corn relative to sorghum from 4.6 to 2 percent.

Description

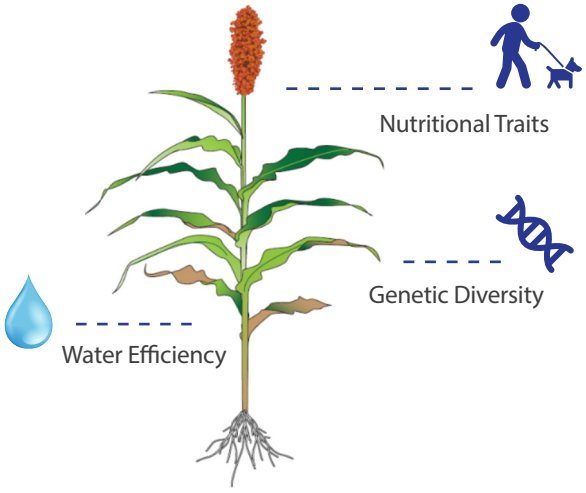
In the U.S., sorghum is grown on approximately six to eight million acres annually. The High Plains represent the prime sorghum production region, with Kansas and Texas contributing more than 80 percent of U.S. sorghum acreage and production. Sorghum's genetic diversity positions the crop as a solution for tomorrow's agricultural challenges. While underexploited, inherit natural diversity provides resources to enhance sorghum for resiliency in marginal environments and weather risk to high-value, unique grain quality based markets.

Despite sorghum's importance for farmers in drought-prone and marginal growing climates and the many new opportunities for sorghum utilization in the bioenergy, bioproducts and food industries, relatively few private resources are being invested in research on genetic improvement, production, or innovative uses. Marginal sorghum investment threatens cropping system diversity and economic stability. Sorghum is more resilient to drought and high- temperature stress compared to other crops and is a vital cropping tool to sustaining our natural resources like the Ogallala.

Kansas State University initiated the Center for Sorghum Improvement in 2001. The recent farmer investment and partnership at K-State re-leverages the center as a collaborative entity across the sorghum research community. The Collaborative Sorghum Investment Program is continuing existing research and education programs, particularly in genetic improvement, production efficiency and sorghum utilization.

Relevance

Research areas prime for knowledge discovery, technology development and extension to industry:



Genetic Tools and Technologies Sorghum has over 40,000 unique genetic accessions. With a focused research thrust, we can translate sorghum's untapped natural genetic diversity to 21st-century agriculture advancement.

Water Sorghum is a key crop in water-limited environments. With dedicated resources, designer sorghums can be developed to

i. build upon resiliency to stress in the dryland systems and
ii. optimize the limited irrigated system with high yield and value attribute traits.

Nutrition Sorghum is a staple food crop across the globe. Grain quality and nutritional research offers promise to create new sorghum value-added markets.

Agriculture Ecosystem Diversity Critical to combatting challenges in monoculture production systems is the need for profitable, diverse cropping tools. Leveraging cropping advancement technologies from major crops has the potential to leapfrog sorghum genetic advancement and invigorate the cropping system.

The Kansas State University *long-term research goal* is to deliver sorghum discoveries and technologies for farmer productivity and profitability.

Agency Contact Information

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Preharvest Food Safety and Security

Background / Description

The goal of this program is to develop strategies to identify and mitigate foodborne pathogens and antimicrobial resistance in beef production systems. Specifically, studies will focus on the ecology of Shiga toxin-producing Escherichia coli (STEC), both O157 and non-O157 serotypes, *Salmonella*, *Campylobacter*, and antimicrobial resistance elements in beef cattle and on the development and testing of on-farm mitigation strategies, with the ultimate goal of enhancing food safety and public health. Because of the economic importance of beef production and beef processing in Kansas, as well as Kansas State University's leadership in beef cattle research, it is logical for researchers to focus on foodborne pathogens and preharvest beef safety. The research outcomes will have major positive impacts on public health, animal wellbeing, and the economic prosperity of the state of Kansas and U.S.

Relevance National/Regional

The food supply in the United States is one of the safest in the world; however, foodborne illnesses do occur and frequently are associated with foods of animal origin. The College of Veterinary Medicine at K-State has an interdisciplinary research team to address scientific issues related to the four vital areas in pre-harvest food safety in beef cattle: STEC (O157:H7 and non-O157), *Salmonella*, *Campylobacter*, and antimicrobial resistance of foodborne and normal gut bacteria. The team with microbiology, molecular biology, epidemiology and production systems expertise, with collaborations with researchers from other departments at K-State, and input from key industry stakeholders is generating valid and industry-relevant outcomes. The long-term research goals are to understand the ecology of foodborne pathogens in cattle and their environment and develop effective and practical strategies for comprehensive reduction or elimination of foodborne pathogens at the farm level.

Shiga toxin-producing E. coli (STEC): Healthy cattle are the major reservoir of STEC, with the organisms residing primarily in the hindgut. These bacteria are shed in the feces, which then serve as a source of contamination of beef, produce and recreational and drinking water. Research efforts in the past have focused primarily on STEC O157:H7. Recently, there is increased recognition that six other STEC serogroups, O26, O45, O1O3, O111, O121 and O145, are also major public health concerns. According to the CDC, the non-O157 STEC serogroups account for twice as many illnesses as STEC O157. However, not much is known about the ecology of the non-O157 STEC in cattle and their environment, partly because methodologies to isolate and detect non-O157 STEC have not been developed. Data on prevalence and factors affecting fecal shedding of these serogroups in the cattle population are needed before strategies for their control can be developed.

Salmonella: The presence of *Salmonella* in beef cattle production systems can cause serious adverse effects in cattle as well as humans. In cattle, *Salmonella* can affect morbidity, mortality, production efficiency and the economic well-being of cattle producers. *Salmonella* is a common cause of gastroenteritis in humans with outbreaks and infections often linked to consumption of contaminated beef, water or other foods. The emergence and dissemination of multidrug-resistant *Salmonella* are also major concerns for public health. The research goals are to understand the ecology and epidemiology of *Salmonella* in cattle.

Campylobacter: The species of *Campylobacter* cause enteritis and in some instances abortion in cattle. However, the importance of *Campylobacter* is as a foodborne pathogen that can cause sporadic cases and outbreaks of human *Campylobacter* infections. In the past, human infections have chiefly been attributed to poultry sources. Recently, cattle have been recognized as an important source of food contamination. The research goals are to understand the ecology and epidemiology of *Campylobacter*.

Antimicrobial Resistance: The use of antimicrobials in animal agriculture is considered a major contributor to the emergence and spread of antimicrobial resistance in the environment. The concern over antimicrobial resistance has important consequences for public health and food-animal industries, including restricted access to global markets. The goal is to monitor prevalence, amplification and dissemination of antimicrobial resistance genes and bacteria that carry resistance genes in beef cattle.

The four issues outlined strengthen the need to understand the ecology and epidemiology of foodborne pathogens for effective preharvest intervention strategies so that cattle with fewer pathogens and lower antimicrobial resistance elements are presented for slaughter. Control strategies aimed at reducing the prevalence and concentration of these bacteria and their resistance elements in cattle feces, thus reducing the overall number of bacteria entering both food and environmental pathways, may be the most effective approach for reducing the overall risk of human infection and maximizing public health outcomes.

Agency Contact Information

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Center for Sensory Analysis and Consumer Behavior

Background

Satisfying, safe and healthful products throughout the lifespan are essential to consumers in the U.S. and around the world. Considerable data show that people generally choose to eat foods and use other consumer products over the long term only if they like them. Because the quality of life of our citizens is partly dependent on the products they choose, and because sales and export of successful products influence the profits from farms and industries, understanding how to create the best products is essential.

Description

The Department of Food, Nutrition, Dietetics and Health at Kansas State University houses the No. 1 ranked sensory analysis program in the world (rankings determined by Journal of Sensory Studies, a primary research journal in the field).

The Center for Sensory Analysis and Consumer Behavior has provided confidential, effective solutions for more than 100 domestic and international companies. The center has tested the appearance, taste, odor and texture of foods; the visual and touch aspects of textiles; the odor, feel and performance of personal care products such as shampoo and cosmetics; the visual and touch aspects of computers; and many other consumer products.

Almost 50 percent of sensory professionals worldwide work in nonfood businesses, but K-State's Sensory Analysis and Consumer Behavior program is the only sensory program in the world to offer courses in products other than food and was the first university sensory program to publish in fields such as pet food, textiles, cosmetics and computers.

Why is this field of science important? Although cost, convenience and health/nutrition are important in food choice, taste reigns supreme. These sensory-derived decisions are critically important because they impact health, culture, the economy, satisfaction, mental states, etc.

Regardless of the product, service or information being tested, our mission is to apply sensory science, including consumer research, to discover solutions, train students, conduct applied research and provide outreach to consumers, companies, and government policymakers.

Improving the initial sensory quality of products, maintaining quality during storage, sustaining repeated product purchase/consumption, enhancing sustainability, enhancing safety and nutrition education, and understanding lifestyle choices as they affect product consumption are major thrusts of the Sensory Analysis and Consumer Behavior program at K-State.

Relevance

The Center for Sensory Analysis and Consumer Behavior at K-State is the oldest and largest university/industry collaborative applied sensory research center in the world. The center has continuing projects with industry to evaluate foods and beverages, pet foods and pet care, personal care products, pharmaceuticals, textiles, automobile components, and services and information for consumers at home and away from home. Many of those have direct impact on state and regional industries, and impact national and international availability of products.

K-State has conducted developmental research to help understand sustained product satisfaction and help predict market success. On-going research includes evaluating consumer information on health and nutrition, and innovative projects examine why consumers choose specific products such as grains, milk, meat, textiles and tablet computers. The center has also studied how consumers provide feedback about products in order to identify what attributes are driving consumers' perceptions and acceptance of the product, which has been valuable during product reformulations to become "clean label." This produces a large contingent of highly educated graduate students for internships and employment and engages faculty who have numerous collaborations with national and international industries, government, nonprofits and other academic institutions.

Agency Contact Information

USDA — National Institute for Food and Agriculture
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Groundwater for Food: Developing and Sharing Technologies to Conserve the Ogallala Aquifer

Background

Groundwater from the Ogallala Aquifer is used extensively to produce food and drive the economy of western Kansas. This region leads Kansas in crop production and comprises the core of the U.S. beef cattle feeding industry. The top eight Kansas agricultural counties are located over the Ogallala Aquifer and represent one-third of Kansas' total value of agricultural production. However, water is increasingly in short supply in the Ogallala region of western Kansas. Kansas State University research in 2013 estimated that, in the Kansas portion of the aquifer, 30 percent of the water was already depleted; by 2060, 70 percent would be depleted; and, by 2100, almost all would be completely depleted. It is common today to have well yields of one-fourth to one-third of historic well yields. In Kansas Groundwater Management District No. 1 in west central Kansas, useful lifetime of the aquifer is estimated at 10 to 30 years.

The rapid depletion of the Ogallala Aquifer has been recognized by both state and local governmental organizations, groundwater management districts, and local citizens. In Kansas, significant regulatory and legislative changes have occurred in recent years in an attempt to extend the life of the Ogallala Aquifer. For example, Kansas enacted legislation that allows local groups of farmers to voluntarily develop their own "local enhanced management areas (LEMAs)." The first LEMA developed in northwest Kansas requires all irrigators to reduce their water withdrawals by 25 percent over a five-year period. Kansas has also enacted a five-year flex program where irrigators can enroll and are then able to use their water over a five-year period, which allows more flexibility and to possibly reduce their overall water use. In 2014 and 2015, Kansas developed a 50-year vision for water. This plan identified research and management needs, as well as suggested needed updates in legislation.

Description

The 50-year vision for water in Kansas calls for a significant investment in research and technology development efforts led by K-State, combined with rapid technology transfer to the agricultural industry. As demand for water resources continues, improved water management practices for crop and livestock production will be critical for sustaining economic viability and population base of the region. The latest tools and technologies must be developed and adopted by water users.

The 50-year vision document identified four major areas where K-State is essential: 1) identifiying and developing new drought-resistant crops and varieties/germplasm; 2) new irrigation technologies; 3) extension programs to enhance adoption of new technologies; and 4) new education curriculum and delivery to university students and the general public on water issues.

K-State has water-related expertise in:

Research: Plant genetics and crop varietal development, crop and animal production, irrigation and water management technologies, and economics.

Education: Curriculum in engineering, water management, plant genetics, economics and computational models to train the next generation of water scientists and managers.

Extension and Outreach: Engagement with agencies and stakeholder organizations to identify alternative methods and policies for managing groundwater and agricultural management challenges, and assisting farmers and other water managers in implementing new practices.

Relevance

The K-State team:

1) Informs citizens, planning agencies and policymakers and helps them understand technical aspects of water resource management and the production, economic and social impacts of policy strategies.
2) Develops more drought-tolerant crop varieties, efficient irrigation technologies, and water and nutrient management. Research and extension efforts guide producers on efficient irrigation strategies for various types of irrigation systems, as well as transition toward limited irrigation and dryland practices. Work is being conducted on Water Technology Farms, which are real working farms, with assistance from private industry.
3) Evaluates alternative food and feed grains, oilseeds and energy crops for drought- and heat-tolerance, adaptation to no-tillage or strip-tillage production systems, and utility as feed for livestock or feedstock for liquid fuel production.
4) Utilizes the latest technologies and computational forecasting tools to quantify and understand interactions and feedbacks between available water resources and societal needs and values.

Kansas seeks long-term solutions to manage a depleting Ogallala Aquifer and to develop agricultural systems, engineering and policy solutions that will sustain the aquifer for current and future generations.

Agency Contact Information

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Urban Food Systems Institute

Background

Food security. We have created a need for resilient food systems capable of adapting to changes due to a growing population, global politics, climate change, dwindling natural resources, market changes and poor diet preferences among consumers.

Workforce development. Local food sales totaled at least $12 billion in 2014, up from $5 billion in 2008. Experts anticipate at least $20 billion by 2020. More than 22 major cities, from Baltimore to Seattle, have created leadership roles for change-makers focused on food. The demand for food systems experts to address obesity and food access, particularly in urban communities, continues to grow.

New Legislation. The *Urban Agriculture Act of 2016* creates new economic opportunities, giving families greater access to healthy food and creating a healthier environment in cities and towns across our nation. The legislation addresses the unique needs of urban farmers by investing new resources and increasing flexibility through existing USDA programs.

Description

Although agriculture increasingly operates globally, it is also becoming more local. As urban centers grow, the demand for locally grown produce is driving the redevelopment of fruit and vegetable production in urban and peri-urban areas. This trend is particularly relevant for produce growers as fruits and vegetables have a relatively short storage/shipping life and have extremely high-nutrient content that can benefit food security in urban communities. Clearly, there is an increasing need for researchers and professionals who are knowledgeable about urban agriculture and the associated local food systems given the expanding consumer demand for local food and the changing demographics of horticultural food crop producers. Careers are developing in this new area, known by several names such as urban agriculture, urban horticulture and urban food systems. Now more than ever, a group of leaders is needed in the agricultural community to help successfully facilitate a revolution in the way consumers think about food.

The Department of Horticulture and Natural Resources, in the College of Agriculture at Kansas State University, identified food crops and global food systems as a target focus area of expertise as part of its 2025 Strategic Plan. The Urban Food Systems graduate program was launched in 2011 and 2013 in Manhattan and Olathe, respectively. Four horticulture faculty oversee this program that currently has seven M.S. students, while 10 students have graduated from the program and are now working in urban agriculture. The department received more than $5 million in grants and contracts with projects encompassing horticulture, food science, food safety, sensory analysis and adult education. In June 2016, the department delivered a highly successful international symposium on urban food systems with more than 150 attendees from across the country and world, and partnered with the University of Minnesota on the second in 2018. Faculty from more than 15 different disciplines across K-State's colleges of Agriculture, Human Ecology, Engineering, Education, and Arts and Sciences collaborate on this program.

Given the success of the Urban Food System Symposium and the number of faculty and staff across the university who are working in this area, K-State has the expertise and leadership to be a regional, national and global change leader in urban food systems. To achieve this goal, the department will formalize this initiative through the institute.

Relevance

With operational and infrastructure investment, the Urban Food Systems Institute will secure and maintain the global leadership position on a permanent basis.

The institute's objectives reflect the land-grant mission:

1. Train the next generation of leaders and extension educators to facilitate successful and resilient urban food systems.
2. Develop and disseminate urban agriculture extension programs and services that support urban agriculture.
3. Expand farm-to-fork research in technologies such as protected production systems (greenhouses, warehouses and vertical and rooftop farming); high-intensity production; appropriate postharvest handling; and sustainable and regenerative farming practices.

The development of the Urban Food Systems Institute will provide a venue for collaborative work among graduate students, researchers, practitioners and industry partners.

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The Center for Food Safety in Child Nutrition Programs

Background

The United States Department of Agriculture's Food and Nutrition Services (FNS) provides healthy meals to more than 31 million children each day in over 100,000 schools through the School Lunch Program, and about 3.2 million children and 112,000 adults are served daily through the Child and Adult Care Food Program. The safety of these meals is of great importance and there is strong federal legislation to support food safety.

As part of their response to a direct initiative of Secretary of Agriculture Tom Vilsack, USDA FNS established The Center of Excellence for Food Safety Research in Child Nutrition Programs at Kansas State University in 2011. K-State was selected to administer the inaugural center through a competitive process. In 2017, K-State was again selected to administer the Center for Food Safety in Child Nutrition Programs after a competitive selection.

Description

The center provides science-based evidence to improve the safety of foods provided through the FNS nutrition assistance programs, particularly those served in schools and child care settings. The center conducts research that has an immediate impact on the safety of food served in child nutrition programs. The goals of the center are to provide a multidisciplinary approach to basic and applied food safety research needs related to child nutrition programs, conduct applied studies to resolve food safety issues in schools and other child nutrition programs, and convey those findings in a way that facilitates the transfer of knowledge to school food service directors and program operators, scientists, policymakers, educators and practitioners.

Faculty from the Department of Hospitality Management and the Department of Food, Nutrition, Dietetics and Health in the College of Human Ecology provide leadership for the center. The center has received a total of $5.8 million for the eight years that it has been funded. Continuation of the center will depend on FNS priorities and funding availability.

Relevance

K-State offers food safety expertise along the entire continuum of the food chain that is unparalleled at any university nationally. Current research initiatives of the center:

- Microbial Growth: Use microbiological testing and pathogen modeling to determine microbial growth in food commonly served in child nutrition programs.
- Employee Behavior Assessment: Determine school nutrition employees' behavioral intentions to follow food safety practices and develop interventions to improve employee practices and the safety of food served.
- Summer Food Service Programs: Identify proper and improper food safety practices in Summer Food Service Programs to identify targeted areas of improvement for educational interventions.
- Child Care: Identify food safety regulations and operational characteristics of child care center and in-home operations participating in the Child and Adult Care Food Program and determine food safety education and training needs.
- Food Allergy Management: Determine best practices and challenges for managing food allergies in schools, including the nature of food allergy reactions.

This applied research is used by FNS to inform public policy. The Institute of Child Nutrition (funded by FNS and housed at the University of Mississippi) uses the results as the basis for educational programs and materials for child nutrition programs across the United States. This collaborative relationship ensures that the research is translated into meaningful resources that have a direct, positive impact on practice.

The center also developed an intensive immersion program about the food science principles that underscore food safety. The course, delivered to management staff in school nutrition programs and state agencies, helps participants learn to establish and foster a food safety culture and expands their understanding of food science as it applies to their programs. Participants are challenged to return to their home state and educate other child nutrition managers and directors utilizing the tools and knowledge they have gained from the course. Since 2013 approximately 300 people from 49 states have completed the program. Alumni have indicated that they have used the knowledge gained to reach an additional 20,000 individuals engaged in child nutrition programs.

The work of the center is enhanced through partnerships with the many programs and institutes at K-State, including the Biosecurity Research Institute, Food Science Institute and Kansas State University Olathe, and with the Kansas Department of Education's Division of Child Nutrition and Wellness.

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Global Food Systems Initiative

Background

The United Nations Food and Agriculture Organization estimates that 1 in every 8 people worldwide is hungry. Yet at the same time, the obesity rate in developed countries is over 30 percent and that rate is increasing in developing countries. *Food security* as defined by the World Health Organization is the "availability and adequate access at all times to sufficient, safe, nutritious food to maintain a healthy and active life."

As the world population grows to surpass 9.7 billion by the year 2050, the problem of worldwide food security and its potential impact on social and political unrest is going to grow as well, unless people come together to work on solutions.

The global food system is immensely complex and addressing current and impending challenges in food security will require novel, varied, and interdisciplinary research approaches.

Description

As a land-grant university, a great deal of K-State's research focus is on food writ large. Food research strengths include applied research in crops — wheat, sorghum and millet — and animals — cattle, swine, goats and sheep — at the production, processing, distribution and protection levels. Additionally, on the consumer side, our research strengths include nutrition, sensory analysis and consumer-based food safety.

Basic science research supports applied work through studies in physics, chemistry, biochemistry, chemical engineering and biology, which provide the basis to develop a clearer understanding of global food systems and to create fundamentally new technologies and methods to help advance solutions. Some specific areas of focus include microbiological research on developing an interface that captures bacterial pathogens to aid rapid culture free detection methods; development of fundamentally new methods of measuring and managing crop quality; genetics — both genetic mapping and genetic modification used in improving performance of crops; and research on insect molecular composition and how it affects product loss. All of these areas of research are supported through both fundamental and applied scientific research and provide knowledge that can be advanced to practical users such as producers.

Engineering research plays an important role in global food systems, encompassing areas such as computer controls, supply chain design, infrastructure issues, and mechanical and building design.

The nexus of food, water and energy is another area requiring interdisciplinary approaches that include agronomists, geographers, geologists, civil engineers and landscape architects to understand and develop sustainable solutions. This work both illuminates the challenges we currently face and anticipates future ones resulting from climate change and population growth.

It is clear that not all solutions to problems facing the complex global food system are technology-based. Understanding political climates, social, economic and moral challenges, and the ability to communicate clearly become barriers to food availability and sustainability. K-State's humanities and social sciences researchers, particularly those with an international focus and critical to our efforts.

A recently awarded NSF grant provides a look into the future of interdisciplinary learning and research. Dr. Melanie Derby, assistant professor of mechanical and nuclear engineering, is leading a team of researchers in food-energy-water system research in rural agricultural areas. That team of scientists, sociologists, engineers, economists and educators will tackle the challenge of innovating solutions designed to protect rural communities.

The visionary goals presented in K-State's 2025 strategic plan will be advanced through the global food systems initiative.

Relevance

Because of our land-grant mission, local, regional, national and international expertise and connections, K-State has the ability to help identify and tackle future demands of the complex global food system.

Questions raised in the sustainability of feeding the growing population under increasingly strained environmental conditions cannot be addressed in a singular approach. K-State has the tools needed to form truly interdisciplinary research approaches to solving these problems.

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Institute for the Health and Security of Military Families

Background

For American military personnel who have served in war, federal programs have long been in place to address physical injuries from bullets and bombs and psychological injuries of wartime trauma. In relatively recent times, however, veterans returning from war have faced difficulties neither anticipated nor addressed by federal programs. These include chronic health problems resulting from exposure to environmental hazards (e.g., chemical defoliants in Vietnam and a complex mix of neurotoxins in the Persian Gulf War) and traumatic brain injury (TBI) encountered during deployment, as well as long-term health impacts (e.g., PTSD). Increasingly, for today's professional military (both active and reserve components), the aftermath of wartime service has consequences not only for veterans' well-being but for their families and communities as well.

Description

Kansas State University is home to a unique cadre of scientists from diverse disciplines with an impressive track record in research, outreach, academic and clinical service programs addressing the health, well-being and sustainment of military and veteran populations:

- Programs and community support networks for military-connected children and youth, with local 4-H clubs, schools and OMK youth/family camps.
- Research and training programs on violence prevention in military families, quality child care and childhood social-emotional health.
- Clinical programs for military personnel, veterans and families.
- Research on the long-term effects of deployment and war trauma on marriages, child and youth development, employment, and financial planning.
- Cooperative Extension services to families of military personnel.
- Online graduate programs for professionals who serve military families.
- Research on the effects of high-intensity functional exercise training on the body composition, fitness and health of active duty military personnel as well as on barriers to physical activity participation for disabled veterans.
- Implementation of a new Military and Veteran Engaged Research Innovation Center at K-State (MAVERICK Center), to provide a multifunctional, cost-effective collaborative space for military and veterans programs that advance the vision of K-State 2025.

In addition to contributions made by researchers from colleges across the university, the Institute is the "tip of the spear" for K-State's alliances with area military installations, the Kansas National Guard, Army Reserve, U.S. Department of Veterans Affairs, the Department of Defense, and other state and national organizations.

Relevance

Our current partnerships with the U.S. departments of Agriculture and Defense have been primarily focused on outreach rather than on research funding for the study of military families. These outreach initiatives support significant programming underway at K-State and across Kansas. Proposals to other federal agencies, such as the Department of Health and Human Services, will expand the reach of the College of Human Ecology and its units. Expanding partnerships to support additional investment in relevant research would enable K-State, the College of Human Ecology and the Institute for the Health and Security of Military Families to capitalize on the expertise available here.

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Agro-combs: Using Tools from Physics to Solve the Challenges of Agronomy

Background

The most critical agricultural challenge is to double crop production by 2050 to meet the food demand of a growing world population. This must be done in a sustainable way by reducing the environmental footprint of crop and livestock production. To solve this challenge plant, soil and environmental scientists need accurate data at relevant time and spatial scales to improve the efficiency of agroecosystems. These data include concentration of multiple agriculturally significant gases. Multi-gas detection is indispensable for several agricultural applications, such as crop breeding, measuring trace gas emissions from agricultural systems, and crop nutrient management. Unfortunately, current technologies are a limitation for sensing agriculturally significant gases. A revolutionary laser spectroscopic method called dual comb laser spectroscopy (DCS) offers self-calibrating, rapid-field scale monitoring of multiple gases simultaneously by a single instrument.

Description

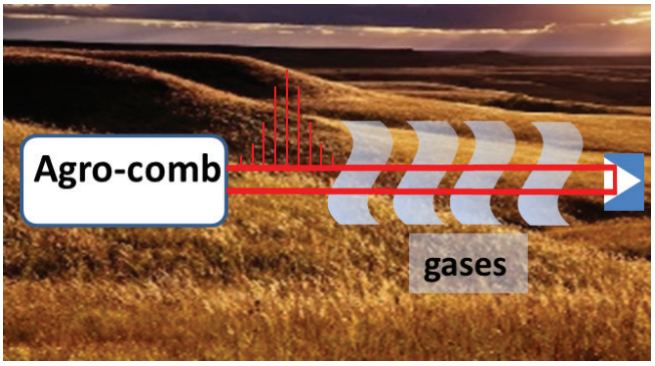
K-State is developing, under an NSF Major Research Instrumentation (MRI) Award, a novel sensor of agriculturally significant gases based on the Nobel Prize-winning technology of optical frequency combs. Dual optical frequency comb spectroscopy (DCS) is poised to transform crop production gas sensing with never-before realized spectroscopic capabilities, and will serve as a next-generation gas-detection platform. K-State, home to experts and facilities in both optical frequency combs and agricultural gas sensing, offers an excellent environment for the development of this key technological advance. An interdisciplinary team of world-class physicists and agronomists is developing a mid-infrared DCS system for the detection of agriculturally significant gases. This is a novel application of frequency combs which we call agro-combs.

Resulting experiments will lead to increased crop yield in the face of growing demands on natural resources. The instrument will allow simultaneous absorption measurements of multiple gas species with high sensitivity over a 10 m path.

Current agricultural gas detection systems are based on tunable laser absorption spectroscopy (TLAS) and Fourier transform infrared spectroscopy (FTIR). They have limitations that create a bottleneck for the development of high throughput phenotyping (HTP) platforms. TLAS has limited spectral coverage and thus can detect only a limited number of gases with a single instrument. FTIR can detect multiple gases but employs a mechanical delay line, limiting scan rates and stability for field deployment.

A few examples of research areas that could benefit from the agro-comb's capabilities:

- studies of native tallgrass prairie systems
- wheat breeding program
- animal production efficiency
- soil nitrogen gaseous losses
- ammonia production
- natural gas leak detection



Relevance

The instrument will be used for the broadband detection of many agriculturally significant gases.

Additional Investment would dramatically expand this work, by allowing multiple prototypes to be built, specially tailored to each application. Furthermore, large-scale funding would allow the integration of multiple laboratories and field sites, expanding the type of experiments that could be conducted with agro-combs in outdoor environments with multiple crops and plots.

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Development and Management of Canola in the Great Plains Region

Background

The Supplemental and Alternative Crops Competitive — SACC — Grants Program is funded through the USDA-NIFA. Kansas State University is part of the SACC Grant Program that supports integrated research and extension projects to increase canola production and satisfy consumer demand that far exceeds U.S. domestic supply.

The project "Development and Management of Canola in the Great Plains Region" provides solutions to global food systems, one of five Grand Challenges identified by the Kansas State University Agricultural Experiment Station and Cooperative Extension Service that are vital to feeding a growing world population.

Producers in the Great Plains region need profitable and reliable winter broadleaf crops that can be grown in rotation with wheat. Canola is an alternative crop that can be used to enhance winter wheat quality and yield. K-State research has shown increases between 18 and 51 percent in wheat yield the first year following winter canola. Other benefits to growing canola include the use of minimum and/or no tillage, decreased soil erosion, improved water infiltration of soils, and enhanced cropping system diversity. Winter canola acres have increased because of improved cultivars, observed rotational benefits to wheat, growing demand for canola oil, and increased research and extension activities.

Description

The long-term goal of this multistate, interdisciplinary, and integrated research and extension project is to facilitate the adoption of winter canola into cropping systems of the southern Great Plains, or SGP. To stimulate acreage and production increases, the project focuses on the following objectives that align closely with the priority areas of the SACC:

1. Develop and evaluate high-yielding and regionally adapted winter canola cultivars. Priority traits include winter survival, tolerance to sulfonylurea herbicide carryover, tolerance to postemergence applications of glyphosate herbicide, yield, oil quality and quantity, hybrid parent lines, and blackleg, or *Leptosphaeria maculans*, disease resistance.
2. Improve canola cropping systems by addressing agronomic management issues identified through stakeholder input. Management studies include crop establishment (seeding rate, planting date, row spacing), irrigation management, growth regulator efficacy, fungicide efficacy, nitrogen management, on-farm testing and crop modeling.
3. Deliver cultivar and agronomic management technologies to new and experienced canola growers through appropriate extension programs. Methods of delivery may include, but are not limited to, field days, risk management schools, extension and journal publications, professional society meetings, agronomy updates, radio and television interviews, web-based applications, peer-to-peer interactions, and social media updates.

Relevance

A high-value market exists for the heart-healthy oil and high-protein meal derived from canola seed. The U.S. imports more than 80 percent of the canola oil used domestically. Production in the major spring canola growing areas has nearly peaked because of competition from other crops; therefore, more winter canola must be grown to meet growing U.S. demand.

Winter canola-planted acres have increased substantially in the SGP. Recently, total planted acres in the region have exceeded 150,000. Federal crop insurance is available, and a regional seed crushing facility provides an end market. New adapted cultivars are needed to increase production to meet this strong demand.

K-State's canola breeding and research program focuses on developing cultivars adapted specifically to the SGP. It is the only public canola breeding program in the region. Nine adapted cultivars have been released by the breeding program since 2010, including Torrington, the most winter hardy cultivar available for commercial production. The program released five adapted, glyphosate-tolerant cultivars that are licensed to private seed companies for sales across the SGP.

Most states do not have statewide winter canola cultivar testing programs. Thus, regional variety testing and agronomic performance trials are an important component of this project. The National Winter Canola Variety Trial, or NWCVT, is also coordinated by K-State and this trial is planted at 36 locations in 18 states. NWCVT data facilitates the release of new cultivars in areas where they can be profitably marketed. Coordination of the NWCVT demonstrates a strong ability to manage a collaborative program with national impact.

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Building Healthy Relationships

Background

Healthy relationships are the foundation of stable and resilient families. Children and adults with stable and satisfying family relationships experience greater emotional stability and health than do individuals who live with family tension and negative interactions. In Kansas, divorce increases the likelihood that families with children will be poor by 46% (State of the Family: Kansas Child and Family Wellbeing Indicators). Indicators of whole family, couples, and individual family member stress and relationship strain include:

- The rate of children in need of care (i.e., protection services) is 8.4 (per 1,000 children in population) as compared to 5.2 for the nation (Casey Family Programs, 2012).
- In 2013, 23,508 domestic violence incidents were reported to law enforcement agencies in Kansas.
- In 2014, compared to the nation's 11% average, 19% of adults in Kansas reported having 3 or more adverse experiences in their childhood (Kansas Behavior Risk Factor Surveillance Survey).

Many Kansas families experience repeated transitions, prolonged stress, unstable situations, and poverty, which negatively impact relationships. Every person deserves the opportunity to have healthy relationships and to live free from the experience of interpersonal violence, toxic stress, and social immobility. Researchers, teachers and outreach professionals in K-State's School of Family Studies and Human Services (FSHS) are dedicated to contributing to the development and enhancement of resilience and healthy relationships to improve the lives of individuals and families.

Description

To address these issues, applied research, clinical services, and programming are underway across units in the School of Family Studies and Human Services to:

1. support healthy relationships across life-course transitions, cultures, family development, and in long-term relationships;
2. assess the impact of witnessing inter-parental violence across generations;
3. examine the impact treatment of depression has on intimate relationships;
4. support healthy partner and/or or parenting relationships;
5. develop and test a violence risk assessment tool to guide prevention and treatment of partner violence efforts in military families;
6. assess the impact romantic relationships and parenting behaviors have on child outcomes;
7. implement and evaluate a relationship education program for pregnant and parenting adolescents;
8. study communication technologies on relationships between former partners and between parents and children following divorce;
9. support and encourage parent-child communication about health and well-being;
10. develop research-based community programs that focus on strengthening family relationships in the context of individual family units and the communities where they reside.

The collaborations of the College of Human Ecology faculty have led to grants and contracts to support research on building healthy relationships, preventing partner violence, and supporting family resilience.

Relevance

Healthy relationships enhance all aspects of life. Children who grow up in homes with parents in healthy relationships do better in all aspects of life. Adults who are in healthy, committed relationships have better physical health, fewer emotional problems, and are more financially successful.

Faculty in K-State's School of FSHS in the College of Human Ecology are conducting applied studies that support healthy relationships. They are receiving private, state, and federal funding for their research and have received national and international recognition for their efforts.

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Military and Veterans Programs
National Institute of Food and Agriculture United States Department of Agriculture

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Lipidomics Research Center: Poised for Discoveries Critical to Crop Improvement

Background

"Lipid" refers to a large and varied group of compounds that are not soluble in water. Lipids are found in every living organism, and every part of crop plants (grain, leaves, roots, etc.). Lipids are important in crops for two reasons. First, seed oils, which are major food and energy products, are lipids. Second, lipids are critical in regulating the resilience of crop plants to the challenges of their environment, due to their roles in membranes and as molecular signals. The goals of scientists studying lipids in crops are (i) to improve oil quantity and quality and (ii) to improve metabolism of lipids to enhance growth and stress resilience of crop plants.

One of the historic bottlenecks in plant lipid research is measuring the thousands of types of lipids. Advances in mass spectrometry have made it possible to easily identify different lipids, as well as rapidly quantify individual lipids; this technology is called "lipidomics".

Established in 2003, the Lipidomics Research Center (LRC) at Kansas State University is the world's longest-serving and best-known facility dedicated to providing the international plant science community with access to cutting-edge lipidomic approaches. LRC scientists have established mass spectrometry-based methods for over a thousand plant lipids. Scientists from over 600 labs have come to LRC or sent samples for analysis, resulting in hundreds of scientific publications. LRC has competed successfully for funding for mass spectrometers in two National Science Foundation (NSF) Kansas EPSCoR and three NSF major research instrumentation competitions.

Description

With the current abundance of genomic information on crop plants, the time is right to combine genetic and large-scale data on plant lipids to make discoveries needed to design crops that produce high yields of seed oils of specific composition and withstand stressful environments.

LRC is poised to lead the plant science community in a major initiative to collect large-scale lipidomic data on crop plants and to utilize that data to enhance crop improvement programs. Experiments conducted at LRC suggest that combining lipidomics data with other plant genomic data will to lead to insights into plant metabolism that facilitate crop improvement. LRC scientists work closely with plant biochemists and agronomists at K-State and across the Midwest. For example, K-State researchers are utilizing lipidomics to design camelina-producing improved biofuels and oils useful in the chemical industry. Other projects are aimed at understanding how lipid differences can improve sorghum and wheat tolerance to heat, cold and drought.

Funding would provide personnel and improvements in sample and data handling and facilitate large-scale acquisition of crop plant lipidomics data and its association with genomic data. It would also provide training opportunities.

Relevance

The rate of increase in worldwide agricultural production is slowing and lags behind the increase in world population. With limited future ability to bring more land into production, increases in yield are needed. These increases must be made as climate variability is increasing. To develop crops with increased yield and more resilience, new knowledge and new strategies are needed. The time is ripe to discover how the understudied group of plant metabolites called lipids act and interact with plant genes.

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Population Health: Center for Outcomes Research and Epidemiology (CORE)

Background

The health and productivity of the U.S. agriculture and food system are vital to the national economy and security. Any disruption of this critical infrastructure, such as from emerging, transboundary, and/or zoonotic disease incursions or changes in endemic disease status, would have devastating impacts on both animal and public health. To prepare for and respond to these risks, the detection, distribution and determinants of disease (i.e., epidemiology) must be understood by all stakeholders across the spectrum of the agriculture enterprise. Maintaining the health status of animal and human populations requires knowledge of detection, distribution and determinants before informed decisions can be made with confidence. As such, federal and state health officials (both human and animal health), veterinary practitioners, livestock producers and allied industry leaders require high-quality information, data analyses and advice on population health risks.

Description

The ability to address these needs and protect and improve animal and public health requires the expertise and integration of epidemiology, surveillance, economics, veterinary medicine and other disciplines, with understanding and application at local, state, regional and national levels. With its Center for Outcomes Research and Epidemiology (CORE), in conjunction with other centers and institutes, networks of collaborating experts within and outside Kansas State University, and close partnerships with the agriculture industries and state/federal government, the College of Veterinary Medicine at K-State brings the necessary expertise under one umbrella. In fact, it may be argued that K-State is a leading university for epidemiological research, service and training in the U.S., as no other institution has its number or breadth of experts within this field. The following is provided by K-State interdisciplinary teams: 1) **outcomes research and evidence-based advice** to stakeholders, such as through intervention effectiveness studies, disease modeling, risk assessment and preharvest strategies to promote food safety and security and address antimicrobial resistance; 2) **enhanced surveillance** by developing novel and practical methods, technology and tools, and incentivizing their use, to enhance on-farm data collection and early disease detection, with supporting data integration, analysis and dissemination of information tailored to the end-user to support decision-making; 3) **diagnostic approaches,** including cutting-edge technologies to detect the unknown and rapidly identify the known pathogens, and sharing of critical disease emergence information to network laboratories and state/national agencies; 4) **innovative thinking and horizon scanning** to support policy and program development, and prepare for effects of land use or climate change, emerging technology, trade dynamics and other factors on the future of livestock production, public health and global food security, as well as resulting implications for disease prevention and control; and 5) **outreach and training** to prepare first responders and animal health officials on disease preparedness and response, while also building these capacities to recruit and develop the next-generation veterinary workforce.

K-State's CORE is a unique interdisciplinary research and training center that excels in population-based and quantitative approaches to enhance animal health for the benefit of animals and society. The current engagement and recognized leadership in significant health and economic issues at the national and global levels are relevant to societal concerns and changing needs.

Relevance

Kansas is at the center of U.S. livestock production and animal health commerce. With the Animal Health Corridor located between Manhattan, Kansas, and Columbia, Missouri, and the Department of Homeland Security building its $1.25 billion National Bio and Agro-defense Facility (NBAF) in Manhattan adjacent to the veterinary college, the K-State College of Veterinary Medicine is strategically placed at the U.S. epicenter of regional, national and global animal health. Its leadership and expertise will be relied upon to work with veterinarians, their human health counterparts, industry and state/federal government to address challenges and find solutions. These sectors rely on transparent, credible data and information, and support its translation and application into practice for informed decision-making at local, regional and national levels. The K-State College of Veterinary Medicine, through the CORE, has a premier, unique interdisciplinary team to tackle these issues and serve as both a liaison and trusted source to support stakeholders in these decisions, help protect and promote our livestock industries, and ensure the prosperity of national and global population health and food security.

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Transboundary and Emerging Infectious Diseases of Food Animals

Background

The United States is fortunate to have a food animal production system that is free of most devastating diseases that are endemic in other parts of the world. This allows abundant, diverse and relatively inexpensive production of animal protein for both domestic consumption and a large export market. However, this industry, and by extension public health and well-being, is vulnerable to accidental or intentional introduction of transboundary animal diseases (TADs) and the potential catastrophic economic and social results. Further, the industry is highly vulnerable to emerging or new diseases brought about by pathogen genomic changes leading to species jump, the spread of pathogens by ever-increasing foreign travel and trade, as well as climate changes. Finally, many microbial organisms found in animals (whether disease-causing in animals or not) can cause serious diseases in humans (so-called zoonotic agents). Examples include among others: rabies, SARS, *Salmonella, E. coli* O157, *Brucella sp*., *Mycobacterium sp*., Avian/Swine Flu, RVF virus, Ebola/Marburg viruses, anthrax, BSE, Henipaviruses and MERS.

It is critical, therefore, that the U.S. maintains and continually improves vigorous monitoring, control plans and capabilities for rapid and accurate detection and control/elimination of transboundary, zoonotic and emerging animal diseases.

Description

Research and education efforts in the Department of Diagnostic Medicine/Pathobiology (DMP) at K-State cover a multitude of potential threats and are directed at developing and improving upon transboundary, zoonotic and emerging disease detection and control countermeasures. Most projects are collaborative in nature, utilizing teams of researchers at various universities; state and federal government agencies, both domestic and international; and private industry. Researchers at K-State maintain strong ties with the USDA, including ABADRU, FADDL and PIADC, with the DHS, and with livestock producers and field veterinarians.

Research aimed at understanding viral pathogenesis and developing safe and effective vaccines and diagnostics are underway for diseases of major concern to food animal health, such as ASF, RVF, CSF, FMD, PRRSv, SIV, SVV, PEDv and HPAI. Active research on arboviruses and their mosquito vectors is conducted in DMP and the Biosecurity Research Institute (BRI) at K-State. State-of-the-art techniques and instrumentation include multiplex molecular detection methods and next-generation sequencing to enhance our ability to rapidly identify specific pathogens in an outbreak situation or provide general biosurveillance tools by utilizing both laboratory and point-of-need testing. College of Veterinary Medicine faculty are using risk assessment, spatial analysis and surveillance methodologies to study the epidemiology of ASF, FMD and other TADs in order to aid potential outbreak prediction and control. Several projects are devoted to educating veterinarians and other first responders to recognize, respond to, and aid recovery from TADs and to train the next generation of veterinary researchers in specialized work requirements.

Capabilities include the training and expertise necessary to safely and securely conduct research in the BSL-2 and BSL-3Ag environments of the Large Animal Research Center (LARC) and BRI, respectively. Researchers are knowledgeable about the compliance requirements associated with select agent work. Other ongoing efforts include initiating activities to transition PIADC and FADDL functions into the new National Bio and Agro-Defense Facility (NBAF) under construction in Manhattan, Kansas.

Relevance

Research conducted in the DMP department is specifically directed at protecting U.S. food animal agriculture, especially the pork, cattle, sheep and poultry industries, from potentially devastating infectious diseases. PRRSv is one of the most important infectious disease problems in pigs and costs the U.S. swine industry up to $600 million in losses each year. Other recent examples of the major economic impact of infectious diseases of food animals in the U.S. include porcine epidemic diarrhea (PED) in 2013-14 and the devastating highly pathogenic avian influenza (HPAI) outbreak in 2015; the latter outbreak was estimated to have cost the poultry/turkey industries approximately $4 billion. Countermeasures for other TADs of major concern to the DHS and USDA, because of their significant potential to cause outbreaks in the U.S. with serious industry and economic ramifications, are currently studied at K-STate and with external collaborators.

Importantly, expertise at K-State includes active work to assist with transition of basic research into practical applications for direct use by industry, government and diagnostic laboratory stakeholders.

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Research & Development for U.S. Bio/Agro-defense: Protecting Agriculture and Preserving Public Health

Background

Awareness is increasing on the risks posed to U.S. agriculture and public health due to processes such as 1) the accidental or deliberate introduction of disease agents previously confined to other parts of the world, 2) the emergence of hitherto unknown pathogens or 3) the acquisition of new capabilities by microbes previously considered benign.

The 2018 White House National Biodefense Strategy outlines five goals with associated objectives for strengthening the biodefense enterprise, including to "Strengthen biosafety and biosecurity practices and oversight to mitigate risks of bioincidents" and to "Ensure a vibrant and innovative national science and technology base to support biodefense."

Description

The Kansas State University Biosecurity Research Institute (BRI) at Pat Roberts Hall is a linchpin of U.S. bio/agro-defense capabilities because of its capacity to support research and development of diagnostic tools, contribute to greater understanding of the basic biology and life cycle of poorly-understood pathogens, and provide a testing ground for possible countermeasures and treatments.

The BRI is one of a few high-containment facilities in the U.S. allowing research on livestock experimentally infected with a broad range of highly pathogenic organisms. For example, the BRI is the designated facility at K-State for work on organisms classified by the U.S. government as select agents. These are agents that have the potential to be weaponized and require specialized facilities and highly trained personnel to ensure constant safety and security. Research at the BRI has already resulted in development and testing of two vaccines for highly pathogenic influenza, a vaccine for classical swine fever, and vaccines for Rift Valley Fever virus. These diseases are either zoonotic or potentially devastating to agriculture, or both.

Among the specialized facilities at BRI are 1) a state-of-the-art Arthropod Containment Level 3 Laboratory and supporting mosquito rearing room that allows researchers to investigate interactions between pathogens and their insect vectors and 2) a food production research suite that supports research on pathogens entering the food production process at various points. BRI has hosted research on mosquito-borne diseases such as Japanese encephalitis and Zika as well as on deadly foodborne pathogens, including Shiga-toxin-producing *Escherichia coli* and potential deliberate contaminants such as *Bacillus anthracis*.

Plant pathogens are also under study at the BRI, including known and emerging pathogens that threaten Kansas and worldwide production of three of the top five crops grown globally, namely wheat, corn and rice. Research topics include improving our ability to predict and detect the emergence of new pathogen varieties with enhanced virulence as well as mitigation strategies for existing and novel types. One example is wheat blast, which is a newly emerged and globally spreading disease causing substantial losses in South America and Southern Asia. This disease, and others, have the potential to disrupt food security and to destabilize already weakened nations.

Relevance

America is unprepared for a bioterrorism attack targeting agriculture — crops or livestock — or food. Interruptions to the food supply, either natural or man-made, threaten public health and economies. Furthermore, a growing worldwide population, changes in land use and climate, and increased global mobility and trade all increase the likelihood of the spread of previously unknown diseases. Improvements in basic science, vulnerability assessments and mitigation strategies are needed to address these real threats.

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Integrated Solutions for U.S. Bio/Agro-defense: National Agricultural Biosecurity Center and its Role in Securing the Agriculture and Food Enterprise

Background

Protecting American agriculture and food from global biothreats while safeguarding the public from zoonotic animal diseases and foodborne pathogens are recognized as vital to U.S. homeland security. The Homeland Security Presidential Directive-9 (HSPD-9), issued on Jan. 30, 2004, identifies six areas as critical for this mission: 1) awareness and warning; 2) vulnerability assessments; 3) mitigation strategies; 4) response planning and recovery; 5) outreach and professional development; and 6) research and development.

Subsequent law and guidance have codified the mandates of HSPD-9 (Public Law 115-43 in 2017 and National Security Presidential Memorandum-14 in 2018).

Description

Kansas State University's National Agricultural Biosecurity Center (NABC) is an important contributor to the activities specified by HSPD-9. This has been recognized by the Food, Agriculture, and Veterinary Resilience (FAVR) group at the Department of Homeland Security (DHS), which has tasked NABC with defining targeted outcomes for each of the HSPD-9 requirements.

The NABC will assist DHS FAVR in defining today's bio/agro-defense capabilities against the defined outcomes to establish a current performance baseline and to identify performance gaps that may exist.

To this end, NABC has created a Food, Agriculture, and Veterinary Intelligence Center to complement and expand activities of the Kansas Intelligence Fusion Center biothreat team. Specifically, NABC will add expertise in agriculture and food domains to intelligence gathering needed for the awareness and warning needs of HSPD-9.

To help make sense of the intelligence being gathered and to inform policymaking regarding surveillance, mitigation strategies and response planning, NABC has been tasked by DHS with conducting pathway risk analyses focused on foreign disease threat introductions to the U.S. Work has been done on both animal (African swine fever) and plant (wheat blast) potential introductions. Pathway analyses include possible routes of introduction, practices that might help reduce the chance of introduction, and the threat associated with particular activities.

NABC also plays an important role in response planning and training; specifically, it has been tasked by DHS to provide a clearinghouse for planning, training and knowledge-based products to help state, local, tribal and territorial entities prepare for transboundary livestock disease outbreaks. The program also entails developing collaborations with academia, industry and state-level government organizations. Curriculum development is required for emergency response planners in the food and agriculture realm. For state response planning elements, an immersive suite of courses is needed to ensure that planners have the necessary levels of agricultural, industry and government knowledge to be effective.

Relevance

America is unprepared for a bioterrorism attack targeting agriculture and/or food. Interruptions to the food supply, whether naturally occurring or man-made, destabilize public health and the economy. Unintentional disease outbreaks in recent years, including avian influenza and porcine epidemic diarrhea virus, have demonstrated this.

Greatly improved awareness and warning, vulnerability assessments, and response planning and recovery are needed. NABC is poised to play an important role in these efforts.

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Computer Network Security Training for Businesses

Background

The amount of sensitive information organizations are collecting on their consumers continues to increase with each passing year. Both parties derive various benefits from such information exchange, but it is predicated on consumers' trust that organizations will safeguard the information they gather. Unfortunately, consumer trust is slowly eroding as the number of cyberattacks on organizations has steadily risen over the past several years.

Recently, there has been a shift in organizations seeking to increase their efforts toward securing their digital assets and networks but they lack expertise in accomplishing their efforts. This has led to an increasing demand for IT security professionals who can help organizations reach their security goals and protect the sensitive information they hold. However, these professionals struggle because organizations have been hesitant to expend resources in information security due to its lack of tangible benefits, immeasurable success and the wide array of potential threats. Additionally, organizations that expend resources toward information security struggle with employee compliance.

Description

This initiative consists of aiding IT security professionals across all levels. Specifically, we teach students and assist IT security professionals with methods for analyzing security vulnerabilities, identifying manageable solutions, redirecting the organizational culture toward one of information security, and properly diffusing and resolving incidents in the event they occur.

Relevance

We believe that improving organizational information security begins at the student level. We expect that offering high-level training in the classroom will better prepare students to handle the growing security demands among organizations. Therefore, we provide them with the knowledge and tools required to lead organizations toward greater information security. Furthermore, we extend knowledge and resources with current information security professionals across a wide range of industries by presenting and publishing high-quality security research at prestigious conferences in the field.

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Center for Research and Innovation in STEM Education (CeRISE)

Background

In 2012 the National Research Council (NRC) released a *report, Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering.* A major goal of this report is to "invite … postsecondary institutions to increase interest and research activity in [Discipline-Based Education Research] and improve its quality and usefulness across all natural science disciplines, as well as guide instruction and assessment across natural science courses to improve student learning." In this report and elsewhere, discipline-based education research (DBER) is defined as research on the teaching and learning of science, technology, engi-neering and mathematics (STEM) topics, which frequently is conducted by faculty who have appointments in the STEM departments. The NRC DBER report and other related reports place added emphasis on the status of discipline-based educational research and implementation of that research within university STEM departments.

STEM education is considered a priority by state and federal governments, and agencies such as NSF and the Department of Education.

At Kansas State University, we are uniquely positioned to become a leader in DBER and in research-based STEM instruction because of our following resources:

- Significant efforts in discipline-based educational research in STEM disciplines such as physics, math, engineering and computer science.
- The Center for Science Education.
- Broad range of disciplines are involved.
- The Teaching and Learning Center.
- Noyce Projects for helping science discipline majors become secondary school teachers.
- First-Year Experience.
- Core faculty who are involved in existing STEM education research and implementation.
- Significant overlap among the goals of the Ce-RISE, strategic plans of several colleges and K-State 2025.

Description

K-State has recently established a center for DBER with faculty at the leading edge of this important field. With key resources, this center will form the core of a world-leading DBER initiative to understand and improve the many teaching and learning issues that affect students, nationally and internationally, in STEM courses during their academic careers. Furthermore, the DBER initiative will enable research elucidating students' transition between school and university and between university and workforce. The research from this initiative will, in turn, lead to development and implementation in a broad range of STEM-related educational experiences not just at K-State but at educational institutions at all levels and throughout the world. As part of the effort, we anticipate coordination across disciplines in ways that will help students see connections and transfer learning from one discipline to another. Thus, K-State will extend its reputation in research-based physics education to other STEM areas, becoming an internationally-known center for high quality, research-based STEM education.

The faculty members involved in the center are from the colleges of Agriculture, Arts and Sciences, Educa-tion and Engineering. The goals for the center are to ***provide a home for conducting cross-disciplinary education research in the STEM disciplines,*** and conducting and publishing research on teaching and learning within and across disciplines, as well as career and academic transitions.

Relevance

Today's STEM students will need many different skills as they move through their careers. Universities today cannot anticipate all of the specific skills that students will need over their lifetimes. However, the ***universities must provide the foundation upon which students can build as they need to respond to the changing situations.*** Thus, universities must respond to the students' future needs by providing educations that cross disciplines and that build on the changes now being made in precollege STEM education.

For example, at the precollege level, the Common Core Standards have increased mathematics standards significantly. The intended result is to make high school graduates ready to begin at a higher level when they start university, thereby easing the transition from secondary school to university.

At K-State, particularly in physics, we have made significant contributions to understanding and to improvements in teaching and learning. We can now contribute to ***research on teaching and learning as students move from one discipline to another, from school to university, and from university to the workforce, areas where research is lacking.*** We have assembled a research team that includes a variety of disciplines and research perspectives to conduct such research, including faculty from all STEM-related disciplines and well as the College of Educa-tion.

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Science Communication Initiative

Background

Importance of science communication has been receiving much attention in the recent past. In early June 2016, an editorial in InsideHigherEd.com called on universities to improve communication about the science and research being done on their campuses (Hulcr, 2016). The article offered an opinion on the importance of such communication and suggested tangible ways of approaching the task. The author noted, "There are enormous benefits to be reaped, financial as well as political, if higher education manages to enter mass media." Higher education has used mass media for a long time, but scientists are often not prepared to provide the right information for nonexpert audiences or to engage with media directly. One path to improve communication between scientists and citizens is for universities to provide better training and collaboration opportunities for both scientists and communicators.

Description

The Science Communication Initiative, or SCI, seeks to engage communities in understanding, enthusiastically promoting and actively participating in science and research. KSCI aims to act as a clearinghouse for science and research communication activities on campus and connect campus entities with community partners. Many campus units and local organizations are already engaged in science and research communication activities, so our aim is to organize collaborative efforts and give all interested parties access to the same resources.

SCI formed in spring 2017 out of an effort to coordinate science communication events and training sessions across campus and regional communities. In early summer 2017, the Science Communication Fellows program, a joint effort between Kansas State University and community partner Sunset Zoo, was noticed by Maddie Sofia, producer for National Public Radio science correspondent Joe Palca. SCI recognized an opportunity to invite high-profile speakers to campus and structure activities around their visit, organizing the first Science Communication Week in November 2017, followed by the second Science Communication Week in November 2018, which were both hugely successful. The Flint Hills Discovery Center also partnered with KSCI, and many campus units — including the Office of the President, the Office of the Senior Vice President and Provost, the Office of the Vice President for Research, and the Graduate School — helped defray costs for the week's events.

Each week included events designed for the general public as well as events for K-State students and faculty. More than 1,000 people attended public lectures, a research colloquium, an open house at a local USDA-ARS facility, Science Café and Science on Tap events, a scholarship expo at K-State Libraries, a graduate student poster competition, an improv workshop for graduate students, and a special session for communications staff.

Future plans include an emphasis on offering continued training for graduate students, particularly in science, technology, engineering and mathematics (STEM) disciplines that typically do not offer communication training; connecting researchers with resources necessary to develop broader impacts plans and communications campaigns as part of grant proposals; reaching out to more partner organizations around the state; and providing more venues in which scientists can directly engage with public audiences.

Relevance

Researchers at K-State and elsewhere recognize a great need for communicating about their discoveries to audiences on a much larger scale than has been done in the past. In some cases, this will satisfy requirements from granting agencies, but other benefits include aiding legislators in understanding the economic value of K-State research efforts; advancements that develop new materials and health and technology advances benefiting the entire population; increasing public understanding of research and scientific issues leading to a more educated workforce; and inspiring tomorrow's researchers.

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Agro-combs: Using Tools from Physics to Solve the Challenges of Agronomy

Background

The most critical agricultural challenge is to double crop production by 2050 to meet the food demand of a growing world population. This must be done in a sustainable way by reducing the environmental footprint of crop and livestock production. To solve this challenge plant, soil and environmental scientists need accurate data at relevant time and spatial scales to improve the efficiency of agroecosystems. These data include concentration of multiple agriculturally significant gases. Multi-gas detection is indispensable for several agricultural applications, such as crop breeding, measuring trace gas emissions from agricultural systems, and crop nutrient management. Unfortunately, current technologies are a limitation for sensing agriculturally significant gases. A revolutionary laser spectroscopic method called dual comb laser spectroscopy (DCS) offers self-calibrating, rapid-field scale monitoring of multiple gases simultaneously by a single instrument.

Description

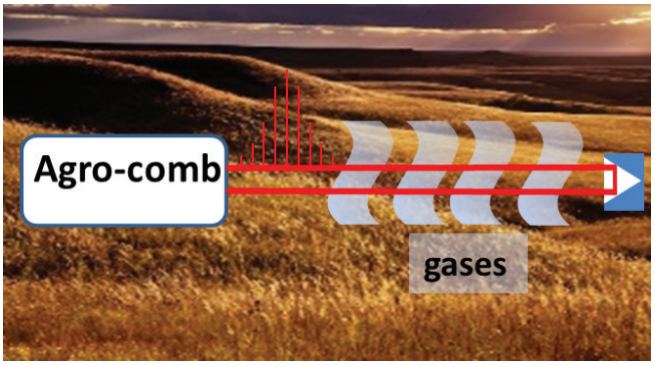
K-State is developing, under an NSF Major Research Instrumentation (MRI) Award, a novel sensor of agriculturally significant gases based on the Nobel Prize-winning technology of optical frequency combs. Dual optical frequency comb spectroscopy (DCS) is poised to transform crop production gas sensing with never-before realized spectroscopic capabilities, and will serve as a next-generation gas-detection platform. K-State, home to experts and facilities in both optical frequency combs and agricultural gas sensing, offers an excellent environment for the development of this key technological advance. An interdisciplinary team of world-class physicists and agronomists is developing a mid-infrared DCS system for the detection of agriculturally significant gases. This is a novel application of frequency combs which we call agro-combs.

Resulting experiments will lead to increased crop yield in the face of growing demands on natural resources. The instrument will allow simultaneous absorption measurements of multiple gas species with high sensitivity over a 10 m path.

Current agricultural gas detection systems are based on tunable laser absorption spectroscopy (TLAS) and Fourier transform infrared spectroscopy (FTIR). They have limitations that create a bottleneck for the development of high throughput phenotyping (HTP) platforms. TLAS has limited spectral coverage and thus can detect only a limited number of gases with a single instrument. FTIR can detect multiple gases but employs a mechanical delay line, limiting scan rates and stability for field deployment.

A few examples of research areas that could benefit from the agro-comb's capabilities:

- studies of native tallgrass prairie systems
- wheat breeding program
- animal production efficiency
- soil nitrogen gaseous losses
- ammonia production
- natural gas leak detection



Relevance

The instrument will be used for the broadband detection of many agriculturally significant gases.

Additional Investment would dramatically expand this work, by allowing multiple prototypes to be built, specially tailored to each application. Furthermore, large-scale funding would allow the integration of multiple laboratories and field sites, expanding the type of experiments that could be conducted with agro-combs in outdoor environments with multiple crops and plots.

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Data Analytics Institute: Large-Scale Data Inference and Computation

Background

Vast amounts of data currently inundate researchers across many fields and disciplines. A consistent, universitywide, large-scale resource is needed to provide high-performance, efficient, flexible data access and computation at Kansas State. This resource would allow K-State to participate in future research opportunities while satisfying compliance and data governance requirements from federal funding agencies. Although large datastores are essential for educational and economic development, near-term shortfalls are projected of nearly 200,000 data scientists trained to advantageously utilize big data and convert it to $300B in economic growth.

Information is currently generated as massive, high-dimensional data sets with complex correlation structures and/or nontraditional formats. These data sets arrive with unprecedented speed. Cutting-edge research in the social sciences, life sciences, physical sciences and education generates petabytes of data that are transformatively collected, transmitted, stored, processed and analyzed, revolutionizing how scientists, engineers, business people and educators approach complex problems. High-dimensional data are generated in diverse fields, including agriculture, astronomy, climate science, ecology, energy, genetic analysis, geospatial sciences, and plant and animal health. These data are often generated in real time and require rapid analysis. Other web-based sources for current massive data sets provide new realms of data to explore, such as online searches, social networking activities and financial transactions, with potential for improved business decisions and informed policymaking.

Description

This initiative proposes development of an interdisciplinary Data Analytics Institute at K-State's Manhattan campus, staffed primarily by data scientists from the mathematics and statistics departments in the College of Arts and Sciences, and faculty associated with K-State's Institute for Computational Research in Engineering and Sciences (ICRES) in the College of Engineering. Local HPC resources at ICRES uniquely provide a platform to train students and staff in cyber-infrastructure. ICRES staff and students deploy entire clusters and learn state-of-the-art high-performance computing and storage by contributing to ongoing research projects. K-State HPC-trained alumni now work at Google, Lawrence Livermore National Laboratory, Cerner, Garmin and multiple other leading technology companies.

ICRES faculty, in collaboration with campus researchers, provide requisite skills for design of big data studies; adaptation of algorithms for parallel computing; collection, storage and retrieval of big data, and modeling and analysis of such data; and interpretation of results. New tools for big data analytics will be developed and disseminated to the broader community. A fundamental goal of the institute is the development of innovative curricula for undergraduate and graduate students to engage in large-scale data-driven science and engineering. The institute could specifically contribute collective expertise to precision agriculture, bioinformatics and security; enhance secondary education; and provide significant advancement for federal and state initiatives on STEM workforce development.

Relevance

Establishment of a Data Analytics Institute aligns closely with K-State 2025 goals related to research, and graduate and undergraduate education, including research experiences for undergraduates. The institute will focus on university strengths and critical needs, particularly in biosciences and animal health at K-State. Creating the institute with cluster hires and/or joint appointments will strengthen and expand research funding opportunities throughout the university. In addition, the institute will facilitate corporate partnerships with industry in the Kansas-Missouri animal health corridor. The K-State Olathe campus offers a convenient venue for engagement between professional development and/or business related to big data.

K-State's ICRES has consistently developed and influenced cyber-infrastructure for research and education. With existing collaborations between leading national and international research organizations (e.g., XSEDE), and the anticipated arrival of NBAF, ICRES has the potential to form alliances with and attract a multitude of cyber-enabled and bioinformatics companies to Manhattan. This project will be a catalyst for these endeavors, provide a vital research test bed, and establish a regional center to train the future cyber-enabled workforce.

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Developing Critical Zone Research on the Konza Prairie

Background

The Earth's Critical Zone (CZ) is the thin outer veneer of our planet, from the top of the tree canopy to the bottom of our aquifers — the region of Earth that supports almost all life. Population growth — and the associated demands for food, fuel and clean water — combined with climate and environmental change place the critical zone under ever increasing pressures. Understanding, predicting and managing land use intensification while mitigating and adapting to rapid climate change, biodiversity decline and sustained provision of key ecosystem services are now some of the most pressing societal challenges of the 21st century. The Critical Zone Observatory Network aims to investigate these processes and pressures through monitoring and observation. Ten US critical zone observatories contribute to a global initiative that includes over 60 research sites on six continents.

K-State aims to join this network by building on the Konza Prairie Long-Term Ecological Research (LTER) program[1], a comprehensive ecological research, education and outreach initiative centered on one of the most productive ecosystems in North America: the tallgrass prairie.

Description

Previous ecological and hydrological research conducted at the Konza LTER have established this site as an ideal location for investigating environmental pressures and processes affecting prairie, karst and former prairie landscapes across North America. It also bears particular relevance to the region overlying the Ogallala Aquifer[2]. The Konza location presents an ideal complement to the existing CZO network, as it is uniquely equipped to address key questions into critical zone functioning that existing CZOs cannot assess.

A region with areas largely unmodified by human activities. Grasslands, rangelands, steppe, tundra, savanna and shrub-grasslands cover 40 percent of the Earth's land surface. North American tallgrass prairie covered ~67 million ha in the U.S. prior to the 1800s. Today, less than 5 percent of these grasslands remain and these are concentrated in the Flint Hills of Kansas and Oklahoma. Konza, therefore, represents a reference ecosystem against which intensively managed former prairies can be evaluated.

A region of ecologic transition and climate gradients. From east to west, tallgrass gives way to mixed grass to shortgrass. The region also lies at the confluence of areas that are predicted to undergo contrasting change in climate (drier to the southwest, wetter to the northeast). Rising temperatures will lead to increased demand for water and energy, which constrains development, stresses natural resources, increases competition for water and requires new management practices, and will also affect the ecologic balance.

A region with significant water challenges. Groundwater serves as the main source of water to irrigate western Kansas and support its residents. Water balance across the region is delicate and aquifer depletion is predicted at current extraction rates. To date, 30 percent of the groundwater has been pumped and a further 39 percent is projected to be depleted over the next 50 years. Recharge supplies only 15 percent of the current pumping and would take an average of 500 to 1,300 years to completely refill the aquifer. There is a pressing need to quantify the processes controlling recharge under climatic, geologic and vadose factors in this region so that effective management strategies can be developed.

A CZO in the Konza region would add to the range of lithologic gradients investigated by the CZO network; bring an unglaciated peri-karst weathering history into consideration and allow the evolving hydrology of this pedologically and geologically dynamic environment to be elucidated. Critically, it would provide the opportunity to examine the consequences of global climate change in an area that could be one of the most dynamic and sensitive regions in the U.S. Steps have been taken to establish new infrastructure at Konza, including vadose zone monitoring arrays, which will bring the site in line with the recommended common measurement approach proposed by the CZO network.

Relevance

This initiative will provide a nexus for collaborative research between K-State departments and colleges, including biology, agronomy, geography, geology and engineering. Furthermore, it will facilitate new opportunities to collaborate with other research institutes within the CZO network.

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1 http://www.konza.ksu.edu/knz/pages/home/home.aspx
2 http://www.konza.ksu.edu/knz/pages/home/home.aspx

National Center for Information & Systems Assurance (CISA)

Background

Our highly networked world, where software pervades all aspects, is dominated by cyber-physical systems (CPS). The dividing line between electronic security, physical security, and safety has blurred to the point of near invisibility. Cyberattacks are a major threat to society; they can inflict physical damage to trillions of dollars in infrastructure and threaten the well-being (and lives) of millions. The correct and secure operation of software is required to protect this critical infrastructure. Recent reports to the National Academy of Sciences urge the adoption of software with "correctness certificates." The Department of Defense (DOD) has developed a "System Assurance Strategy" that stresses security throughout a system's lifecycle and requires DOD programs to account for vulnerabilities. The Food and Drug Administration has developed guidance for the security of medical systems and device software. The Institute of Electrical and Electronics Engineers released the report "Building Code for Medical Device Software Security" in response to mounting pressure to secure the medical infrastructure. Kansas State University researchers have been key participants in many of these efforts, with a distinguished history of developing technologies for construction of safe and secure systems.

Description

The Center for Information and Systems Assurance (CISA) is a leader in cybersecurity research, teaching and outreach. In 2010, CISA was designated as a National Center of Academic Excellence for Research in Cyber Security by the National Security Agency and Department of Homeland Security. For more than 15 years CISA researchers have collaborated with partners such as Rockwell Collins, Boeing, HP, Microsoft, Honeywell, Galois, Adventium and Idaho National Lab to design secure, mission-critical software systems. New collaborations in safety, security and education research are being explored.

CISA has also contributed to securing the national infrastructure. DOD contractors integrate custom and off-the-shelf components from hundreds of suppliers to build complex distributed systems. Because current design, acquisition and vulnerability assessment techniques are insufficient for this complexity, security flaws and cost overruns are common. CISA researchers have developed tools to design and assemble such software systems quickly and at low cost. CISA researchers have also developed tools that protect medical communication, reduce programming errors and simplify integration of security into next-generation CPS. CISA members also have multiple prestigious awards, including five National Science Foundation (NSF) CAREER awards, and more than $1.25M in DOD funding to study the safety and security of dynamically composable CPS.

Additional funding will significantly enhance CISA capabilities to solve the challenges of next-generation CPS. These challenges include faster, less costly design of zero-failure mission-critical systems, tools to protect the nation's critical infrastructure, and partnerships with corporate and local, state and national agencies to educate the general population on ways to overcome cybersecurity challenges.

CISA is uniquely poised to tackle these issues. CISA will develop usable security solutions that seamlessly integrate with current verification and validation activities, and produce secure systems by increasing uptake and reducing development costs. Enabling techniques include reasoning based on formal languages and type theory, code generation, and developer tools evaluated for usability. A shortage of cybersecurity engineers has been regularly cited as a potential threat to national security. CISA will continue to develop tools for security education at K-State, Kansas State Polytechnic and K-State Olathe, and determine how to most effectively present security education material.

Relevance

CISA has a reputation of building secure software protocols and systems. Given existing collaborations with cybersecurity industry leaders and the anticipated arrival of the National Bio and Agro-defense Facility (NBAF), CISA will promote collaboration with cybersecurity and biosecurity companies, and help establish a regional center to train the future cybersecurity workforce. CISA has also established CANSec, a semiannual workshop to present ongoing research and promote collaboration.

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Networking, Security, and Resiliency for Critical Infrastructures

Background

Daily societal activities increasingly depend on interdependent critical infrastructures such as power grids, telecommunication networks, transportation networks, food networks and water distribution networks. In contrast to isolated systems, interdependent networked systems demonstrate emergent behaviors caused by unpredictable, rare nonlinear interactions between numerous social, physical and cyber components. Because infrastructure systems are large, they are often decentrally controlled through cybersystems. Although decentralization and self-organization theoretically reduce failure risk, interdependencies can lead to disruptive and massive cascading failures.

Interdependent and multilayer networks characterize critical social and engineered infrastructures, but a thorough understanding of their behaviors through fundamental results is still lacking. For example, the smart grid concept includes application of advanced computer, communications and power technologies to obtain a highly automated, responsive and resilient, transmission and distribution infrastructure. At the distribution level, the smart grid integrates distributed, renewable generation sources with energy storage and provides demand response management to customers through dynamic pricing. At the transmission level, communication architecture creates an intelligent infrastructure that can detect and mitigate faults faster than those faults can propagate, thus providing utility operators with improved efficiency and reliability. Although ongoing efforts to design a next-generation communication network within the smart grid framework are in progress, lack of flexibility and programmability of network equipment has impeded experimentation of new schemes. Consequently, power operators are reluctant to adopt untested solutions.

Description

This project has two primary goals. The first is to study interdependencies between critical infrastructure networks and provide fundamental insights on the impact of these interdependencies related to reliability of the coupled system in order to increase reliability by developing analytical tools to measure and adapt system interdependencies. The goal is to address key issues to allow rigorous experimentation and analysis of networking solutions in the real-world environment. For example, large-scale experiments that incorporate resources from the Smart Grid Lab at Kansas State University, K-State networking resources, and the Global Environment for Network Innovations (GENI) test bed will be performed. To date, a hybrid simulator has been created that integrates continuous-time behaviors of the power system with discrete-event behaviors of the communication network. This platform has demonstrated performance impacts of the communication network and the power system when the physical infrastructure is designed to maximize robustness. Furthermore, this platform demonstrated that an OpenFlow communication network could perform equally well with or better than its multiprotocol label switching (MPLS) counterpart. Finally, a smart grid prototype was deployed on the nationwide GENI network test bed to demonstrate OpenFlow's ability to provide services comparable to MPLS.

Relevance

Numerous critical infrastructures in Kansas and the United States rely on secure networking and communications. In Kansas, power and networking companies have demonstrated endorsement by sponsoring K-State's Electrical Power Affiliates Program (EPAP). This research has also received national contributions from Raytheon BBN Technologies, KanREN, Internet2, the National Science Foundation, and National LambdaRail.

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Coupled Climate, Cultivation, and Culture in the Great Plains: Understanding Water Supply and Water Quality in a Fragile Landscape

Background

Our work focuses on the Smoky Hill watershed in the Central Great Plains (CGP), a region with longstanding water quality and quantity concerns. In addition to multiple bio-physical stressors, the CGP has a socio-economic system already overwhelmed with population shifts, concentrated land tenure, dependency on a highly variable limited water supply, economic uncertainty, cultural resistance and skepticism of climate science.

Description

Water is a critical component of Earth's system; its relative abundance and quality drive native and managed ecosystems, as well as human enterprises on the landscape. Freshwater is central to agriculture, industry, residential development and other economic aspects, providing needed an essential ecosystem. Existing freshwater resources are being challenged by increasingly unsustainable land and water use. The distribution, abundance and quality of freshwater supplies will be affected by projected climate change and variability. Unless landscapes are managed proactively, sustaining even present levels of ecosystem goods and services from aquatic systems will be impossible. Among the most pressing environmental challenges related to freshwater are how to formulate and implement sustainable, science-based strategies to adapt to climate variation, land use land cover (LULC) change, and other sources of human development. To achieve sustainable landscape management, integrative mechanistic models are needed that account explicitly for human-landscape interactions and incorporate detailed, well- developed, coupled models of hydrosystems, aquatic ecosystems and human system responses to a changing climate. The purpose of our research is to develop coupled integrated mechanistic models of these systems in the CGP — the hydrosystem, the human system and the aquatic ecosystem — utilizing an agent-based decision framework to evaluate whole- system response to climate variation scenarios derived from historical data and downscaled climate projections over different time scales. Finally, policy optimization modeling using this framework will help identify effective policy strategies to achieve water resource and ecosystem resilience in the face of human cynicism about climate change.

Relevance

Our research has the potential to transform the science supporting water sustainability efforts on several fronts. Specifically, our research will:

Dry Smoky Hill River

(a) improve upon current climate downscaling techniques using a modified ensemble-mean approach and stochastic downscaling methods; (b) produce qualitative and quantitative understandings of decision-maker behavior in the CGP; (c) develop a spatially explicit, landscape-scale synthesis of existing ecological data to understand how climate changes and watershed alterations impact riverscape-scale biodiversity, (d) facilitate understanding of how climate change will interact with a range of other stressors to impact the functional capacity of wetlands, (e) develop a new theoretical modeling framework for understanding integrated human-natural systems, especially with how to endogenize cultural factors (f) provide mathematical models for representing such systems, and solution approaches for the models, and (g) produce a robust policy optimization model that integrates interactions between human, water and ecological systems to maximize adaptability and sustainability in the face of future climate change.

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Community Collaboration in Juvenile Justice

Background

K-State Juvenile Justice Collaborative (K-State JJC), a multidisciplinary team of experts from sociology/ criminology, communication studies, family studies and human services, and K-State Research and Extension are collaborating on a project funded by the Kansas Department of Corrections and Kansas Advisory Group. Funding for this effort originates from Title II grants awarded by the Office of Juvenile Justice and Delinquency Prevention, a federal office legislated to support delinquency prevention and reduction, including juvenile justice system improvement. The goal of the project is to increase local capacity and enhance community collaboration in the area of juvenile justice. The team includes Kansas State University faculty members and graduate research assistants from the departments of sociology and criminology, communication studies, family studies and human services, K-State Research and Extension and researchers from the Docking Institute at Fort Hays State University.

Description

Working with stakeholders (e.g., local police, schools, correctional staff, court services, youth and other community stakeholders) in western Kansas, the project team will facilitate community collaboration to enhance local decision-making processes and effectiveness. During the two-year award period, facilitators from K-State Research and Extension, which has a presence in the 105 Kansas counties, will work closely with community members to use established dialogue and deliberation procedures to increase knowledge and understanding concerning issues related to juvenile justice in their own communities. These issues include a developmental approach to youth concerns, trauma-informed care, disproportionate minority contact, and best practices in working with specialized groups such as LGBTQI youth. This project is enhanced by combining the knowledge base and experiences of experts in diverse fields with the knowledge base and experiences of local community members. Local communities will be intimately involved in data collection and analysis, identifying youth-directed issues as recognized by community stakeholders. Ultimately, the project aims to empower local communities with a diverse set of tools that can then be utilized to support growth and health of youth, families, schools and their communities. As a result, a scalable, comprehensive toolkit may then be offered to other counties across Kansas and beyond to widen the scope of impact.

Relevance

Supporting healthy communities and individuals has a direct impact on diverse areas of concern in Kansas, such as education and the workforce, and health, education, labor and pensions. Moreover, the funds received are facilitated by the work of appropriations. The project reflects key features of Kansas State University's strengths, including its strength through interdisciplinary collaboration, its alignment with two colleges' strategic plans relating to research and engagement, its reflection of Kansas State University's land-grant mission and research focus as reflected in K-State 2025, and its alignment with the Kansas congressional delegation's committee assignments. Federal and state contact information can be found below.

Agency Contact Information

Funding is provided by the Office of Juvenile Justice and Delinquency Prevention through the Kansas Department of Corrections and in conjunction with the Kansas Advisory Group (KAG). Title II funding is provided from federal awards: 2015JFFX0058, 2016JFFX0006, and 2017JFFX0060 (CFDA #16.540). The KS Juvenile Justice Specialist, Brock Landwehr, is the point of contact concerning these funds. He may be contacted through Kansas Department of Corrections, Juvenile Services, 714 SW Jackson, Suite 300, Topeka, KS 66603. Phone 785-296-4120.

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Immersive 3D/4D Visualization for Education and Research

Background

Immersive environments and visualization technologies have catalyzed a revolution in education, storytelling and research. Rich interactive simulations have proven effective at improving the educational experience in fields such as engineering, architecture, health care and military operations. Similarly, these simulations are used in groundbreaking basic research in STEM fields. We have extensive knowledge and expertise in developing these kinds of technologies to support STEM training and research. We have state-of-the-art technology and manufacturing laboratories that are used to enhance university education through the creation of immersive digital environments and analog replicas. Examples of key contributions to education and research:

- 3D visualizations and 3D prints for architectural and medical purposes.
- 20' x 8' Panoramic Immersive Screen for virtual representations and experiences in research.
- 3D/4D virtual reality games using state-of-the-art computer hardware and software for education.
- Pedagogical expertise in problem-based learning.

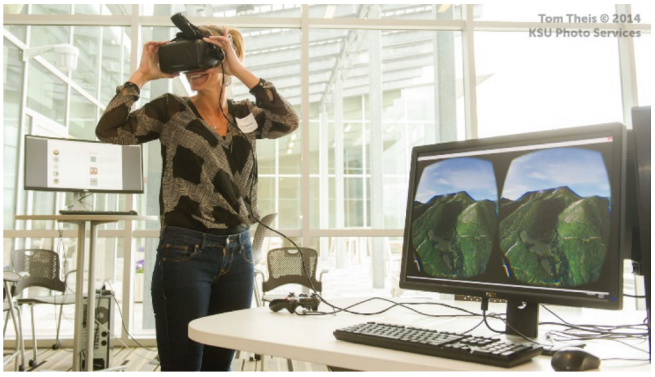
Interdisciplinary expertise of faculty in the College of Architecture, Planning and Design can be leveraged to contribute toward new educational opportunities, such as serious gaming, as well as novel research opportunities in info- and geovisualization.

Description

Educational Opportunities: Integration of serious gaming (where learning is the primary goal) may assist in building a diverse workforce and increasing opportunities for innovation while encouraging critical decision-making strategies. Simulations incorporated in the serious games can provide project-based experiential learning leading to better-prepared graduates entering the workforce and the public to learn critical social and environmental issues today.

Military Training Opportunities: Using immersive technologies and environment offer a novel way to support the training of troops to help in navigation and situational awareness. We are using these technologies to better understand how spatial memory is retained and how we might better use this knowledge to support the wayfinding and navigational skills for our military personnel.

Research Opportunities: Information visualization and geovisualization are technological methods used in research throughout the sciences and humanities. Our area of expertise is in creating high-fidelity virtual simulations of real and imaginary places, across multiple spatial and temporal scales. This expertise provides an opportunity to conduct research in environmental perception and spatial cognition, as well as engaging in the visualization of future alternatives for scientific and engineering assessment.



The adaptation of visualization technology to support these efforts combined with the recreation of these forms holds promise for improving education and scientific outreach.

Relevance

Incorporation of problem-based learning enhanced by visualization technology and serious gaming may increase the efficacy of STEM education and military training. Likewise, the ability to create a virtual environment with high realism enables us to better understand how landscape and built-environment landmarks influence spatial memory. Finally, these same technologies can be used to support research in STEM fields (by exploring realistic environments and conditions, and how interventions are magnified).

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Developing a Value Literate Culture in Science

Background

The complexity and broad impact of 21st-century STEM demand that researchers be more attentive to the ethical and social implications of their work. However, training in these areas is limited and, where it is available, often not well-integrated with STEM practice.

The establishment of rules about Responsible Conduct of Research (RCR) is a more prescriptive attempt to ensure that science is conducted ethically, produces reliable results and is communicated honestly with the public. Unfortunately, RCR training that focuses on narrow, rule-based prohibitions has been shown to have limited scope and impact.

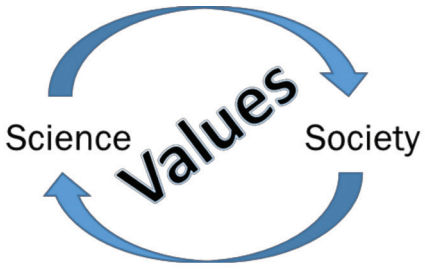
This project aims to remedy the shortcomings of RCR training by investigating the link between RCR compliance and scientists' views about the goals and values of science. It will improve our understanding of the ethical and social dimensions of STEM by investigating new methods for integrating humanities and social sciences into STEM training.

Description

This interdisciplinary collaboration between Kansas State University's philosophy and physics departments explores an underexamined determinant of RCR compliance: the goals and values that inform everyday scientific practice. Examples of such practices include identifying research topics, recruiting research teams, designing research plans that will yield robust evidence, and selecting and recruiting research participants. Each of these tasks requires making value judgments: about which policy problems are most important, whose perspectives are important, what experimental risks are worth taking, and when and how results should be shared with the public.

This project will investigate scientists' understanding of the aims of science and the effect such attitudes have on their motivation to engage in responsible conduct of research. Seeded by an initial, three-year grant from the National Science Foundation the project has two strands. The first strand gathers K-State science faculty to discuss their views about the goals and value of science and their relationship to good scientific practices. Scientists will discuss questions such as what role science should be playing in public policy, who is responsible for controlling unintended consequences of science, and what possible trade-offs there are between searching for truth, predictive accuracy and social benefit. The second strand of the research will develop an instrument for evaluating the attitudes of scientists toward the aims of science and their motivation to engage in RCR. This instrument will be the basis of further study into the most effective means for promoting responsible conduct amongst scientists.

The project is one of several initiatives at K-State to better integrate STEM with humanities and social science to help improve STEM research and education.



Relevance

The project will enhance efforts to promote RCR by identifying ways in which RCR principles serve or possibly hinder the goals of science. The hope is that RCR training can be made less burdensome and more productive by having it better incorporate scientists' values and language. By deepening engagement with the broader social context of science, this project will also improve understanding of a range of ethical challenges:

(i) potential misapplication of dual-use research,

(ii) the social impact of research,

(iii) diversity in science, and

(iv) duties to engage with the public.

The team aims to help scientists translate their own goals and values into good practices of teaching, mentoring and research, and will help them shape future science training by jointly clarifying how ethical STEM practice fits into general goals of science. The project will need continued funding to meet its goals to:

(i) modify RCR training to be more effective,

(ii) develop new methods for including ethical decision-making in STEM training,

(iii) integrate ethics and humanities training with science training,

(iv) foster intentional recognition by researchers of the ethical and social dimensions of their work, and

(v) improve broader impacts of science.

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Lipidomics Research Center: Poised for Discoveries Critical to Crop Improvement

Background

"Lipid" refers to a large and varied group of compounds that are not soluble in water. Lipids are found in every living organism, and every part of crop plants (grain, leaves, roots, etc.). Lipids are important in crops for two reasons. First, seed oils, which are major food and energy products, are lipids. Second, lipids are critical in regulating the resilience of crop plants to the challenges of their environment, due to their roles in membranes and as molecular signals. The goals of scientists studying lipids in crops are (i) to improve oil quantity and quality and (ii) to improve metabolism of lipids to enhance growth and stress resilience of crop plants.

One of the historic bottlenecks in plant lipid research is measuring the thousands of types of lipids. Advances in mass spectrometry have made it possible to easily identify different lipids, as well as rapidly quantify individual lipids; this technology is called "lipidomics".

Established in 2003, the Lipidomics Research Center (LRC) at Kansas State University is the world's longest-serving and best-known facility dedicated to providing the international plant science community with access to cutting-edge lipidomic approaches. LRC scientists have established mass spectrometry-based methods for over a thousand plant lipids. Scientists from over 600 labs have come to LRC or sent samples for analysis, resulting in hundreds of scientific publications. LRC has competed successfully for funding for mass spectrometers in two National Science Foundation (NSF) Kansas EPSCoR and three NSF major research instrumentation competitions.

Description



With the current abundance of genomic information on crop plants, the time is right to combine genetic and large-scale data on plant lipids to make discoveries needed to design crops that produce high yields of seed oils of specific composition and withstand stressful environments.

LRC is poised to lead the plant science community in a major initiative to collect large-scale lipidomic data on crop plants and to utilize that data to enhance crop improvement programs. Experiments conducted at LRC suggest that combining lipidomics data with other plant genomic data will to lead to insights into plant metabolism that facilitate crop improvement. LRC scientists work closely with plant biochemists and agronomists at K-State and across the Midwest. For example, K-State researchers are utilizing lipidomics to design camelina-producing improved biofuels and oils useful in the chemical industry. Other projects are aimed at understanding how lipid differences can improve sorghum and wheat tolerance to heat, cold and drought.

Funding would provide personnel and improvements in sample and data handling and facilitate large-scale acquisition of crop plant lipidomics data and its association with genomic data. It would also provide training opportunities.

Relevance

The rate of increase in worldwide agricultural production is slowing and lags behind the increase in world population. With limited future ability to bring more land into production, increases in yield are needed. These increases must be made as climate variability is increasing. To develop crops with increased yield and more resilience, new knowledge and new strategies are needed. The time is ripe to discover how the understudied group of plant metabolites called lipids act and interact with plant genes.

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Building Transformational Innovation-based Partnerships

Background

The Advanced Manufacturing Institute (AMI) at Kansas State University has a successful track record of providing a broad range of industry-focused integrated business and engineering development services to accelerate the innovation process of new product and processing technologies.

Established as a Kansas Center of Excellence in 1985, AMI serves to advance technologies, people and companies through collaborative engineering and business partnerships in the following ways:

- From 1995 to present, AMI has completed more than 2,800 product design, design/build custom automation, product testing and new venture development projects with 600-plus businesses and organizations throughout the United States.
- AMI actively supports applied research and development efforts on diverse technologies such as aircraft cabin air filtration, noncontact concrete railroad tie inspection and precision agriculture.
- Since 1995, AMI has continuously operated an engineering/business student internship program that has served to accelerate the hands-on learning of over 600 undergraduate and graduate students.
- Since 2004, AMI has served as a funded University Center for the U.S. Dept. of Commerce Economic Development Administration (EDA). In this capacity, AMI focuses on accelerating innovations through building innovation networks and collaborations with individual companies, communities, and regions.
- In 2016, AMI was awarded the Kansas State University Excellence in Engagement Award for its performance on a large-scale, innovation-based, regional development project, co-funded by the EDA, USDA-Rural Development and the Kansas Department of Commerce.

Description

Kansas State University proposes to significantly expand and amplify AMI's innovation capacity in support of university faculty/student research teams through the transformation of AMI into the Kansas State University Technology Development Institute (TDI). Through this transformed institute, new early-stage, hands-on, proof-of-concept partnerships will be forged with university researchers. University-based innovation teams comprised of industrially experienced, hands-on, technical and business professionals, will work in partnership with university research teams. The TDI will rapidly construct university/industry open innovation networks to accelerate research projects, directly engage technology brokers and suppliers, scout prospective industry partners, and directly contribute industrially experienced technical and business expertise to harden early-stage university innovations.

Equipping TDI to serve as an early-stage university proof-of-concept partner will:

- Enable faculty/student research teams to capture more sponsored research funding through demonstration their teams are equipped for early market validation in the discovery process, and to carry their innovations further in the subsequent technology transfer/commercialization processes.
- Employ a systematic development process that enables faculty/students to focus on learning and discovery and TDI to focus on hardening, refining and transitioning innovations to industry partners.
- Equip TDI to host an open and accessible university makerspace to increase student experiential mentoring via industry-experienced design and development professionals.
- Position the university to have greater engagement and economic impact with the companies, communities and regions served.

Relevance

As a state, Kansas needs to increase its economic vitality through greater innovation-based economic development engagement. Existing companies need to grow, jobs and personal income need to increase, and communities and regions need new companies and sources of innovation to prosper. The state's companies, communities and regions could all greatly benefit from more direct engagement with an accelerated university innovation ecosystem.

Being able to accelerate the university transformation process of converting scientific discoveries into marketable products and services is not only vital to health of the university innovation ecosystem, it is increasingly critical in order to sustain financial support from federal/state agencies and industry sponsors. In addition, engaging students actively in this innovation acceleration process better equips today's university research teams and tomorrow's future graduates to have a greater near-term impact on society and the state and nation's economies.

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Microbiomes of Aquatic, Plant and Soil Systems (MAPS): Mediating Sustainability

Background

Microbiome science (understanding the natural role of microbes such as bacteria and algae) is essential to understanding the Earth's ecosystems and is a national priority. The challenge of simultaneously feeding a growing population, sustaining agriculture, maintaining soil quality, and minimizing greenhouse gases and water contaminants requires new data-driven solutions based in a fundamental understanding of the role and dynamics of Microbiomes of Aquatics, Plants, and Soils (MAPS). MAPS mediate disease and productivity of plants, control the quality of water, and moderate greenhouse gas production. MAPS hold the key to assessing and predicting the effects of global environmental change and mitigating ecosystem degradation.

Description

Our project transcends traditional microbiological (Fig. 1) and disciplinary boundaries by harnessing cutting-edge research tools and coupling technologies to rigorous field, experimental and environmental approaches while working from genes to ecosystems. The resultant discoveries and enabling technologies are providing critical knowledge to help scientists, engineers, and policymakers develop approaches to sustain food production systems while preserving biodiversity and ecosystem services. We address five of the eight Grand Challenges outlined by the U.S. National Academies of Science: Biogeochemical Cycles, Biodiversity and Ecosystem Functioning, Climate Variability, Hydrologic Forecasting, and Land Use Dynamics.

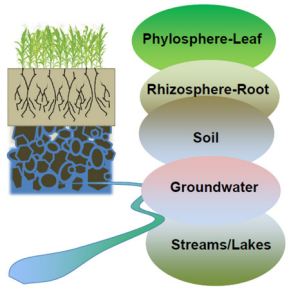

Fig. 1. Overlapping and interacting habitats of microbiomes of aquatic, soil and plant systems (MAPS).

Our goals: 1) elucidate MAPS-mediated ecosystem functions useful for predicting ecosystem responses to a variable precipitation regime; 2) develop best practices for promoting MAPS for desired ecosystem services (e.g., plant productivity, soil and water quality); and 3) use our MAPS research to enrich educational and outreach opportunities. We merge perspectives of multiple environmental disciplines and powerful genomic approaches to explore how MAPS regulate the environment and are affected by global change.

Kansas is dominated by agricultural land uses overlaid by a precipitation gradient broadly representative of both current and future precipitation regimes (Fig. 2). It is in these landscapes that society must grapple with food production while sustaining broader environmental health. Thus, Kansas

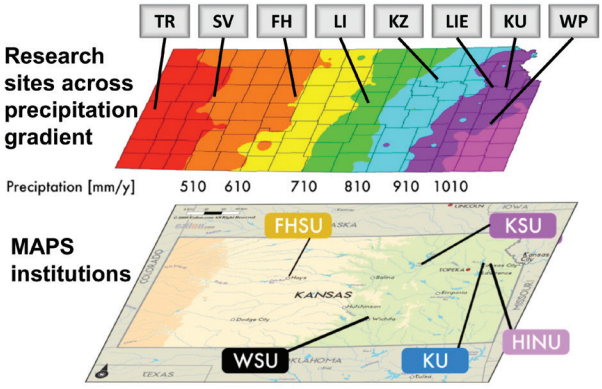

Figure 2: Kansas MAPS involves: University of Kansas (KU), Kansas State University (KSU), Wichita State University (WSU), Fort Hays State University (FHSU), and Haskell Indian Nations University (HINU). The precipitation gradient across the state, covers from arid grassland [510 mm/y] to deciduous forest [1010 mm/y]. Research sites are Tribune (TR), Smoky Valley (SV), Fort Hays (FH), The Land Institute (LI), Konza (KZ), The Land Institute-East (LIE), KU Field station (KU) and Welda Prairie (WP).

is an ideal living laboratory to explore our core concepts and build future research capacity.

Relevance

The critical role of microbiomes promoting plant production and other services opens the possibility that microbiomes could be managed for environmental benefits in an analogous way as probiotics may aid human health. Multiple recent national science initiatives underscore the relevance of MAPS: 1) the White House announcement of the National Microbiome Initiative that aims to advance microbiome science for our national interests; 2) the international Unified Microbiome Initiative (UMI) seeks to understand the role of microbiomes in all Earth systems, and 3) plant pathologists have created the Phytobiomes Road Map to increase understanding of interactions among microbes and plants.

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EPICENTER: Laboratory for a Network Science Approach to Predict and Control the Spread of Infectious Diseases

Background

Few events disrupt society and cause economic loss as severely as an out-of-control infectious disease. Terrorist activities or natural causes can produce an epidemic that may result in human deaths, disposal of herds and destruction of crops. Fundamental to EPICENTER's mission is the conviction that epidemic dynamics and intervention strategies must be derived while accounting for underlying complex networks that describe multiple and dynamic interconnections among involved systems.

Description

EPICENTER, a laboratory in Kansas State University's College of Engineering, provides resources to build, analyze and simulate data-driven computational models for biomedical and biological systems represented as complex networks. Research at EPICENTER challenges scientific boundaries by addressing the impact of heterogeneity, interdependence and stratification of networks in spreading processes. These three characteristics abound in natural and man-made infrastructures and networks, but fundamental questions remain unanswered regarding interconnected and stratified/multilayer networks.

EPICENTER has successfully conducted several research projects since its inception in 2007. Current projects include the following:

- *Predictive models of infectious diseases*. This project aims to develop innovative, multiscale computational models and tools to describe potential transmission cycles of zoonotic pathogens that could be introduced into the United States. Data generated by these models will be used to produce an operationally relevant predictive model that estimates the timing and spatial extent of emerging disease, and the transmission risk to humans. Studied diseases include Ebola, Rift Valley fever, and Japanese encephalitis.
- *Spreading processes over multilayer and interconnected networks*. The research goal of this project is to establish mathematical tools and techniques to understand the role of multilayer and interconnected topologies in spreading processes. For example, a multilayer network is a physical contact network in which a disease can propagate among individuals and an online information-dissemination network in which information can propagate among those same individuals. In zoonotic diseases, interconnected networks include the network of animals and the network of humans in which a virus can transfer from one population (network) to another.
- *Integrated models of disease spread, supply chain logistics and communication networks*. The objective of this project is to develop integrated models that capture interdependencies among disease dynamics, supply chain logistics and communication networks. For example, the spread of disease is influenced by the movement of animals, plants and food products through the supply chain. Effective management of this movement and deployment of countermeasures, such as vaccines, require effective risk and crisis communication plans that engage multiple stakeholders. Stakeholders also constitute a network through which information is transmitted. The integrated modeling approach is expected to yield new insight to prevent, mitigate and respond to infectious disease outbreaks.

Relevance

The National Agricultural Biosecurity Center (NABC), Institute for Computational Comparative Medicine (ICCM), Center of Excellence for Emerging and Zoonotic Animal Diseases (DHS CEEZAD), the planned National Bio and Agro-defense Facility (DHS NBAF) and EPICENTER are all located in Manhattan, Kansas, thus making Kansas the national leader in developing countermeasures to naturally occurring and intentionally introduced plant, animal, human and zoonotic diseases.

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Computer Vision & Image Understanding

Background

Tremendous defense, intelligence and law enforcement potential is emerging from image recognition technologies. The volume of video available from satellites, unmanned and conventional fixed video platforms is growing exponentially. The challenge no longer is having video intelligence The challenge is sorting through the massive volume of raw intelligence that exists and making it actionable. Whether this image is a human face of a suspected member of ISIS or Al Qaeda obtained from a UAV or a suspect ship potentially evading North Korean sanctions taken from a satellite, the ability to rapidly sort through millions of images automatically is a powerful force multiplier for warfighters and the intelligence analysts who support them.

One specific area of application for this emerging technology is counternarcotics. In Afghanistan alone, the DOD has spent over $8 billion in the last 17 years combating heroin production. Currently Afghanistan produces an estimated 80 percent of the world's heroin. Heroin production is the major source of income for the Taliban insurgency and the value of this crop is estimated to be as high as $6 billion annually. Quite literally, heroin production is fueling the insurgency that has cost the U.S. over 1,800 service personnel lives and 20,000 casualties, to say nothing of the human costs associated with heroin addiction worldwide.

The counternarcotics challenge in Afghanistan is that it is an extremely rural country that is almost the size of Texas with a weak central government. One possible tool in this fight is the use of image recognition technology to help the DOD and our Afghan partners automatically identify and then destroy both heroine production and distribution facilities and the poppy crops themselves prior to harvest.

Description

Kansas State University, working in conjunction with a current industry leader in this domain, proposes to work on the following identified challenges for the DOD:

- Real-Time Object Detection and Tracking — This is currently extremely labor intensive and limited to the number of available personnel who can view footage. There is the potential to use both machine learning and computer vision to automate this entire process and disrupt the Taliban's production and distribution network.
- Automatic Image Enhancement — Depending on the aerial platform, image and video quality is often suboptimal. DOD needs to, for example, enhance images by removing background haze and smoke.
- Persistent Surveillance and Tracking — Providing persistent surveillance over a wide area is currently impossible given a limited number of analysts available who can view footage in real time. Automating this process provides the DOD with a tremendous new capability in counternarcotics and would allow for greater change detection.
- Data Mining of Existing Data Sets — A large volume of data accumulated 2001 has potentially useful intelligence to determine patterns of life of individual subjects or areas, network analysis and anomaly detection that is not being realized absent automated data mining

Relevance

The United States has made a massive investment in various platforms that provide both analysts and warfighters with real-time image and video intelligence. Historically, the limiting factor in processing this intelligence was personnel. However, the advent of advanced algorithms and machine learning have the potential to make what was once thought impossible possible and largely automate this entire process.

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Scene Perception & Event Comprehension Theory (SPECT): An integrated computational, behavioral and neuroscientific model of event perception, understanding, and memory

Background

In our everyday lives, we encounter an endless stream of visual events that we effortlessly understand and later remember. These range from mundane events, such as someone buying a hotdog from a street vendor, to criminal events, such as an armed robbery, or suspicious events, such as leaving a backpack on a sidewalk. However, we cannot process all the available information we see due to our limited cognitive resources. Instead, we only perceive and remember those people, places, things and events that we pay attention to, and how we understand them determines how we later remember them. This has tremendous importance for intelligence and security operations. For example, when a surveillance operator watches a bank of CC TV security monitors, what determines what she pays attention to or ignores? Furthermore, how does she understand that someone's actions are a security risk? And what will she later remember to write in a report? These questions have become more important as security camera footage has been increasingly used to track and apprehend criminals (e.g., the Boston Marathon bombers, or New York's Chelsea bomber). If we could use artificial intelligence (AI) to automate what a surveillance operator does, we could do it more efficiently at a much larger scale. But to make such an automated AI system, we must first understand how people perceive, understand and remember what they see. How the human brain accomplishes these feats is only now beginning to be understood. Likewise, different AI programs have recently been developed to recognize people, objects or events at human levels of accuracy, but have not integrated these capabilities. Separately, psychologists have spent decades studying how people perceive scenes, understand complex events and later remember what they saw as three separate research topics. But progress in each of the above areas has been blocked by the lack of a theoretical approach that spans all three processing stages and the lack of necessary interdisciplinary collaboration using such an integrative approach. We have developed the first such integrative theoretical framework and will use it to leverage recent rapid developments in both cognitive neuroscience and artificial neural networks to bridge these gaps.

Description

Our project is unique in the breadth of our approach, spanning from the first perceptual processes that occur during single-eye fixations to later recall of events from long-term memory, based on our theoretical framework, the Scene Perception & Event Comprehension Theory (SPECT). We will bring together a team of cutting-edge, internationally renowned experts across multiple disciplines from K-State, SUNY Stony Brook, NIU and NYU in psychological science, neuroscience and computer science. We will triangulate the behavioral, neural and computational processes involved in event processing to develop a computational model of SPECT. Our research methods will have human participants watch CCTV videos while we track their eye movements and measure their brain activity, and later test their memory for the events in the videos. We will also create computational models to account for the relationships between viewers' eye movements and their brain activity, and between their brain activity and their memory for the video contents. These computational models will provide a cognitive architecture for future applications in security and intelligence.

Relevance

Our project produces numerous impacts on security and intelligence capabilities. We will create a computational architecture for computer applications that can take a previously unseen video and automatically predict which video segments human viewers will later remember. To do this, the software will determine when a new event begins (e.g., a robbery) and when it ends, then store a description of the event (an event model) in memory, then repeat the process for the next event (e.g. a get-away). The event model descriptions will include rich information about the events (people, places, things, people's actions and their inferred goals that predict their later actions). These event model descriptions will be stored in a deep neural network similar to human long-term memory. The computational architecture will make a key contribution to taking CCTV video footage, deriving understanding from it, and producing annotated descriptions of the footage in a retrievable format that makes sense to human analysts. This will have vitally important implications for security and intelligence.

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National Center for Information & Systems Assurance (CISA)

Background

Our highly networked world, where software pervades all aspects, is dominated by cyber-physical systems (CPS). The dividing line between electronic security, physical security, and safety has blurred to the point of near invisibility. Cyberattacks are a major threat to society; they can inflict physical damage to trillions of dollars in infrastructure and threaten the well-being (and lives) of millions. The correct and secure operation of software is required to protect this critical infrastructure. Recent reports to the National Academy of Sciences urge the adoption of software with "correctness certificates." The Department of Defense (DOD) has developed a "System Assurance Strategy" that stresses security throughout a system's lifecycle and requires DOD programs to account for vulnerabilities. The Food and Drug Administration has developed guidance for the security of medical systems and device software. The Institute of Electrical and Electronics Engineers released the report "Building Code for Medical Device Software Security" in response to mounting pressure to secure the medical infrastructure. Kansas State University researchers have been key participants in many of these efforts, with a distinguished history of developing technologies for construction of safe and secure systems.

Description

The Center for Information and Systems Assurance (CISA) is a leader in cybersecurity research, teaching and outreach. In 2010, CISA was designated as a National Center of Academic Excellence for Research in Cyber Security by the National Security Agency and Department of Homeland Security. For more than 15 years CISA researchers have collaborated with partners such as Rockwell Collins, Boeing, HP, Microsoft, Honeywell, Galois, Adventium and Idaho National Lab to design secure, mission-critical software systems. New collaborations in safety, security and education research are being explored.

CISA has also contributed to securing the national infrastructure. DOD contractors integrate custom and off-the-shelf components from hundreds of suppliers to build complex distributed systems. Because current design, acquisition and vulnerability assessment techniques are insufficient for this complexity, security flaws and cost overruns are common. CISA researchers have developed tools to design and assemble such software systems quickly and at low cost. CISA researchers have also developed tools that protect medical communication, reduce programming errors and simplify integration of security into next-generation CPS. CISA members also have multiple prestigious awards, including five National Science Foundation (NSF) CAREER awards, and more than $1.25M in DOD funding to study the safety and security of dynamically composable CPS.

Additional funding will significantly enhance CISA capabilities to solve the challenges of next-generation CPS. These challenges include faster, less costly design of zero-failure mission-critical systems, tools to protect the nation's critical infrastructure, and partnerships with corporate and local, state and national agencies to educate the general population on ways to overcome cybersecurity challenges.

CISA is uniquely poised to tackle these issues. CISA will develop usable security solutions that seamlessly integrate with current verification and validation activities, and produce secure systems by increasing uptake and reducing development costs. Enabling techniques include reasoning based on formal languages and type theory, code generation, and developer tools evaluated for usability. A shortage of cybersecurity engineers has been regularly cited as a potential threat to national security. CISA will continue to develop tools for security education at K-State, Kansas State Polytechnic and K-State Olathe, and determine how to most effectively present security education material.

Relevance

CISA has a reputation of building secure software protocols and systems. Given existing collaborations with cybersecurity industry leaders and the anticipated arrival of the National Bio and Agro-defense Facility (NBAF), CISA will promote collaboration with cybersecurity and biosecurity companies, and help establish a regional center to train the future cybersecurity workforce. CISA has also established CANSec, a semiannual workshop to present ongoing research and promote collaboration.

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Nuclear Radiation Detector and Systems Development

Background

National security concerns arise when terrorist and rogue states pursue nuclear weapons development. The U.S. departments of Defense (DOD), Energy (DOE) and Homeland Security (DHS) must identify security barriers, and develop new technologies to detect and mitigate these threats. National strategic research must include improved nuclear detectors and sensor systems for safeguard programs. Establishment of a center dedicated to development of radiation sensors and radiation measurement techniques is a direct response to national security needs.

In addition to faculty who are leaders in several areas relevant to nuclear detection, Kansas State University has nuclear capabilities unique to the Midwestern region of the U.S. The Semiconductor Materials and Radiological Technologies (SMART) Laboratory at K-State, one of the largest and most diverse university-based, radiation-detector development laboratories in the nation, is dedicated to research and development of new, innovative radiation-detector technologies. Over the past 14 years, the SMART Lab has benefited from numerous government and corporate sponsors, including the DOD, NSF, DOE Nuclear Engineering Educational Research program (NEER), and DOE NNSA office, totaling more than $23 million in extramural research support. A class-100 clean room and a recently installed dry room (<0.1 percent humidity) are dedicated to the fabrication of innovative radiation detectors.

The radiation-detector development group at K-State is involved in groundbreaking projects that emphasize development, design and fabrication of innovative nuclear radiation-detector materials and devices for applications such as nuclear materials monitoring, radiation imaging, radiation dosimetry and remote radiation sensing. The SMART Lab has extensive materials purification and crystal-growth facilities, semiconductor-detector processing fabrication equipment, electronics design and testing equipment, and radioactive calibration sources and detection calibration facilities, allowing the lab to be a fully operable facility for radiation-detector design and development. SMART Lab detectors have been featured in local and national news, and 21 U.S. patents have been awarded to SMART Lab researchers for novel detector designs, in addition to five Research & Development (R&D) 100 awards for innovative detector designs. The K-State nuclear program has conducted seminal civil defense research and maintains a world-class reputation in radiation shielding research. DOE, DHS and DOD laboratories are currently testing detectors from the SMART Lab. K-State operates the only university research nuclear reactor in an 11-contiguous-state region within the Great Plains. The K-State nuclear reactor is used extensively to test and characterize detector technologies developed in the SMART Lab. Additional support is provided by the K-State Electronics Design Laboratory (EDL), staffed with professional electronics engineers with combined experience exceeding 80 years. Proximity to the Fort Riley military installation offers potential dual-use development and testing in a secure environment.

Description

The mechanical and nuclear engineering (MNE) and chemical engineering (CHE) departments at K-State are renowned for innovative radiation-detector research. In addition to the K-State TRIGA Mark II nuclear reactor and the EDL, K-State seeks to combine and exploit these resources to establish a National Center for Strategic Applications of Nuclear Sensors (SANS). This interdisciplinary center will have four primary missions: (1) explore new radiation-detector materials, (2) design and fabricate novel radiation detectors with unprecedented performance, (3) develop integrated detector systems and arrays vital to national security, and (4) train the next generation of leaders in detector technology needed to replace the first generation of nuclear-trained scientists and engineers whose ranks are rapidly dwindling due to retirements.

Relevance

A combination of faculty, expertise and facilities will make the SANS center foremost in nationwide university- and government-based radiation-detector research, complete with materials research, neutron and gamma-ray detector development, electronics design, wireless detection technologies, and radiation monitoring and imaging devices. Establishment of the SANS center is a direct response to national security needs for development of new radiation detectors to mitigate nuclear materials. Detector development is highly relevant to a variety of radiation-detection applications such as stockpile stewardship, homeland security, astrophysics and space satellites, medical imaging, oil well logging, active personnel dosimetry, high-resolution gamma ray spectroscopy, and alternative methods for neutron detection.

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Immersive 3D/4D Visualization for Education and Research

Background

Immersive environments and visualization technologies have catalyzed a revolution in education, storytelling and research. Rich interactive simulations have proven effective at improving the educational experience in fields such as engineering, architecture, health care and military operations. Similarly, these simulations are used in groundbreaking basic research in STEM fields. We have extensive knowledge and expertise in developing these kinds of technologies to support STEM training and research. We have state-of-the-art technology and manufacturing laboratories that are used to enhance university education through the creation of immersive digital environments and analog replicas. Examples of key contributions to education and research:

- 3D visualizations and 3D prints for architectural and medical purposes.
- 20' x 8' Panoramic Immersive Screen for virtual representations and experiences in research.
- 3D/4D virtual reality games using state-of-the-art computer hardware and software for education.
- Pedagogical expertise in problem-based learning.

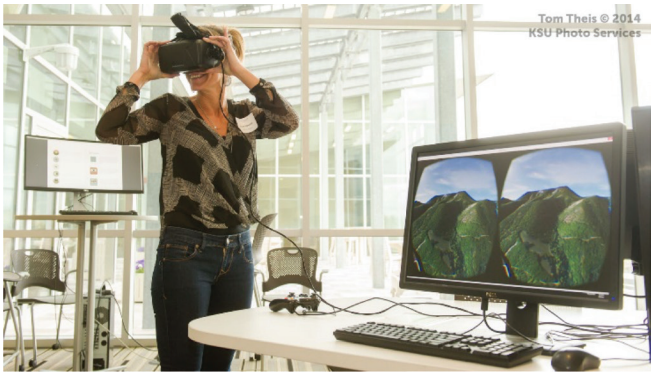
Interdisciplinary expertise of faculty in the College of Architecture, Planning and Design can be leveraged to contribute toward new educational opportunities, such as serious gaming, as well as novel research opportunities in info- and geovisualization.

Description

Educational Opportunities: Integration of serious gaming (where learning is the primary goal) may assist in building a diverse workforce and increasing opportunities for innovation while encouraging critical decision-making strategies. Simulations incorporated in the serious games can provide project-based experiential learning leading to better-prepared graduates entering the workforce and the public to learn critical social and environmental issues today.

Military Training Opportunities: Using immersive technologies and environment offer a novel way to support the training of troops to help in navigation and situational awareness. We are using these technologies to better understand how spatial memory is retained and how we might better use this knowledge to support the wayfinding and navigational skills for our military personnel.

Research Opportunities: Information visualiziation and geovisualization are technological methods used in research throughout the sciences and humanities. Our area of expertise is in creating high-fidelity virtual simulations of real and imaginary places, across multiple spatial and temporal scales. This expertise provides an opportunity to conduct research in environmental perception and spatial cognition, as well as engaging in the visualization of future alternatives for scientific and engineering assessment.



The adaptation of visualization technology to support these efforts combined with the recreation of these forms holds promise for improving education and scientific outreach.

Relevance

Incorporation of problem-based learning enhanced by visualization technology and serious gaming may increase the efficacy of STEM education and military training. Likewise, the ability to create virtual environment with high realism enables us to better understand how landscape and built-environment landmarks influence spatial memory. Finally, these same technologies can be used to support research in STEM fields (by exploring realistic environments and conditions, and how interventions are magnified).

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Building Healthy Relationships

Background

Healthy relationships are the foundation of stable and resilient families. Children and adults with stable and satisfying family relationships experience greater emotional stability and health than do individuals who live with family tension and negative interactions. In Kansas, divorce increases the likelihood that families with children will be poor by 46 percent (State of the Family: Kansas Child and Family Wellbeing Indicators). Indicators of whole family, couples and individual family member stress and relationship strain include:

- The rate of children in need of care (i.e., protection services) is 8.4 (per 1,000 children in population) as compared to 5.2 for the nation (Casey Family Programs, 2012).
- In 2013, 23,508 domestic violence incidents were reported to law enforcement agencies in Kansas.
- In 2014, compared to the nation's 11 percent average, 19 percent of adults in Kansas reported having three or more adverse experiences in their childhood (Kansas Behavior Risk Factor Surveillance Survey).

Many Kansas families experience repeated transitions, prolonged stress, unstable situations and poverty, which negatively impact relationships. Every person deserves the opportunity to have healthy relationships and to live free from the experience of interpersonal violence, toxic stress and social immobility. Researchers, teachers and outreach professionals in K-State's School of Family Studies and Human Services (FSHS) are dedicated to contributing to the development and enhancement of resilience and healthy relationships to improve the lives of individuals and families.

Description

To address these issues, applied research, clinical services, and programming are underway across units in the School of FSHS to:

1. Support healthy relationships across life-course transitions, cultures, family development and long-term relationships;
2. Assess the impact of witnessing interparental violence across generations;
3. Examine the impact treatment of depression has on intimate relationships;
4. support healthy partner and/or parenting relationships;
5. Develop and test a violence risk assessment tool to guide prevention and treatment of partner violence efforts in military families;
6. Assess the impact romantic relationships and parenting behaviors have on child outcomes;
7. Implement and evaluate a relationship education program for pregnant and parenting adolescents;
8. Study communication technologies on relationships between former partners and between parents and children following divorce;
9. Support and encourage parent-child communication about health and well-being;
10. Develop research-based community programs that focus on strengthening family relationships in the context of individual family units and the communities where they reside.

The collaborations of the College of Human Ecology faculty have led to grants and contracts to support research on building healthy relationships, preventing partner violence and supporting family resilience.

Relevance

Healthy relationships enhance all aspects of life. Children who grow up in homes with parents in healthy relationships do better in all aspects of life. Adults who are in healthy, committed relationships have better physical health, fewer emotional problems, and are more financially successful.

Faculty in K-State's School of FSHS in the College of Human Ecology are conducting applied studies that support healthy relationships. They are receiving private, state and federal funding for their research and have received national and international recognition for their efforts.

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Military and Veterans Programs
National Institute of Food and Agriculture United States Department of Agriculture

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Large-Scale Integration of Clean Technologies in the Power Grid

Background

Increased global demand for energy and dwindling fossil fuel reserves are causing concern regarding global warming, climate change and sustainability. This has resulted in worldwide interest in clean energy technologies such as wind and solar energy and electric vehicles. Total worldwide wind power capacity has increased from 74 gigawatts (GW) in 2006 to 487 GW in 2016; the United States' share of wind power capacity surpassed 80 GW in 2016. Similarly, solar energy capacity in the United States increased from less than 1 MW in 2000 to more than 40 GW in 2016; 14.8 GW of this capacity was installed in 2016. Regarding consumption of electricity, more than 100,000 electric vehicles have been sold in the United States since 2013. Despite many benefits of clean energy, integration of these systems into the power grid can lead to a new set of technical challenges, such as power plant scheduling to accommodate fluctuating wind and solar power, mitigating power quality issues due to increased usage of power electronics converters, reducing maintenance costs while providing high reliability and availability of wind turbines, and integrating high levels of rooftop solar photovoltaic (PV) generation and electric vehicles.

Government and industry have funded several research projects at Kansas State University, making the university a leader in power engineering research and education in Kansas. The proposed research aims to leverage prior research and strength in power systems and cyber-physical systems to seek innovative solutions for an increasing penetration of clean technologies into the power grid.

Description

Objectives of the proposed multidisciplinary research include removing barriers and developing human capital through education to advance sustainable energy pathways associated with electricity generation and its use in transportation while utilizing synergy between clean electricity generation and consumption. Faculty, students, industrial companies and government agencies will collaborate for successful commercialization.

The research will investigate enhancement of wind- turbine efficiency and durability, energy forecasting, integrated planning, reconfigurable grid-interactive converters, and integration of advanced cyber and communication technologies for optimized operation of the cyber-physical system with a high penetration of renewable resources. Increased efficiency and long-term reliability are crucial in order for wind turbines to compete directly with natural gas. Accurate forecasting will allow improved characterization of the stochastic nature of renewable resources, leading to more efficient planning and operation of the electric power grid. The investigation will allow opportunities to build models and tools that will facilitate more effective utilization of existing renewable resources, and integration of a significantly larger amount of additional renewable generation into the power grid.

The research will include solid-state converters, considered enabling technology, to realize a wide range of critical technologies such as grid-tied wind and solar energy systems and electric hybrid vehicles. These converters can significantly enhance flexibility and controllability of the power grid, consequently transferring the existing energy infrastructure to the next generation with a massive deployment of clean technologies.

Research related to power-distribution networks will focus on large-scale integration of solar rooftop generation and electric vehicles with on-site storage. Life cycle analysis will consider air quality and climate change impacts using the triple bottom line of social, environmental and economic concerns. Public education will increase understanding of the benefits of electric cars and wind and solar energy. The requested amount for the project is $4 million to be used by K-State for research, education and outreach. Some of the funding will be used for installation of solar PV generation, which will be fully instrumented and connected to the Smart Grid Laboratory at K-State, for real-time data collection and analysis.

Relevance

In order to reduce dependence on foreign oil and reduce carbon emissions, and promote economic prosperity, clean energy technologies must be a top priority of the U.S. government. Clean energy not only combats climate change but also creates new opportunities for jobs and business. The proposed research is focused on maintaining the world leadership of the United States in research and education related to clean energy generation, and utilizing and advancing the K-State 2025 plan to be a Top 50 public research university.

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Innovation in High-Performance Building Envelopes Collaborative Research Program

Background

Buildings consume a staggering amount of energy in the U.S.: nearly 40 percent of all energy consumed, more energy than that used by either transportation or industry (Source: EIA). Building energy costs also have a significant economic impact for businesses, whose utilities can be around 20 percent of operating expenses, and for households, whose utilities can be around 10 percent of expenditures. Thus, designing future buildings to conserve energy is crucial to the sustainability of our society, economy and environment.

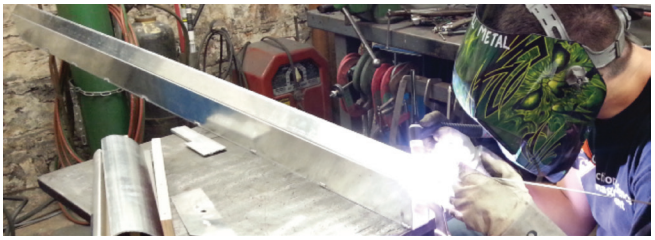
The International Energy Administration estimates that 40 percent of future energy reductions can be made by improving the performance of building envelopes: the walls, windows, roofs and foundations of buildings (Source: Technology Roadmap: Energy Efficient Building Envelopes - 2013). High-performance building envelopes reduce heating, cooling and lighting energy in buildings by reducing unwanted energy flow through the building skin while making daylight available to offset electrical lighting use.

Due to the inherent complexity of buildings, innovation in building envelopes isn't simply discovered in laboratories — but instead comes from the application of science and technology to problems identified in the real world.

Description

During the last five years at Kansas State University, a collaborative research program in the area of high-performance building envelopes has brought together experts in building science with professional architects, engineers and manufacturers to explore real-world performance challenges in building envelopes.

Research teams composed of graduate students use the College of Architecture, Planning & Design's state-of-the-art facilities and laboratory resources to build and test prototype building envelopes while applying advanced computer analysis tools to study the energy and economic impacts of designs. Collateral benefits of the program include the transfer of research methods and tools with collaborating professionals and industry partners while expanding the skills of graduate students in professional degree programs.



As it enters its sixth year of activity, the program seeks to expand by identifying:

- Partners to serve as potential clients for activities such as energy consulting and design assistance.
- Manufacturers interested in collaborating with the program to expand or realize R&D.
- Partnerships or funding that can expand the program's outreach and service.

Relevance

Building better-performing buildings and upgrading existing buildings is critical to sustaining future prosperity and growth in our communities and cities. Knowledge of building envelopes is an important asset for future professionals, and the dialogue around emerging design and analysis methods offers an incentive for professionals and manufacturers to work together to ensure improved building performance. Lastly, this project intends to support the state economy by benefiting Kansas professionals and manufacturers who collaborate in the project.

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Aluminum Nitride for High-Power Electronics and Ultraviolet Light-Emitting Diodes

Background

Aluminum nitride is an undeveloped semiconductor that offers promising new solid-state device capabilities and high energy-saving efficiencies compared to silicon, the most common well-known semiconductor. Aluminum nitride's physical, optical and electrical properties are superior to silicon for high-power electronic devices and ultraviolet (UV) light-emitting diodes (LEDs), two technologies poised to develop into multibillion-dollar-per-year industries within five to seven years. Kansas State University and the startup company Nitride Solutions Inc., leaders in producing high-quality aluminum-nitride single crystals and thin films, propose to team together to move beyond materials synthesis to device fabrication and development of systems incorporating these devices.

Description

Funds are sought to support research to solve lingering technical challenges related to material synthesis, device fabrication, device characterization and electronic system design that incorporates aluminum- nitride devices. Funds are also sought to provide education and training necessary to produce qualified researchers to accelerate the growth of this new industry. Funds will support K-State faculty and students, in partnership with Nitride Solutions, to develop advanced manufacturing technologies for aluminum- nitride-based solid-state devices. Funding is requested to help establish a Kansas-based, advanced, solid-state-device industry that will create jobs and bring Kansas technological recognition.

These funds will support research to create high-purity, low-defect density materials, develop practical device fabrication processes, and design electrical circuits to support new devices. Funds will also support education to produce engineering students with specialized talent, technical skills and entrepreneurial spirit needed for this burgeoning industry to thrive.

Relevance

Although silicon has these properties needed for low-power electronic devices for computers, mobile phones and photovoltaics, its properties are not well-suited for high-power switches and transistors as used in electrical conditioning in power supplies, motor controllers, and power-distribution systems. Because aluminum nitride can withstand higher voltages, currents and temperatures than silicon or silicon carbide (the current choice for power electronics), its devices can switch more than 10 times the power, while being more than six times smaller than comparable silicon devices. In addition, aluminum-nitride devices can operate 200 degrees hotter, while providing all advantages at increased energy efficiencies.

Aluminum nitride is the only semiconductor material suitable for making deep UV LEDs. UV LED light sources are essential for biological contamination detection and for killing pathogens in air and water. Aluminum nitride-based UV light sources also directly impact a broad array of defense technologies. Biological detection, identification, diagnosis, therapy and elimination, hostile fire identification (HFI) systems, superior light detection and ranging (LIDAR), three-dimensional (3D) imaging through smoke, short-range free-space communication and target recognition are critical military applications enabled by aluminum nitride-based UV light sources. As in all defense-related material platforms, this technology will filter down to commercial and private use for anti-collision systems in cars, faster wireless communication and a multitude of future products.

Since 1997, K-State has been a research leader in the synthesis of nitride semiconductors. In fact, former K-State students founded Nitride Solutions to capitalize on this technology. Proposed funding would support the next step in the manufacturing chain by developing technology to create electronic devices and UV LEDs from aluminum nitride. Ultimately, aluminum-nitride electronic devices will be deployed in electric vehicles, wind turbines, elevators, computer power supplies, solid-state UV light sources for nonchemical disinfection of water and food, and environmental monitoring.

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21st Century Technology for Legacy Engines

Background

Legacy engine is a term applied to industrial engines designed and manufactured before low-emission levels were required and before advanced control systems were employed. Typically, they are 20 to 50 years old. Most large legacy engines are mechanically sound and capable of operating reliably for many more decades. Many can perform at present-day standards if retrofitted with advanced technology. The challenge comes in designing technology appropriate for a given engine.

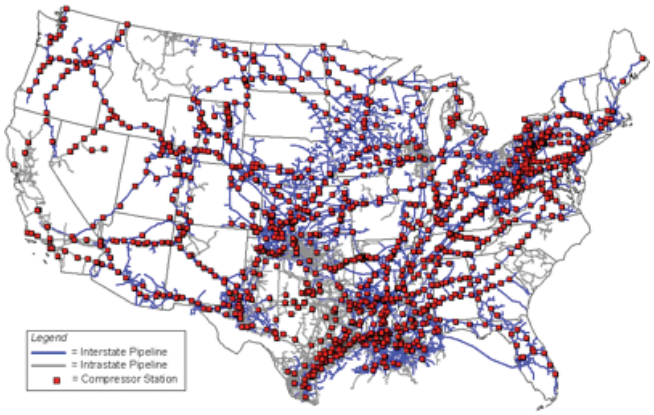
Description

Large reciprocating engines provide motive power throughout U.S. industry. These engines are ruggedly built and typically are capable of continuously generating several thousand horsepower each. They run at relatively low speeds and can continue to operate efficiently more or less indefinitely if properly maintained. These engines must meet myriad air quality regulations. These regulations vary widely with locality and application, and literally hundreds of different requirements can potentially apply to a given engine.

Pipeline compression engine. (Source: CTS, Combined Technology Solutions)

Use of these engines is widespread but, by far, the single largest use is in compression stations for the natural gas pipeline system. There are more than 17 million installed horsepower-for-gas pipeline compression stations in the U.S. Exact figures for the amount supplied by legacy engines are difficult to obtain, but saying 50 percent of installed power is from legacy engines is reasonable.

These engines are sufficiently large, and local requirements are sufficiently unique that each engine must be treated as more or less one of a kind. Upgrading each engine is a unique process, often with trial-and-error approaches. Our proposed research program is quite simple in concept. We propose to develop analytical tool packages that can be used to accurately predict the impact of available technologies on a given legacy engine and its emissions. The automotive engine industry has shown this level of analysis is feasible, but it is a much different proposition to apply it to hundreds of different engines, rather than design of a new engine that will be reproduced a million times. We plan to seek funding through the DOE Natural Gas Infrastructure R&D Program initiative.



Major natural gas pipelines and compressor stations. (Source: U.S. Energy Information Administration)

Relevance

The pipeline system map demonstrates the nationwide impact of this research. The ability to continue to use legacy engines is important for maintaining low-cost and reliable delivery of natural gas throughout the country. Through incorporation of advanced technology, these engines can contine to provide this service, meet current and future emission requirements, and be part of the solution to improve the environment by delivering an environmentally friendly fuel throughout the country.

Agency Contact Information

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Lipidomics Research Center: Poised for Discoveries Critical to Crop Improvement

Background

"Lipid" refers to a large and varied group of compounds that are not soluble in water. Lipids are found in every living organism, and every part of crop plants (grain, leaves, roots, etc.). Lipids are important in crops for two reasons. First, seed oils, which are major food and energy products, are lipids. Second, lipids are critical in regulating the resilience of crop plants to the challenges of their environment, due to their roles in membranes and as molecular signals. The goals of scientists studying lipids in crops are (i) to improve oil quantity and quality and (ii) to improve metabolism of lipids to enhance growth and stress resilience of crop plants.

One of the historic bottlenecks in plant lipid research is measuring the thousands of types of lipids. Advances in mass spectrometry have made it possible to easily identify different lipids, as well as rapidly quantify individual lipids; this technology is called "lipidomics".

Established in 2003, the Lipidomics Research Center (LRC) at Kansas State University is the world's longest-serving and best-known facility dedicated to providing the international plant science community with access to cutting-edge lipidomic approaches. LRC scientists have established mass spectrometry-based methods for over a thousand plant lipids. Scientists from over 600 labs have come to LRC or sent samples for analysis, resulting in hundreds of scientific publications. LRC has competed successfully for funding for mass spectrometers in two National Science Foundation (NSF) Kansas EPSCoR and three NSF major research instrumentation competitions.

Description

With the current abundance of genomic information on crop plants, the time is right to combine genetic and large-scale data on plant lipids to make discoveries needed to design crops that produce high yields of seed oils of specific composition and withstand stressful environments.

LRC is poised to lead the plant science community in a major initiative to collect large-scale lipidomic data on crop plants and to utilize that data to enhance crop improvement programs. Experiments conducted at LRC suggest that combining lipidomics data with other plant genomic data will to lead to insights into plant metabolism that facilitate crop improvement. LRC scientists work closely with plant biochemists and agronomists at K-State and across the Midwest. For example, K-State researchers are utilizing lipidomics to design camelina-producing improved biofuels and oils useful in the chemical industry. Other projects are aimed at understanding how lipid differences can improve sorghum and wheat tolerance to heat, cold and drought.

Funding would provide personnel and improvements in sample and data handling and facilitate large-scale acquisition of crop plant lipidomics data and its association with genomic data. It would also provide training opportunities.

Relevance

The rate of increase in worldwide agricultural production is slowing and lags behind the increase in world population. With limited future ability to bring more land into production, increases in yield are needed. These increases must be made as climate variability is increasing. To develop crops with increased yield and more resilience, new knowledge and new strategies are needed. The time is ripe to discover how the understudied group of plant metabolites called lipids act and interact with plant genes.

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Networking, Security, and Resiliency for Critical Infrastructures

Background

Daily societal activities increasingly depend on interdependent critical infrastructures such as power grids, telecommunication networks, transportation networks, food networks and water distribution networks. In contrast to isolated systems, interdependent networked systems demonstrate emergent behaviors caused by unpredictable, rare nonlinear interactions between numerous social, physical and cyber components. Because infrastructure systems are large, they are often decentrally controlled through cyber systems. Although decentralization and self-organization theoretically reduce failure risk, interdependencies can lead to disruptive and massive cascading failures.

Interdependent and multilayer networks characterize critical social and engineered infrastructures, but a thorough understanding of their behaviors through fundamental results is still lacking. For example, the smart grid concept includes application of advanced computer, communications and power technologies to obtain a highly automated, responsive and resilient transmission and distribution infrastructure. At the distribution level, the smart grid integrates distributed, renewable generation sources with energy storage and provides demand response management to customers through dynamic pricing. At the transmission level, communication architecture creates an intelligent infrastructure that can detect and mitigate faults faster than those faults can propagate, thus providing utility operators with improved efficiency and reliability. Although ongoing efforts to design a next-generation communication network within the smart grid framework are in progress, lack of flexibility and programmability of network equipment has impeded experimentation of new schemes. Consequently, power operators are reluctant to adopt untested solutions.

Description

This project has two primary goals. The first is to study interdependencies between critical infrastructure networks and provide fundamental insights on the impact of these interdependencies related to reliability of the coupled system in order to increase reliability by developing analytical tools to measure and adapt system interdependencies. The goal is to address key issues to allow rigorous experimentation and analysis of networking solutions in the real-world environment. For example, large-scale experiments that incorporate resources from the Smart Grid Lab at Kansas State University, K-State networking resources and the Global Environment for Network Innovations (GENI) testbed will be performed. To date, a hybrid simulator has been created that integrates continuous-time behaviors of the power system with discrete-event behaviors of the communication network. This platform has demonstrated performance impacts of the communication network and the power system when the physical infrastructure is designed to maximize robustness. Furthermore, this platform demonstrated that an OpenFlow communication network could perform equally well with or better than its multiprotocol label switching (MPLS) counterpart. Finally, a smart grid prototype was deployed on the nationwide GENI network testbed to demonstrate OpenFlow's ability to provide services comparable to MPLS.

Relevance

Numerous critical infrastructures in Kansas and the United States rely on secure networking and communications. In Kansas, power and networking companies have demonstrated endorsement by sponsoring K-State's Electrical Power Affiliate's Program (EPAP). This research has also received national contributions from Raytheon BBN Technologies, KanREN, Internet2, the National Science Foundation and National LambdaRail.

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Integrated Solutions for U.S. Bio/Agro-defense: National Agricultural Biosecurity Center and its Role in Securing the Agriculture and Food Enterprise

Background

Protecting American agriculture and food from global biothreats while safeguarding the public from zoonotic animal diseases and foodborne pathogens has been recognized as being vital to U.S. homeland security. The Homeland Security Presidential Directive-9 (HSPD-9), issued on Jan. 30, 2004, identifies six areas as critical for this mission: 1) awareness and warning; 2) vulnerability assessments; 3) mitigation strategies; 4) response planning and recovery; 5) outreach and professional development; and 6) research and development.

Subsequent law and guidance have codified the mandates of HSPD-9 (Public Law 115-43 in 2017 and National Security Presidential Memorandum-14 in 2018).

Description

Kansas State University's National Agricultural Biosecurity Center (NABC) is an important contributor to the activities specified by HSPD-9. This has been recognized by the Food, Agriculture, and Veterinary Resilience (FAVR) group at the Department of Homeland Security (DHS), which has tasked NABC with defining targeted outcomes for each of the HSPD-9 requirements.

The NABC will assist DHS FAVR in defining today's bio/agro-defense capabilities against the defined outcomes to establish a current performance baseline and to identify performance gaps that may exist.

To this end, NABC has created a Food, Agriculture, and Veterinary Intelligence Center to complement and expand activities of the Kansas Intelligence Fusion Center biothreat team. Specifically, NABC will add expertise in agriculture and food domains to intelligence gathering needed for the awareness and warning needs of HSPD-9.

To help make sense of the intelligence being gathered and to inform policymaking regarding surveillance, mitigation strategies and response planning, NABC has been tasked by DHS with conducting pathway risk analyses focused on foreign disease threat introductions to the U.S. Work has been done on both animal (African swine fever) and plant (wheat blast) potential introductions. Pathway analyses include possible routes of introduction, practices that might help reduce the chance of introduction, and the threat associated with particular activities.

NABC also plays an important role in response planning and training; specifically, it has been tasked by DHS to provide a clearinghouse for planning, training and knowledge-based products to help state, local, tribal and territorial entities prepare for transboundary livestock disease outbreaks. The program also entails developing collaborations with academia, industry and state-level government organizations. Curriculum development is required for emergency response planners in the food and agriculture realm. For state response planning elements, an immersive suite of courses is needed to ensure that planners have the necessary levels of agricultural, industry and government knowledge to be effective.

Relevance

America is unprepared for a bioterrorism attack targeting agriculture and/or food. Interruptions to the food supply, whether naturally occurring or man-made, destabilize public health and the economy. Unintentional disease outbreaks in recent years, including avian influenza and porcine epidemic diarrhea virus, have demonstrated this.

Greatly improved awareness and warning, vulnerability assessments, and response planning and recovery are needed. NABC is poised to play an important role in these efforts.

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Education Leadership in K-12 Schools

Background

In an era dominated by higher standards and greater accountability for America's schools, the Kansas State University response is to prepare great leaders at all levels who know how to implement change. The College of Education (COE) at K-State is utilizing partnerships for educational leadership development that will have wide and lasting impact in Kansas and across the nation. The programs and the activities in the college are led by its Department of Educational Leadership, which includes preparation of K-12 school leaders as well as faculty who specialize in adult education. This group uses a partnership model for collaborating with schools and other educational organizations to provide leadership training that touches the lives of thousands of learners and hundreds of schools. The COE believes that partnering for a new generation of leaders produces better results by focusing on the different leadership needs associated with various community and school contexts. This foundational premise accounts for the success of current programs and informs the design of future programs.

Description

The COE at K-State is creating models and implementing educational and professional development activities to increase the number and quality of educational leaders in Kansas schools at all levels. These include:

- Educational Leadership Academies in Dodge City, Garden City, Junction City, Manhattan, Salina, Topeka and other large school districts working with economically and socially diverse populations have provided graduate education and leadership development opportunities for school principals across the state. K-State's academies have operated since 1987 and have drawn national praise, having prepared over 500 school leaders at principal and superintendent levels. New academies are in development that expand to include indigenous populations.
- The Kansas Educational Leadership Institute (KELI) emerged from collaborative planning by five major Kansas professional entities interested in developing and supporting leadership for Kansas schools and districts in the 21st century. Partners in this effort are Kansas Association of School Boards, Kansas State Department of Education, Kansas School Superintendents Association, Kansas State University and United School Administrators of Kansas. KELI supports first-year Kansas superintendents and recently expanded to include school principals and special education directors. These licensed leaders participate in seminars, a mentoring program, leadership coaching and academic work. The KELI mission and model are unique in the country.
- The COE has a long history of collaboration to provide educational leadership opportunities at Fort Leavenworth with the Command and General Staff College (CGSC). The Adult Education Program has awarded nearly 1,000 graduate degrees in a cohort master's program to officers at the CGSC during its nearly three-decade history. The program also awarded 12 doctorates to faculty and faculty developers at CGSC.
- K-State faculty, graduate students and school partners are collaborating on research that demonstrates the efficacy of the university's leadership models and programs. More funding is being sought to provide support for the extensive and rigorous research and evaluation that is needed to promote this K-State model into a nationally recognized and adopted exemplary practice.
- The educational leadership graduate program is actively seeking funds to enhance professional development of school leaders in such topical areas as computer science.

Relevance

Preparing successful educational leadership is the primary mission of the Educational Leadership Program and relates to the college's 2025 plan, Themes III (provide quality graduate education that prepares students for leadership), and IV, (increase service to communities through systematic engagement). These activities also relate to K-State 2025, Themes III and IV.

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Office of Career, Technical and Adult Education
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Military-Connected Learners: Research and Teacher Preparation

Background

The College of Education (COE) at Kansas State University is committed to a military/veteran focus as part of our work. The needs and strengths of military personnel, veterans and their families have been systematically addressed by the faculty of the COE, who educate teachers, principals, superintendents, adult educators, school counselors, special educators, postsecondary advisors and college student personnel services staff. The college's award-winning military initiative is a collegewide program that has been in place for several years. The focus of the initiative is military-connected learners at all education levels, recognizing especially that veterans in college face challenges in adjusting to a college culture that differs greatly from the highly structured military culture. Therefore, this college is designing programs and conducting research related to military-connected learners.

- The college, in partnership with the Kansas State Department of Education, was awarded a Troops to Teachers grant to establish a robust system to recruit, train and hire military veterans and dependents for Kansas classrooms.
- The college became one of the first 100 universities to join Operation Educate the Educators, a nationwide Joining Forces initiative that was given guiding principles set forth by the American Association of Colleges for Teacher Education and the Military Child Education Coalition.
- The school counseling program has developed a Certificate of Competence in Counseling Military-Connected Students for school counselors and candidates in counselor education graduate programs based on the theoretical and research framework and best practices in parent/family counseling and education strategies and interventions.
- The Military Child Education Coalition awarded the College of Education the 2014 LTG (Ret.) H.G. "Pete" Taylor Higher Education Partnership of Excellence award in recognition of our work with school partners in educating military-connected students.
- A faculty-developed leadership training program, the Brigade Command Team Spouse Development Program, was awarded the Malcolm Knowles Award for Outstanding Program in Adult Education in 2010.
- The college produced a widely disseminated documentary, "A Walk in My Shoes: Military Life" (https://coe.ksu.edu/walk-in-my-shoes/military-life.html), in which seven people currently connected to the College of Education — retired soldiers, spouses, a child and educators — share their perspectives on the rewards and challenges of being connected to the military. Topics include the realities of deployments for the family and the soldier, post-traumatic stress disorder (PTSD) and the social/emotional needs of military-connected children.
- Our adult education graduate program is active at Fort Leavenworth and has awarded over 600 graduate degrees to officers at the Command and General Staff College in the past 25 years.
- Faculty and graduate students conduct research related to timely topics in education. Several recent dissertations have addressed military and veterans' issues, such as the impact of deployment on school behavior, creativity and cognitive development in military courses, effects of stress in the military classroom, military faculty self-efficacy, and faculty development at military colleges.

The COE has focused experience in working with military-and former military-connected adult learners, and it has an award-winning teacher preparation program. Therefore, K-State's College of Education has the potential to make a significant contribution to remediating the shortage of teachers in Kansas and across the country.

Description

The College of Education at Kansas State University has the capacity and commitment to recruit, support and prepare former military personnel to become K-12 teachers via its outstanding teacher preparation program. A special emphasis is on science and math teachers, and the college's current NSF-funded program provides fellowships for individuals with math or science degrees to become teachers. The COE also has in place a cooperative dual degree for those interested in concurrent math or science and education degrees.

Relevance

This initiative is aligned with K-State and the College of Education's commitment to serve the military and their families. In addition, these endeavors align with K-State's 2025 themes I-IV, and three of the college's 2025 goals, one of which relates specifically to engage in issues, activities and research related to the military.

Agency Contact Information

Department of Education: Fund for the Improvement of Postsecondary Education, Lynn Mahaffie, Assistant Secretary, 202-453-6914; Office of Elementary and Secondary Education, Frank Brogan, Assistant Secretary, 202-401-0113, and Department of Defense Education Activity (DoDEA), Thomas Brady, Director, 571-372-0590.

Fundamental Cancer Research

Background

Cancer is the second leading cause of death in the United States. Around 600,000 people die from cancer each year, or approximately 22 percent of all deaths. Congress established the National Cancer Institute (NCI) in 1937 and expanded it in 1971, giving broad powers to establish centers to do research and treat patients.

In 1978, Drs. Richard Consigli and Terry Johnson envisioned Kansas State University's participation in the cancer fight by establishing the Center for Basic Cancer Research at Kansas State University. The Center is now responsible for close to $500,000 dollars in expenditures directed at research and education at K-State. This effort represents approximately 5 percent of the private research donations given to K-State in a given year.

To grow the center, we have recently initiated our Center of Excellence Grants to build the foundation for a more comprehensive cancer research program and more PO-1-type projects.

Recently, we awarded our first Center of Excellence Grant, focused on fundamental research surrounding pancreatic cancer. The center has three areas of focus: cancer detection, drug discovery and studies involving in-vivo techniques and magnetic resonance imaging.

Description

The Johnson Cancer Research Center (JCRC)

VISION: It will take a leading role in conquering cancers in our time.

MISSION: Further the understanding of cancers by funding cancer research and supporting higher education, training and public outreach.

GOALS:

- Improve cancer-related research and education
- Provide scholarships and fellowships
- Enrich the student experience
- Educate citizens about cancer and cancer research

The Johnson Cancer Research Center has a variety of awards (grants, stipends and scholarships) to advance cancer research and education of K-State faculty and students. The awards are funded by private donations of both cash gifts and endowed funds. Faculty and students apply for awards in the fall and spring semesters. A review committee selects the most promising research applications for funding after extramural, peer review by cancer experts at other research institutions. In addition to funding research and training, the center has a variety of outreach programs to inform the public about cancer and cancer research at K-State.

Relevance

Funding mechanisms for faculty

Innovative research grants provide research assistance for new faculty establishing research programs and veteran faculty exploring new frontiers.

Equipment grants are available to research cores to purchase new equipment to remain competitive and to offer technical expertise to K-State researchers.

Faculty travel fellowships are awarded to faculty to allow collaboration with other institutions, receive training on new research techniques, and travel to scientific conferences.

Center of excellence grants encourage and develop interdisciplinary research programs focused on specific cancer research problems.

Student education & training programs

Cancer research awards encourage undergraduate involvement in laboratory research.

Summer stipends support graduate student research when other assistance is not available.

Travel fellowships provide the opportunity for graduate students to present research and network at professional meetings.

Public outreach

Presentations about cancer, risk reduction and research.

Collaborations with community groups to educate the public about cancer.

Events & activities to raise awareness about cancer and cancer research at K-State.

Website: https://cancer.k-state.edu/

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Research & Development for U.S. Bio/Agro-defense: Protecting Agriculture and Preserving Public Health

Background

Awareness is increasing on the risks posed to U.S. agriculture and public health due to processes such as 1) the accidental or deliberate introduction of disease agents previously confined to other parts of the world, 2) the emergence of hitherto unknown pathogens or 3) the acquisition of new capabilities by microbes previously considered benign.

The 2018 White House National Biodefense Strategy outlines five goals with associated objectives for strengthening the biodefense enterprise, including to "Strengthen biosafety and biosecurity practices and oversight to mitigate risks of bioincidents" and to "Ensure a vibrant and innovative national science and technology base to support biodefense."

Description

The Kansas State University Biosecurity Research Institute (BRI) at Pat Roberts Hall is a linchpin of U.S. bio/agro-defense capabilities because of its capacity to support research and development of diagnostic tools, contribute to greater understanding of the basic biology and life cycle of poorly-understood pathogens, and provide a testing ground for possible countermeasures and treatments.

The BRI is one of a few high-containment facilities in the U.S. allowing research on livestock experimentally infected with a broad range of highly pathogenic organisms. For example, the BRI is the designated facility at K-State for work on organisms classified by the U.S. government as select agents. These are agents that have the potential to be weaponized and require specialized facilities and highly trained personnel to ensure constant safety and security. Research at the BRI has already resulted in development and testing of two vaccines for highly pathogenic influenza, a vaccine for classical swine fever, and vaccines for Rift Valley Fever virus. These diseases are either zoonotic or potentially devastating to agriculture, or both.

Among the specialized facilities at BRI are 1) a state-of-the-art Arthropod Containment Level 3 Laboratory and supporting mosquito rearing room that allows researchers to investigate interactions between pathogens and their insect vectors and 2) a food production research suite that supports research on pathogens entering the food production process at various points. BRI has hosted research on mosquito-borne diseases such as Japanese encephalitis and Zika as well as on deadly foodborne pathogens, including Shiga-toxin-producing *Escherichia coli* and potential deliberate contaminants such as *Bacillus anthracis*.

Plant pathogens are also under study at the BRI, including known and emerging pathogens that threaten Kansas and worldwide production of three of the top five crops grown globally, namely wheat, corn and rice. Research topics include improving our ability to predict and detect the emergence of new pathogen varieties with enhanced virulence as well as mitigation strategies for existing and novel types. One example is wheat blast, which is a newly emerged and globally spreading disease causing substantial losses in South America and Southern Asia. This disease, and others, have the potential to disrupt food security and to destabilize already weakened nations.

Relevance

America is unprepared for a bioterrorism attack targeting agriculture — crops or livestock — or food. Interruptions to the food supply, either natural or man-made, threaten public health and economies. Furthermore, a growing worldwide population, changes in land use and climate, and increased global mobility and trade all increase the likelihood of the spread of previously unknown diseases. Improvements in basic science, vulnerability assessments and mitigation strategies are needed to address these real threats.

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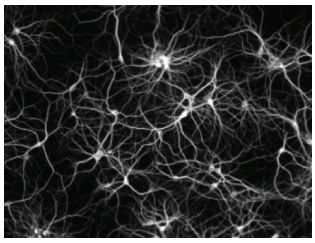
Cognitive and Neurobiological Approaches to Plasticity (CNAP) Center

Background



Changes that occur in the brain as a function of growth, aging or experience are referred to collectively as plasticity. Plasticity is essential for adaptive behaviors and is critical for healthy functioning. CNAP researchers investigate plasticity in humans and animal models using basic and translational research techniques. The overarching goal of this recently funded center is to understand the mechanisms of cognitive and neural plasticity with the ultimate goal of promoting healthy functioning.

Description

The CNAP Center of Biomedical Research Excellence was funded in July 2017 with a $10.6 million, five-year grant from the National Institute of General Medical Sciences. CNAP is housed at Kansas State University in the Department of Psychological Sciences and is partnered with the Department of Psychology at Wichita State University. The grant will support four projects, three research cores and three programs as well as a host of other research activities. The research cores:

- The Behavioral Neuroscience core, housed in the K-State Department of Psychological Sciences, which has been modernized to enable the use of cutting-edge neuroscience techniques for application to animal models of disease.

- The Neuroinformatics core, housed in the K-State Engineering Complex along with the Beocat Computing cluster, which is facilitating the visualization, sharing, and analysis of large data sets
- The Driving Simulator core, housed at Wichita State University, which will support research on plasticity and driving behavior in a state-of-the-art virtual reality immersive driving environment with integrated eye-tracking capabilities.

Relevance

Research projects will occur along three themes:

- ***Aging and neurodegeneration*** research will connect with multidisciplinary centers on aging at K-State and Wichita State. The average age of the U.S. population has been increasing significantly, and people over 65 now represent about 15 percent of the population, with projections of about 22 percent by 2040. Understanding factors that promote healthy aging (both in terms of cognitive performance and delaying disease onset) can have a major financial impact in addition to the overall impact on the well-being of the U.S. population. Our projects related to aging are designed to understand mechanisms that impact on important everyday functioning, which is critical for maintaining an independent lifestyle.
- ***Neurobiology of reward and decision*** will examine neuronal plasticity of reward valuation, with links to decision-making and alcohol abuse. Given the numerous disorders associated with deficient reward valuation and decision-making processes, including ADHD, drug abuse, gambling and obesity, there are rich opportunities for CNAP to make a significant impact on the field in these areas. Our projects in this area will examine factors that influence the development of alcohol abuse in adolescence/early adulthood and the neural circuits of flexible decision making.
- ***Translational/comparative neuroimaging*** is an area of recent growth and additional planned growth at K-State. With the establishment of a new small animal imaging core in the Department of Chemistry, coupled with plans to grow human neuroscience in the Department of Psychological Sciences and the collaborative use of human neuroimaging facilities at University of Kansas Medical School, we are in a position to support both animal model and human neuroimaging techniques. These techniques can be implemented to answer questions relating to aging and neurodegeneration as well as work in the neurobiology of reward and decision, significantly advancing our understanding of neuronal plasticity mechanisms within these areas. Neuroimaging is an essential technique for understanding neuronal plasticity, and we aim to develop a strong focus on this area over the course of the next five years.

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Integrated Solutions for U.S. Bio/Agro-defense: National Agricultural Biosecurity Center and its Role in Securing the Agriculture and Food Enterprise

Background

Protecting American agriculture and food from global biothreats while safeguarding the public from zoonotic animal diseases and foodborne pathogens are recognized as vital to U.S. homeland security. The Homeland Security Presidential Directive-9 (HSPD-9), issued on Jan. 30, 2004, identifies six areas as critical for this mission: 1) awareness and warning; 2) vulnerability assessments; 3) mitigation strategies; 4) response planning and recovery; 5) outreach and professional development; and 6) research and development.

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Relevance

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Greatly improved awareness and warning, vulnerability assessments, and response planning and recovery are needed. NABC is poised to play an important role in these efforts.

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Building Healthy Relationships

Background

Healthy relationships are the foundation of stable and resilient families. Children and adults with stable and satisfying family relationships experience greater emotional stability and health than do individuals who live with family tension and negative interactions. In Kansas, divorce increases the likelihood that families with children will be poor by 46 percent (State of the Family: Kansas Child and Family Wellbeing Indicators). Indicators of whole family, couples and individual family member stress and relationship strain include:

- The rate of children in need of care (i.e., protection services) is 8.4 (per 1,000 children in population) as compared to 5.2 for the nation (Casey Family Programs, 2012).
- In 2013, 23,508 domestic violence incidents were reported to law enforcement agencies in Kansas.
- In 2014, compared to the nation's 11 percent average, 19 percent of adults in Kansas reported having three or more adverse experiences in their childhood (Kansas Behavior Risk Factor Surveillance Survey).

Many Kansas families experience repeated transitions, prolonged stress, unstable situations and poverty, which negatively impact relationships. Every person deserves the opportunity to have healthy relationships and to live free from the experience of interpersonal violence, toxic stress and social immobility. Researchers, teachers and outreach professionals in K-State's School of Family Studies and Human Services (FSHS) are dedicated to contributing to the development and enhancement of resilience and healthy relationships to improve the lives of individuals and families.

Description

To address these issues, applied research, clinical services, and programming are underway across units in the School of FSHS to:

1. Support healthy relationships across life-course transitions, cultures, family development and long-term relationships;
2. Assess the impact of witnessing interparental violence across generations;
3. Examine the impact treatment of depression has on intimate relationships;
4. support healthy partner and/or parenting relationships;
5. Develop and test a violence risk assessment tool to guide prevention and treatment of partner violence efforts in military families;
6. Assess the impact romantic relationships and parenting behaviors have on child outcomes;
7. Implement and evaluate a relationship education program for pregnant and parenting adolescents;
8. Study communication technologies on relationships between former partners and between parents and children following divorce;
9. Support and encourage parent-child communication about health and well-being;
10. Develop research-based community programs that focus on strengthening family relationships in the context of individual family units and the communities where they reside.

The collaborations of the College of Human Ecology faculty have led to grants and contracts to support research on building healthy relationships, preventing partner violence and supporting family resilience.

Relevance

Healthy relationships enhance all aspects of life. Children who grow up in homes with parents in healthy relationships do better in all aspects of life. Adults who are in healthy, committed relationships have better physical health, fewer emotional problems, and are more financially successful.

Faculty in K-State's School of FSHS in the College of Human Ecology are conducting applied studies that support healthy relationships. They are receiving private, state and federal funding for their research and have received national and international recognition for their efforts.

Agency Contact Information

Administration for Children and Family
US Department of Health and Human Services

Military and Veterans Programs
National Institute of Food and Agriculture United States Department of Agriculture

Family Advocacy Program Manager
Secretary of Defense for Military Community and Family Policy

Institute for the Health and Security of Military Families

Background

For American military personnel who have served in war, federal programs have long been in place to address physical injuries from bullets and bombs and psychological injuries of wartime trauma. In relatively recent times, however, veterans returning from war have faced difficulties neither anticipated nor addressed by federal programs. These include chronic health problems resulting from exposure to environmental hazards (e.g., chemical defoliants in Vietnam and a complex mix of neurotoxins in the Persian Gulf War) and traumatic brain injury (TBI) encountered during deployment, as well as long-term health impacts (e.g., PTSD). Increasingly, for today's professional military (both active and reserve components), the aftermath of wartime service has consequences not only for veterans' well-being but for their families and communities as well.

Description

Kansas State University is home to a unique cadre of scientists from diverse disciplines with an impressive track record in research, outreach, academic and clinical service programs addressing the health, well-being and sustainment of military and veteran populations:

- Programs and community support networks for military-connected children and youth, with local 4-H clubs, schools and OMK youth/family camps.
- Research and training programs on violence prevention in military families, quality child care and childhood social-emotional health.
- Clinical programs for military personnel, veterans and families.
- Research on the long-term effects of deployment and war trauma on marriages, child and youth development, employment, and financial planning.
- Cooperative Extension services to families of military personnel.
- Online graduate programs for professionals who serve military families.
- Research on the effects of high-intensity functional exercise training on the body composition, fitness and health of active duty military personnel as well as on barriers to physical activity participation for disabled veterans.
- Implementation of a new Military and Veteran Engaged Research Innovation Center at K-State (MAVERICK Center), to provide a multifunctional, cost-effective collaborative space for military and veterans programs that advance the vision of K-State 2025.

In addition to contributions made by researchers from colleges across the university, the Institute is the "tip of the spear" for K-State's alliances with area military installations, the Kansas National Guard, Army Reserve, U.S. Department of Veterans Affairs, the Department of Defense, and other state and national organizations.

Relevance

Our current partnerships with the U.S. departments of Agriculture and Defense have been primarily focused on outreach rather than on research funding for the study of military families. These outreach initiatives support significant programming underway at K-State and across Kansas. Proposals to other federal agencies, such as the Department of Health and Human Services, will expand the reach of the College of Human Ecology and its units. Expanding partnerships to support additional investment in relevant research would enable K-State, the College of Human Ecology and the Institute for the Health and Security of Military Families to capitalize on the expertise available here.

Agency Contact Information

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Physical Activity, Cancer, and Treatment Outcomes

Background

A recent large (1.4 million people) epidemiological study, funded by the National Institute of Cancer, demonstrated a significant risk reduction for 26 major cancers in those who are physically active, with an obesity-independent risk reduction for many of these cancers. In addition, once diagnosed with cancer, patients who exercise have an increased survivability versus sedentary counterparts. This data suggests that exercise has both a preventive and therapeutic effect on cancer and cancer treatment(s), respectively. However, the effect(s) of exercise on the tumor microenvironment, as well on the cardiovascular system with traditional cancer treatments, are unknown.

Description

The Department of Kinesiology in the College of Human Ecology is conducting translational research, including determining molecular mechanisms of cancer genesis, treatment outcomes in preclinical models through cardiovascular function in the exercising human cancer survivor. Main themes, description and departmental expertise:

Exercise, the tumor microenvironment and outcomes with radiation therapy. Tumors contain areas of low oxygen that make them resistant to radiotherapy and more likely to metastasize, thus strategies to enhance tumor oxygenation are clinically relevant. Our data demonstrate that exercise training can greatly enhance tumor oxygenation, which would enhance patient prognosis as well as responses to radiation therapy. Dr. Brad Behnke is using exercise — real and simulated — as an intervention to impact the tumor microenvironment and potentially enhance outcomes and prognosis of cancer patients.

Long-term cardiovascular effects of cancer treatment: In cancer patients and survivors, exercise is prescribed to specifically combat the fatigue associated with cancer treatment, as well as improve depression and other psychological aspects associated with the diagnosis and treatment of cancer. Dr. Carl Ade has demonstrated that chemotherapy treatment can have long-term (10-plus years) deleterious effects on the capacity of the body to increase blood flow, which would contribute to the chronic fatigue reported by cancer survivors. Drs. Ade and Behnke plan to assess the impact of cancer treatment on cardiovascular outcomes in human (Ade) and pre-clinical models (Behnke).

Enhanced nitric oxide signaling to improve tumor oxygenation: Cyclic hypoxia within the core of solid tumors upregulates at least 35 genes associated with enhanced tumor growth and metastasis. This cyclic hypoxia is associated with vasomotion and poor nitric oxide-mediated signaling in the blood vessels perfusing tumors. Dr. David Poole has identified a role of nitrate/nitrite supplementation in human patients with heart failure as a means to enhance oxygen delivery to poorly perfused tissue. Dr. Poole is extending this original line of research to determine if nitrate supplementation can enhance nitric oxide bioavailablity within tumor blood vessels to mitigate cyclic hypoxia and down-regulate pro-metastatic genes.

Cancer and reduced exercise capacity. Cancer patients universally report fatigue after diagnosis through treatment and recovery. In fact, many cancer patients ascribing fatigue as the most distressing side effect of cancer and its treatment. This cancer-related fatigue is typically attributed to the side effects of cancer treatment. However, Dr. Steven Copp has recently demonstrated that the disease itself, prior to diagnosis (i.e., before any tumor burden occurs), reduces the capacity to perform work and exercise. Dr. Copp is investigating mechanisms responsible for this early loss of functional capacity and whether exercise training can prevent fatigue in cancer patients prior to treatment.

Relevance

Roughly 1 in 2 people will hear the words "you have cancer" in their lifetime. It is becoming evident that many of these cancers are preventable with a healthy lifestyle involving exercise. In addition, in cancer patients exercise may enhance outcomes (e.g., kill a fraction of the tumor) with traditional therapies (chemotherapy and radiation) and prevent cardiovascular dysfunction associated with the primary tumor as well as treatment. Faculty in the Department of Kinesiology have received local and national funding (e.g., NIH, American Cancer Society) for their research endeavors and are synergistically attacking this disease using what is often referred to as aerobic exercise therapy in cancer patients.

Agency Contact Information

National Institute of Health
National Cancer Institute, Division of Cancer Biology

Aviation Global Initiative

Background

Kansas State University Polytechnic Campus is uniquely positioned to leverage opportunities for advancements in both manned aviation and unmanned aerial systems to capture global leadership within key sectors of these technical areas in higher education. This effort is aimed at substantially impacting the regional and state economies through increased enrollments, leveraged innovation and resulting commercial opportunities. This intersection of technology, along with Polytechnic's experience and rapidly expanding market demand, provides an extraordinary opportunity to establish K-State and the state of Kansas as national and global leaders in this technology.

With a rich history in aviation, applied research and education, Kansas State Polytechnic has a unique opportunity to become a community of learning and partner of choice for global companies and world-class talent. An innovative statewide economic growth strategy will build upon an existing set of capabilities, assets and organizations to create a world-class collaborative ecosystem around manned and unmanned aeronautics.

Description

The focus on manned and unmanned aeronautics includes training UAV system operators and managers and future aviation industry leaders. The strategies and initiatives envisioned by Kansas State University are focused not only on local impact, but also on economic prosperity and competitiveness across the state.

This initiative also fulfills a strategic national need by contributing to national workforce development in the aviation and aerospace sectors, which are currently experiencing a historic labor and talent shortage resulting in air transportation system disruptions.

Kansas State University is poised to lead a statewide effort to advance economic development in aviation through research, innovation and training. Linking research and training efforts from around the state into a globally competitive coalition will enable Kansas to become the world leader for solutions to challenging problems in applied aviation.

Relevance

Kansas State Polytechnic will pull relevant organizations and departments in the state together to develop a targeted and intentional vision/plan to court this industry. This is the cornerstone of a larger state-wide strategy to retain global aerospace manufacturing and training dominance. To further this plan, we are seeking assistance with these major sub-initiatives:

1. Test Site — Kansas State University has been designated as an affiliate member of the Pan-Pacific UAS Test Range Complex (PPUTRC), headed by the University of Alaska, Fairbanks and administered through the FAA. UAS flight test operations under K-State's direction will require an initial investment of $1 million and an annual sustainment budget of $500,000.
2. ASSURE (Alliance for System Safety in UAS through Research Excellence) collaboration — K-State continues to be a major contributor to the UAS ASSURE Center of Excellence administered by the FAA. However, a stronger FAA research prioritization on Kansas members' core strengths of UAS airworthiness and standards development is needed. The ASSURE and Test Site initiative have significant potential to leverage each other's success moving forward.
    a. There are near opportunities for dialogue with personnel from Sen. Cochran's office to determine how best to champion ASSURE in the future. These conversations may help Kansas to have a stronger voice in the future of this center of excellence.
3. Aircraft Certification — There is an emerging need to train world engineers in the practice of aircraft certification, the single most significant key to a safe national airspace system. When Kansas State Polytechnic's certification program was presented to FAA mid-management personnel, they suggested that it become the national standard. Assistance is needed to convince senior FAA leadership to prioritize certification training standardization, policies and standards.
4. Kansas UAS Airspace Integration Partnership Program — Kansas is seeking to be designated as a partner state to develop low-altitude UAS airspace integration policies. Advocacy for the Kansas effort would certainly enhance the chance of success.
5. Bi-state UAS Cluster Initiative — Kansas State Polytechnic is involved in the UAS Cluster Initiative that is working toward economic development in UAS technology in Kansas and Oklahoma. Funding advocacy for the Small Business Association Grant, which supports the program, is key to its successful future: https://uascluster.com/.

Agency Contact Information

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National Transit Survey Institute (NTSI)

Background

Across the nation and at all levels of government, there has been a resurgence of interest in public transportation. This interest stems from transit's ability to meet a number of pressing social concerns. Economic development specialists see transit as offering a key amenity to attract young knowledge-workers, lure growing businesses, ensure community reslience to fluctuations in fuel prices, reduce congestion, allow older adults to age in place, and preserve property values. Environmental advocates see transit as a means to reduce air pollution, slow greenhouse gas emissions, revitalize existing urban areas, foster alternative travel behavior (such as walking, biking and shared-use modes), and mitigate the need for costly investments in additional roadway infrastructure. Equity advocates see transit as an essential service to foster food, health care and employment access for lower-income populations as well as a critical component to meeting federal civil rights and environmental justice objectives. All of these groups are united in their concern that transit is actually achieving these goals.

One of the best means to assess and monitor transit performance is by analyzing the results of on-board surveys. Most public operators conduct such surveys already and recent civil rights guidance from the Federal Transit Administration ensures that all will need to do so in the near future. Unfortunately, despite the substantial sums of public monies required to conduct these surveys, the resulting data are surprisingly difficult to attain. There is no single public repository for this information with the result that even within a single transit agency data are often lost over time. Furthermore, the lack of data availability hinders the work of outside researchers, auditors and public advocates to examine the success of the transit systems. Those systems themselves are unable to easily examine the survey instruments and data from their peers to inform their own surveying efforts or compare their results.

In short, the major public investment in transit survey data creation is not being optimized. There is a demonstrated need for an institute dedicated to collecting, archiving, researching and disseminating this information.

Description

The National Transit Survey Institute (NTSI) combines a secure data repository, research center and outreach program to advance transit use and transportation justice. NTSI is in the process of developing the nation's only secure and searchable archive for transit survey data. This resource provides, for the first time, a platform for the systematic, academic inquiry of ridership across the transit services in the United States. NTSI researchers use this resource to develop innovative approaches for exploring transit survey data. Current research evaluates transit equity, particularly in light of the federal civil rights guidance, as well as the role of transit in fostering community resilience, especially regarding older adults, people with disabilities, low-income families and rural households.

NTSI researchers also assess and refine transit surveying techniques, which are undergoing a rapid transformation with the availability of handheld GPS-enabled data-entry technologies. NTSI partners with public agencies and consultants to implement and test these new approaches to surveying. This activity provides an important engagement and service learning opportunity for Kansas State University faculty and students. Furthermore, this outreach is critical to NTSI's mission of advancing the quality of transit data to advance the effectiveness of transit.

Relevance

Public agencies in the United States spend millions of dollars annually to collect transit survey data. Currently, the benefits of that investment are quite limited. The NTSI is working to greatly expand the public return on those investments. The NTSI first makes those data available and second, provides a research environment to make those data relevant. This environment incorporates undergraduate and graduate students in engaged scholarly work with high value both for academia and for practice. These efforts are an integral part of the 2025 plans of the Department of Landscape Architecture and Regional & Community Planning, the College of Architecture, Planning & Design, and Kansas State University.

Agency Contact Information

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Center for Rail Infrastructure Durability and Sustainability

Background

Railways are the backbone of the United States' economic system because they allow swift, economical, fuel-efficient movement of agricultural products, coal and finished goods. However, maintaining freight movement requires efficient train networking and reliable track systems. Kansas State University currently utilizes multidisciplinary expertise in railway track systems — $4.1 million in research contracts with the Federal Railroad Administration — to investigate methods of improving safety and durability of concrete railroad ties. Additionally, K-State researchers are assisting KDOT to evaluate track infrastructure for heavier carloads and to evaluate track ballast nondestructively. K-State departments involved in this research include civil engineering, mechanical and nuclear engineering, and industrial and manufacturing systems engineering.

Description

The overarching objective of this multidisciplinary research is to enhance current understanding of how various materials and fabrication processes interact and consequently affect railway durability and sustainability. K-State has pioneered development of a laser-speckle imaging (LSI) device that can be used in rugged environments such as railroad tie production facilities. This patented device has led to development of a system that images concrete railroad ties to determine if they are properly assembled at the manufacturing plant to prevent cracking and failure in track.

K-State researchers are also developing methods to determine how raw materials and manufacturing processes affect durability of the railroad ties in states such as Kansas, where many freezing and thawing cycles occur each year. Therefore, K-State recently installed a specially designed, 120-cubic-foot environmental chamber dedicated to testing full-size railroad ties under water-saturated freezing and thawing cycles. This chamber is the only test apparatus of its kind in the U.S. capable of testing full-scale railroad ties.

Use of LSI techniques and full-scale freeze-thaw testing of concrete railroad ties has positioned K-State at the forefront of railroad track systems' durability research. Therefore, K-State proposes to establish a Center for Rail Infrastructure Durability and Sustainability (CRIDS). The proposed center will be used to further develop and deploy existing K-State-developed technologies to improve durability and sustainability of the U.S. rail infrastructure. Funding for the Rail Infrastructure Durability and Sustainability Center will have the following objectives:

- *New Railway Infrastructure Environmental Test Chamber*. Long-term durability of railroad ties under repeated loading from heavy-freight and high-speed railway lines should be tested under extreme weather conditions, including hot and cold temperatures, wet and dry conditions, and varying subgrade materials and temperatures. Funds will be used to design and build the first high-tech, varying-climate, full-scale test chamber for railroad track systems in the U.S.
- *Durability of Railroad Ties Under Various Load and Support Conditions*. Railroad ties made with newly developed materials could provide longer life, thereby increasing sustainability of the railroad infrastructure. Existing full-scale testing capabilities at K-State will be enhanced to include the ability to evaluate the performance of railroad ties under varying load and support conditions, such as found on heavy-freight and high-speed railways with different supporting ballast conditions.
- *Deployment of Existing Laser-Speckle Technology*. K-State researchers will demonstrate application of the newly developed LSI technology at concrete railroad tie manufacturing plants in the U.S., and assist with implementation of the technology in these plants for improved quality assurance. This technology will allow optimal components (concrete mixtures and prestressing reinforcement) to be selected for maximum durability.

Relevance

Sharp increases in rail traffic in the last 10 years have caused railways to become increasingly critical to the U.S. economy. Improved materials and test methods for railroad tie systems and development of reliable test procedures for new ties and components, will help prevent derailments and increase the lifespan of current railways.

Agency Contact Information

Federal Railroad Administration
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FAA Airliner Cabin Environment Research Center of Excellence

Background

The recently enacted FAA Reauthorization Bill (HR 302, section 326) directs the FAA to commission a large research program to the Airliner Cabin Environment Research Center of Excellence (ACER), for which K-State is a leading university. The corresponding appropriation is required from Congress to fund this mandate.

ACER is graduated, having completed its original 10-year research program. Auburn University and Kansas State University are currently the administrative leads and technical leads, respectively. K-State and Auburn, as members of ACER, have conducted much of the background research upon which the above legislation is based. Additionally, K-State and Auburn participated in the Vehicle Integrated Propulsion Research program (VIPR), in which NASA teamed with the Air Force, Boeing, Pratt & Whitney and several other companies as well as K-State and Auburn to conduct on-aircraft research, which provides additional foundation for the HR 302 mandated project.

Description

It is proposed that funding be provided so that Kansas State University, Auburn University and industry partner Teledyne Technologies may complete the research described in the reauthorization bill. Specifically, a research program will be conducted as mandated in HR 302:

(1) to identify and measure the constituents and levels of constituents resulting from bleed air in the cabins of a representative set of commercial aircraft in operation of the United States;

(2) to assess the potential health effects of such constituents on passengers and cabin and flight deck crew;

(3) to identify technologies suitable to provide reliable and accurate warning of bleed air contamination, including technologies to effectively monitor the aircraft air supply system when the aircraft is in flight; and

(4) to identify potential techniques to prevent fume events.

It is requested that total funding of $19 million be provided through the Airliner Cabin Environment Research Center of Excellence.

Relevance

Because they fly at high altitudes where the ambient atmospheric pressure is insufficient to support human life, occupants of airliners are dependent upon the air that the aircraft environmental control systems provide to pressurize and ventilate the cabins. For the vast majority of all airliners, bleed air from the aircraft engines is the source of this air. There have been persistent concerns about fume events resulting from contamination of bleed air by engine lubricating oil and other substances.

Reported fume events potentially attributed to bleed air contamination occur on between 1:1,000 and 1:10,000 flights, depending on the aircraft and other factors. The severity of these events can range from minor annoyance to serious crew incapacitation. Given the large number of flights, reported events occur on almost a daily basis just in the U.S. Additional concerns have been raised about repeated exposure and long-term low-level contamination for crew members and frequent flyers.

These fume events are spread over all makes and models of aircraft and it has been difficult to predict in advance when an event will occur. This unpredictability has made it challenging to have the instrumentation in place needed to accurately characterize fume events. Recent bleed air sensor research by K-State and Auburn shows good promise for identifying aircraft likely to have fume events which, in turn, will make detailed characterization feasible.

Even more promising, K-State and Auburn conducted on-engine bleed air sensing research for the FAA and the VIPR program that indicates particulate and/or organic compound sensing technologies have good potential for detection of bleed air contamination in-flight. As there are multiple bleed air sources on an airliner, in-flight detection provides a means for real-time resolution and events can be mitigated in-flight, eliminating exposures and costly turn-backs and diversions. The planned research will develop the path for implementation of this technology and likely will lead to the elimination of a very long-standing issue within the air transportation industry.

Agency Contact Information

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Agriculture Advanced Research and Development Authority (AGARDA)

Background

Farm Bill, Sec. 7132, Agriculture Advanced Research and Development Authority Pilot, enacted in December 2018, stipulated, "Subtitle K of the National Agricultural Research, Extension, and Teaching Policy Act of 1977 (7 U.S.C. 3310 et seq.) is amended by adding at the end the following: Sec. 1473H. Agriculture Advanced Research and Development Authority Pilot" (AGARDA Pilot). Many other federal agencies have advanced research and development authorities in place to drive innovation. The concept is not new and the outcomes have been highly beneficial, which bodes well for this pilot agriculture initiative.

Description

AGARDA intent: "to address research challenges in agriculture and food through targeted acceleration of novel, early-stage innovative agricultural research with promising technology applications and products; or development of qualified products and projects, agricultural technologies, or innovative research tools."

AGARDA goals: "(A) to develop and deploy advanced solutions to prevent, prepare and protect against unintentional and intentional threats to agriculture and food in the United States; (B) to overcome barriers in the development of agricultural technologies, research tools, and qualified products and projects that enhance export competitiveness, environmental sustainability and resilience to extreme weather; (C) to ensure that the United States maintains and enhances its position as a leader in developing and deploying agricultural technologies, research tools, and qualified projects and products that increase economic opportunities and security for farmers, ranchers, and rural communities; and (D) to undertake advanced research and development in areas in which industry by itself is not likely to do so because of the technological or financial uncertainty."

AGARDA leadership duties: "The Secretary, acting through the (AGARDA) Director, shall accelerate advanced research and development by — (A) identifying and promoting advances in basic sciences; (B) translating scientific discoveries and inventions into technological innovations; (C) collaborating with other agencies, relevant industries, academia, international agencies, the Foundation for Food and Agriculture Research, and other relevant persons to carry out the goals (above), including convening, at a minimum, annual meetings or working groups to demonstrate the operation and effectiveness of advanced research and development of qualified products and projects, agricultural technologies, and research tools; (D) conducting ongoing searches for, and support calls for, potential advanced research and development of agricultural technologies, qualified products and projects, and research tools; (E) awarding grants and entering into contracts, cooperative agreements, or other transactions… for advanced research and development of agricultural technology, qualified products and projects, and research tools; (F) establishing issue-based multidisciplinary teams to reduce the time and cost of solving specific problems; (G) serving as a resource for interested persons regarding requirements under relevant laws that impact the development, commercialization, and technology transfer of qualified products and projects, agricultural technologies, and research tools."

AGARDA priority: "In awarding grants and entering into contracts, cooperative agreements, or other transactions, the Secretary shall give priority to projects that accelerate the advanced research and development of qualified products and projects that — (A) address critical research and development needs for technology for specialty crops; or (B) prevent, protect, and prepare against intentional and unintentional threats to agriculture and food."

Relevance

AGARDA Funding: "In addition to funds otherwise deposited in the Fund…, there is authorized to be appropriated to the Fund $50,000,000 for each of fiscal years 2019 through 2023, to remain available until expended." Feeding the world requires innovation in all the areas highlighted for AGARDA. Maintaining the U.S. standard of living requires the same, since U.S. discretionary spending relies, first and foremost, on affordable food.

Agency Contact Information

U.S. Department of Agriculture

USDA-ARS Ogallala Aquifer Program

Background

Funding in the USDA-ARS budget for FY 2018 is requested for the Ogallala Aquifer Program. This program conducts research and outreach activities to protect the Ogallala Aquifer and retain the economic integrity of the Southern Great Plains region, including the Texas High Plains and portions of Oklahoma, New Mexico, Kansas and Colorado — all states that are dependent on the survival of the Ogallala Aquifer.

The Ogallala Aquifer in western Kansas and the Texas High Plains is declining at an unacceptable rate with average depletion rates of 1 to 3 feet per year. Agricultural irrigation use accounts for nearly 90 percent of the groundwater withdrawals in the region. Water availability, cost and policy, together with technology development and adoption rates, will shape the rural landscape in the coming decades. To ensure the sustainability of rural communities in this region, continued investments are needed in irrigation management and agronomic research concerning water use efficiency, improved hydrologic assessments of water availability and sustainability, socioeconomic considerations, and wise public policy regarding water rights and public outreach engaging all stakeholders.

Description

The Ogallala Aquifer has provided water for the regional development of a highly significant agricultural economy. Ninety percent of groundwater withdrawals are used for irrigation. This region produces about 4 percent of the nation's corn, 25 percent of the hard red winter wheat, 23 percent of the grain sorghum, 28 percent of the cotton, and 42 percent of the fed beef. Local grain production is used primarily as feed grains for intensive beef, dairy and swine production. The Ogallala Aquifer is a finite resource with aquifer recharge being much less than withdrawals. The aquifer impacts the Kansas State University Agricultural Experiment Station and Cooperative Extension Service and the other lead universities on this project. Together, our research into the complex nature of water availability, uses, technological improvements and pricing will drive the discussions and decisions relative to water policy.

Relevance

The initiative will:

- Develop, evaluate and disseminate information and technologies for water users that will result in balancing economic, environmental and social concerns;
- Provide scientifically sound data and knowledge to planners and policymakers, which will enable them to develop effective water management policies that will result in balancing utilization and protection of the Ogallala Aquifer.

Objectives

- Investigate and improve water management within existing cropping systems.
- Develop and evaluate integrated crop and livestock systems that reduce dependence on underground water resources.
- Assess groundwater resources in the Ogallala Aquifer and their relationships with climate.
- Enhance the knowledge base of producers, water professionals and policymakers.
- Evaluate the implications of alternate water policy options.

Funding for FY 2018 will allow the partners to continue developing innovative conservation measures for the Ogallala Aquifer resource through a multistate university and federal program. The group will develop, evaluate and transfer technologies that will allow efficient water utilization while conserving and protecting the Ogallala Water Aquifer. The consortium also will develop and establish the program as the resource for data and knowledge in the development of fair and effective water policy.

Partners

USDA-Agricultural Research Service (lead agency)
Texas AgriLife Research
Texas AgriLife Extension Service
Kansas State University
West Texas A&M University
Texas Tech University

Agency Contact Information

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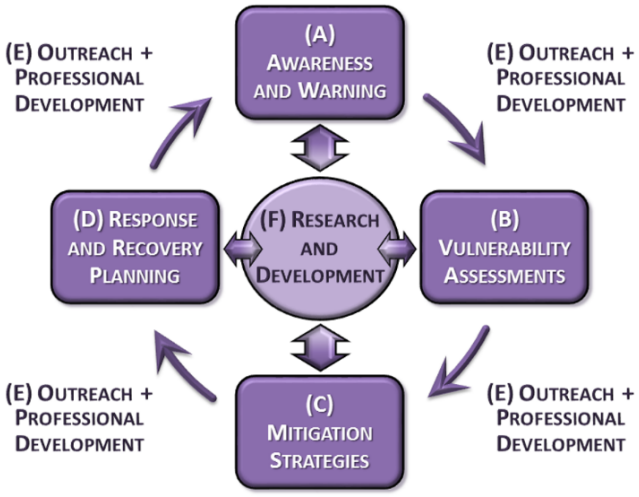
National Plant Diagnostic Network (NPDN)

Background

Protecting American agriculture — crops, livestock — and food from global biothreats while safeguarding people from zoonotic animal diseases and foodborne pathogens is vital to U.S. homeland security. As a result, Homeland Security Presidential Directive-9 (HSPD-9) was issued Jan. 30, 2004. The major requirements delineated in HSPD-9 include ***(A) awareness and warning; (B) vulnerability assessments; (C) mitigation strategies; (D) response planning and recovery; (E) outreach and professional development; and (F) research and development.***



Public Law 115-43 in 2017 amended the Homeland Security Act of 2002 to codify mandates of HSPD-9 in federal statute for the U.S. Department of Homeland Security (DHS). Plus, National Security Presidential Memorandum/NSPM-14, Sept. 18, 2018, stipulates continued adherence to HSPD-9 by federal agencies.

Description

Kansas State University's College of Agriculture is home to the Regional Center of Great Plains Diagnostic Network (GPDN), a nine-state consortium of plant diagnostic laboratories: Montana, North Dakota, South Dakota, Wyoming, Nebraska, Colorado, Kansas, Oklahoma and Texas. GPDN is one of the five regional networks of the National Plant Diagnostic Network (NPDN). NPDN is comprised of over 70 labs nationally that together constitute critical components of our national biosecurity infrastructure.

The GPDN Regional Center provides administrative oversight and diagnostic technical and surge support to the region. In addition, the lab information management system, (PDIS software) used by 30 states was developed and is supported by GPDN. PDIS facilitates sample tracking and data upload to the NPDN National Data Repository.

GPDN sponsors training and education opportunities for diagnosticians to attain and maintain proficiency with advanced diagnostic technologies and achieve competence with approved standard operating procedures.

The GPDN director currently serves as the executive director of the National Network, providing national leadership to oversee the implementation of policies and procedures to enhance performance, increase capabilities and capacity, and to improve stakeholder support.

GPDN maintains strong working relationships with state and federal regulatory agencies to partner in protecting plant systems. Over the past several years, GPDN has partnered with USDA APHIS Plant Protection and Quarantine to support response efforts for the introduction of several pests and pathogens with the potential to negatively impact productivity and profitability of Kansas agriculture and/or disrupt export of Kansas commodities.

GPDN and NPDN were created as called for in HSPD-9 and as such, contribute to (A) awareness and warning, (D) response planning and recovery, and (E) outreach and professional development. GPDN and NPDN provide triage and surge support to APHIS PPQ response and serve as a primary mechanism to facilitate the early detection of newly emerged and/or introduced pathogens and pests.

GPDN and NPDN benefit animal health in the region and nationally by protecting the crop systems that generate the feed to support our livestock operations.

Relevance

America is unprepared for a bioterrorism attack targeting agriculture — crops, livestock — and food. Interruptions to the food supply, whether naturally occurring or man-made, destabilize public health and the economy. Unintentional disease outbreaks in recent years have proven the case. Greatly improved Awareness and Warning are needed.

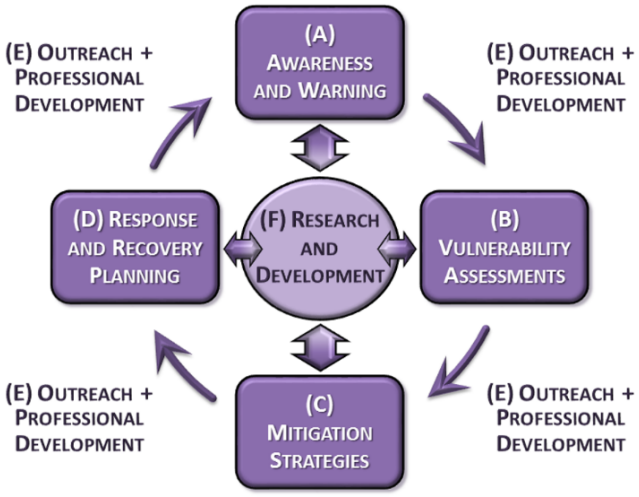
Agency Contact Information

U.S. Department of Agriculture (USDA)
National Institute for Food and Agriculture (NIFA)
Mike Fitzner, 202-401-4939

National Animal Health Laboratory Network (NAHLN)

Background

Protecting American agriculture — crops, livestock — and food from global biothreats while safeguarding people from zoonotic animal diseases and foodborne pathogens is vital to U.S. homeland security. As a result, Homeland Security Presidential Directive-9 (HSPD-9) was issued on Jan. 30, 2004. The major requirements delineated in HSPD-9 include ***(A) awareness and warning; (B) vulnerability assessments; (C) mitigation strategies; (D) response planning and recovery; (E) outreach and professional development; and (F) research and development.***



Public Law 115-43 in 2017 amended the Homeland Security Act of 2002 to codify mandates of HSPD-9 in federal statute for the U.S. Department of Homeland Security (DHS). Plus, National Security Presidential Memorandum/NSPM-14, Sept. 18, 2018, stipulates continued adherence to HSPD-9 by federal agencies.

Description

The Kansas State University College of Veterinary Medicine's Veterinary Diagnostic Laboratory (KSVDL) is a full-service, AAVLD-accredited laboratory with a mission to develop and deliver accurate, innovative and timely diagnostic and consultative services to the veterinary and animal health community in Kansas, the nation and world. KSVDL is in the National Animal Laboratory Health Network (NAHLN) as a tier-2 laboratory.

NAHLN supports animal agriculture nationwide through development and enhancement of a coordinated network of diagnostic laboratories to support early detection, rapid response, containment and recovery from high-consequence animal diseases. NAHLN provides an automated high-throughput diagnostic protocol to facilitate rapid and accurate examination of samples from diseases of importance for food animal security. A major mission for the success of a great nation is its ability to provide food and water resources to its citizens and globally through exports. An essential element in this process is the health and well-being of our food production animals. As a result, having NAHLN at the forefront of diagnosing and preventing the spread of high-consequence diseases is of vital importance to our food supply and food exports. With globalization and increased international travel, the NAHLN is more important than ever in the protection of the U.S. animal food supply.

K-State's KSVDL and the National Agricultural Biosecurity Center (NABC) have participated with NAHLN in significant ways. Examples include the development, enhancement and delivery of targeted technical training support programs, with 1) exercises and reviews of best practices from NAHLN labs; 2) expanded animal health diagnostic screening capabilities regionally; 3) proficiency testing of personnel and conducting surveillance testing for CSF, ASF, FMD, APMV-1, HPAI, SIV, CWD, Scrapie, VHS, PRV, ISV, and emerging diseases; 4) increased testing capacity of the KSVDL by conducting research on new methodologies; 5) development of training strategy framework for NAHLN laboratories by assessing lessons learned; and 6) in the occurrence of an outbreak, perform post-surveillance testing to ensure disease freedom in affected areas.

Relevance

America is unprepared for a bioterrorism attack targeting agriculture — crops, livestock — and food. Interruptions to the food supply, whether naturally occurring or man-made, destabilize public health and the economy. Unintentional disease outbreaks in recent years have proven the case. Greatly improved ***Awareness and Warning*** *are needed*.

Agency Contact Information

U.S. Department of Agriculture (USDA)
National Institute for Food and Agriculture (NIFA)
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TITLE XII – USAID Feed the Future Innovation Labs

Background

Feed the Future is the U.S. government's global hunger and food security initiative, and under this initiative are 24 Feed the Future Innovation Labs. The Feed the Future Innovation Labs follow the success of the Collaborative Research Support Program that was authorized under the "Title XII — Famine Prevention and Freedom From Hunger" of the Foreign Assistance Act of 1961. Kansas State University is the recipient of four of the 24 labs and is positioned as a leader among the 65 U.S. universities active in the initiative.

Description

The establishment of the Innovation Labs is creating new partnerships between U.S. and developing nation universities across the globe with a focus on building human and institutional capacity while advancing scientific frontiers beneficial domestically as well as internationally.

It is evident:

- No country can grow without educated leaders, scientists, entrepreneurs, doctors, teachers, nurses, engineers and other high-skilled drivers of economic growth. Lack of well-educated citizenry is a major impediment to international development; it undermines U.S. development assistance efforts and makes private sector engagement costly and difficult.
- A World Bank study shows the returns to higher education investments are substantial. Contrary to prevailing thought, the poorer the country the greater the return on investment to higher education. In fact, the poorest world region, sub-Saharan Africa, shows the highest rates of return from investments in higher education at 21.9 percent, which is nearly double that for primary and secondary education in the region.
- The Innovation Labs are a two-for-one investment. They solve critical agricultural problems that impact food security and poverty through research conducted collaboratively between U.S. and developing country students and scientists while also building the developing country capacity to solve their own problems in the future.
- More than 65 U.S. universities throughout the nation are engaged in the Innovation Labs. This global engagement increases the reach of U.S. research institutions, creates linkages that facilitate U.S. economic ties with developing countries and fosters economic growth in developing countries that benefit their economy and ours.
- The Innovation Labs are tackling the world's most challenging agricultural development problems and sharing scientific knowledge throughout the world on issues such as productivity, climate resiliency, income generation and human nutrition. To remove dependency on development assistance it is essential to train a workforce of well-educated citizens to enable the transition to independent economic growth.

Through Feed the Future, the U.S. government contributes to this global effort, working hand in hand with partner countries to develop their agriculture sectors and improve global food security. Putting "whole-of-government" into practice, Feed the Future draws on the agricultural, trade, investment, science, development, and policy resources and expertise of departments and agencies across the U.S. government. In just a few years, this U.S. government initiative is already delivering results that are helping reduce poverty and hunger while also improving nutrition for millions of children and families around the world.

SUSTAINING PROGRESS

In May 2015, members of the U.S. Senate introduced S 1252 the "Global Food Security Act," which builds upon previously introduced legislation. Similar legislation was introduced in the House slightly earlier — H 1567 the "Global Food Security Act of 2015 — authorizing legislation to codify and strengthen USAID's Feed the Future's comprehensive approach to cultivating the transformative potential of agriculture-sector growth.

The legislation codifies the U.S. government's commitment to the productivity, incomes and livelihoods of small-scale producers, particularly women, by working across agricultural value chains and expanding farmers' access to local and international markets. It strengthens the initiative's existing accountability mechanisms and establishes parameters for robust congressional oversight, monitoring and evaluation of impact toward this commitment.

Both bills call for a strategic approach emphasizing:

- Coordination through USAID, of a whole-of-U.S.-government approach that currently includes the participation of 10 additional federal agencies.
- A foundation in country strategies, ownership and engagement.
- The harnessing of science, technology and innovation.
- Leveraging of unique partnerships in development, including private sector and research institutions.
- A focus on women's economic empowerment and nutrition.
- An expansion in the capacity of local organizations and institutions.
- Resilience approaches to ensure that chronically vulnerable populations are linked to market systems so they can truly escape poverty.
- Engagement in consultative processes with critical external stakeholders, including civil society and the private sector.

TITLE XII – USAID Feed the Future Innovation Labs

Relevance

Kansas State University is currently leading four USAID Feed the Future Innovation Labs:

1) Applied Wheat Genomics Innovation Lab
2) Reduction of Post-Harvest Loss Innovation Lab
3) Sorghum and Millet Innovation Lab, and the
4) Sustainable Intensification Innovation Lab

Kansas State University is the only university in the U.S. to have successfully competed for four of the new innovation labs.

Kansas State University also will continue its work with other existing and new USAID Feed the Future Innovation Labs as it continues its leadership in global food systems.

Agency Contact Information

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NSF Long-Term Ecological Research (LTER) Program at Konza Prairie: Contributing to the Conservation and Management of Grasslands Worldwide

Background

The Long-Term Ecological Research (LTER) program was created by the National Science Foundation (NSF) in 1980 to support a network of research sites to address critical ecological questions that cannot be answered with more typical short-term observations or experiments. Funding is provided by NSF in the form of renewable six-year grants, which are peer-reviewed and renewed based on the quality of science, research productivity and contributions to network and synthesis activities. NSF conducts rigorous reviews of LTER sites at the midpoint of each grant cycle, as well as a comprehensive review of the entire LTER Network every 10 years.

Relevance

K-State's Konza Prairie Biological Station is the core research site for the Konza Prairie LTER (KNZ) program. Konza Prairie, an 8,600-acre native tallgrass prairie research station, is jointly owned by Kansas State University and The Nature Conservancy and managed by K-State's Division of Biology. Konza Prairie was one of the six initial LTER sites funded in 1980, and LTER funding for the site was renewed in 2014 for the next six years at a level of $6.76 million, bringing total LTER funding for the program to more than $29 million. In addition, the core LTER program provides a research platform that facilitates successful competition for additional federal funding from a variety of agencies.

LTER funding from NSF supports a multi-investigator, interdisciplinary research program centered at the Konza Prairie Biological Station with a long-term goal of building a comprehensive understanding of ecological processes in tallgrass prairie and other grasslands while contributing to broad synthetic and conceptual advances in ecology. The Konza LTER program also provides education and training to students (K-12 to postgraduate), public outreach and knowledge to inform grassland management and conservation. Our site-based research focuses on the tallgrass prairies of Kansas, but cross-site and comparative studies with other grasslands extend the relevance of this research globally.

Konza Prairie LTER research is organized around four major themes — land-use change, climatic variability, altered biogeochemical cycles and restoration ecology — and builds on a 30-year foundation of long-term experiments and measurements in terrestrial and aquatic grassland ecosystems.

Konza Prairie Biological Station has approximately 120 active registered research projects by Kansas State University scientists in five colleges and 14 departments, as well as more than 60 visiting scientists and students from other research institutions across the U.S. and world. Research conducted at Konza Prairie has resulted in more than 1,700 publications, including more than 275 student theses and dissertations.

Konza Prairie Schoolyard LTER funding also supports on-site K-12 activities, undergraduate and graduate education, and training, community outreach and engagement with grassland managers and conservationists. Collectively, LTER research and associated cross-site and comparative studies are contributing to improved management, conservation and restoration of grasslands globally.

Agency Contact Information

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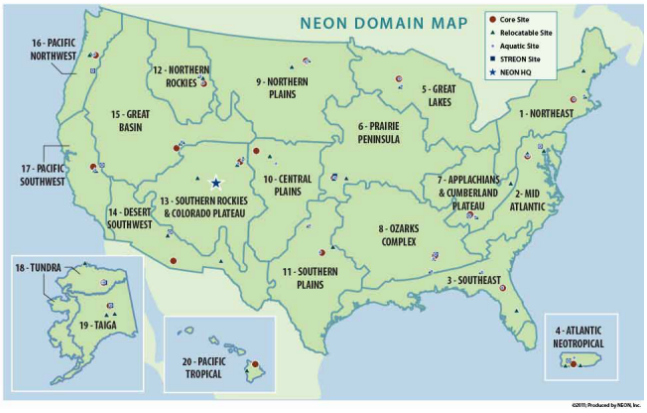
NSF National Ecological Observatory Network (NEON): Monitoring the Health of the Nation's Ecosystems and Building Research and Training Infrastructure

Background

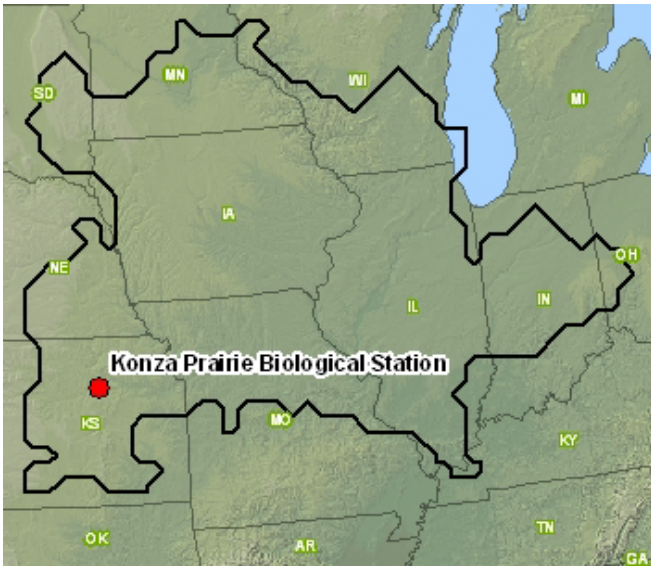
The National Ecological Observatory Network (NEON) is a continental-scale ecological observation facility sponsored by the National Science Foundation to gather and synthesize data on the nation's natural resources and biodiversity. It consists of state-of-the-art environmental sensors and standardized research equipment and sampling protocols at a network of sites distributed across the U.S. (including Alaska, Hawaii and Puerto Rico) strategically selected to represent different ecosystem types, land uses and climates.



NEON conducts site-based measurements of a broad range of environmental and ecological variables, and couples this with airborne remote sensing and other continental-scale data sets (e.g., satellite data) to document the health of the nation's ecosystems and to assess how those ecosystems are changing through time. Sensor networks, instrumentation, experimental infrastructure, natural history archives and remote sensing are linked with computational, analytical and modeling capabilities to create an integrated NEON infrastructure. In this way, NEON aims to transform ecological research by enabling studies of major environmental challenges at regional to continental scales, and by training a new generation of ecologists and environmental scientists to work with this regional-to-continental scale data.

Relevance

NEON sites are distributed across 20 large regions (eco-climatic domains), with each region having a core terrestrial and aquatic site and two additional sites that represent contrasting environmental conditions or different land uses. For the Prairie Peninsula region, the core terrestrial and aquatic sites are located at Kansas State University's Konza Prairie Biological Station, and an additional relocatable site is located at the University of Kansas field station. The two Kansas sites are the only NEON sites in the multistate Prairie Peninsula region.



NEON moved through an intensive concept, approval and design stage from 2006 through 2012. NEON funding was approved by Congress, and most NEON sites are now fully instrumented and collecting data. At the Kansas sites, construction of instrument towers was completed in 2015, and field research is fully underway. NSF expects that all NEON core sites will collect data for at least 30 years.

Continued funding for NEON will ensure that biological field stations in Kansas, including K-State's Konza Prairie Biological Station, are supported with state-of-the-art environmental research equipment, providing unique capabilities for Kansas scientists and valuable training opportunities for students at K-State and elsewhere. For example, in 2016-2018 NEON supported aircraft flyovers with state-of-the-art sensor technology to collect remotely-sensed data for Kansas field sites. NEON also provides training and employment opportunities for teams of local students each year. The co-location of NEON infrastructure and the Konza LTER program also provides unique research and training opportunities for students and scientists at institutions throughout Kansas and beyond. This will facilitate additional research funding built around NEON and LTER capabilities and data availability, and will help in attracting the nation's top ecological scientists and students to Kansas.

Agency Contact Information

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Food Animal Residue Avoidance and Depletion (FARAD) Program

Background/Description

The Food Animal Residue Avoidance and Depletion (FARAD) program is an integrated extension and applied research program that maintains the Food Animal Residue Avoidance Databank, which is designed to eliminate adverse drug and chemical residues from appearing in the edible tissues of food-producing animals. FARAD helps keep food animals healthy and safe for human consumption through outreach activities that include a telephone hotline (1-888-USFARAD), website for request by veterinarians for direct residue avoidance assistance (www.FARAD.ORG), and mobile applications for field use. FARAD is a veterinary tool designed to keep adverse levels of drugs and chemicals from contaminating milk, meat and eggs destined for human consumption. No other federal or private entity duplicates work carried out by FARAD. FARAD straddles the missions of USDA (agriculture research and extension) and FDA (food safety). FARAD is an integrated extension and applied research program that provides required, scientifically valid information on how to avoid drug, environmental and pesticide contaminant residues in milk, meat and eggs, thus helping to avert food safety crises. FARAD provides the scientific basis for determining the appropriate withdrawal interval when drugs are used in an extra-label manner, a scenario often employed when veterinarians are trying to reduce antimicrobial resistance in animals they treat. The research component of this program involves development of mathematical models that predict withdrawal times and then can be used in real time by veterinarians in field situations. FARAD publishes handbooks and journal digests of these data to increase availability to practitioners, as well as contributing technical manuscripts to the peer-reviewed scientific literature of this field. FARAD is also used when food-producing animals are mistakenly exposed to environmental contaminants (e.g., pesticides, biotoxins, melamine, etc.), or, for example, to nuclear fallout seven years ago from the Fukushima reactor disaster in Japan. FARAD provides veterinarians with a legal mechanism for determining withdrawal intervals for extra-label drug use or contaminant exposures. Because it is often not economically viable for pharmaceutical companies to pursue a drug label claim for minor species, FARAD is the only source for food safety and drug withdrawal information for veterinarians treating these particular species (e.g., sheep, goats, reindeer, elk, ducks, pheasant, quail, rabbits, fish, shrimp and honeybees). Veterinarians often must use drugs approved for both animals and humans to address animal health and welfare and to enhance public safety. Public Law 103-396, Animal Medicinal Drug Use Clarification Act (AMDUCA), authorized in 1994, permits veterinarians to prescribe drugs in an extra-label manner to treat conditions for which there are no effective approved drugs. AMDUCA requires a scientifically derived withdrawal period for drugs used in an extra-label manner. FARAD is the only approved source for such information and, in fact, enables much-needed drug usage in food animal practice. FARAD serves as the veterinarian's clearinghouse for residue data.

Relevance

The FARAD program was developed in 1981 by pharmacologists and toxicologists at four land-grant universities. Dr. Jim Riviere, emeritus faculty member of the College of Veterinary Medicine at Kansas State University, is one of the co-founders of this program. Presently, FARAD is overseen and operated by faculty and staff in the colleges of Veterinary Medicine at Kansas State University, University of California at Davis, University of Florida, North Carolina State University, and Virginia-Maryland College of Veterinary Medicine. FARAD continues to serve as the primary resource for veterinarians to maintain a drug- and chemical residue-free food supply. In 2017, FARAD received 3,607 calls, which represented a 7.2 percent increase in residue avoidance cases compared to 2016. Calls are very diverse and range from "ordinary requests" for drug withdrawal recommendations (related to extra-label drug use often to reduce potential for antimicrobial resistance, or after accidental drug overdoses) to "extraordinary requests," which include pesticide and contaminant exposures (e.g., oil products spilled from freight trains), as well as disasters such as hurricanes. The global veterinary drug residue avoidance database effort continues to be pursued, a development which would greatly impact the food safety community, and provide direct support for Kansas beef exporters.

Agency Contact Information

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Supplemental Nutrition Assistance Program Education (SNAP-Ed)

Background

A total of 13% of Kansas' population falls below the federal poverty line, with 16.8% of Kansas children under age 18 at or below the 100% poverty level (2015 data). Kansas also ranked 32nd in the U.S. in hunger and household food insecurity at 14.6% (USDA Household Food Security in the US, 2015). Since 1995, Kansas State University Supplemental Nutrition Assistance Program Education (SNAP-Ed), coordinated and delivered by Kansas State Research and Extension working closely with the Kansas Department for Children and Families (DCF), is addressing food insecurity, improving nutrition and preventing or reducing diet-related chronic disease and obesity among eligible, low-income individuals and families.

The Supplemental Nutrition Assistance Program (SNAP), is a Federal program that provides nutrition benefits to low-income individuals and families that are used to purchase food. The program is administered by the USDA Food and Nutrition Service (FNS).

Description

The Kansas SNAP-Ed program uses multi-level interventions, including direct education, to reach its population in ways that are relevant and motivational, while addressing environmental, policy and social system constraints in the community. Evidence shows that implementing multiple changes at various levels is effective in improving eating and physical activity behaviors and changing the risk and rates of chronic disease and obesity. Activities conducted at the individual and interpersonal levels through a series of direct nutrition education lessons are evidence based and assist in changing healthy eating patterns across the lifespan. The direct nutrition education aims to improve overall dietary quality, increase food resource management skills, increase participation in physical activity, and improve food safe food handling and preparation. In addition, community and public health approaches focus efforts in neighborhoods, grocery stores, schools and communities.

Relevance

In 2017 to 2018, around 24,000 low-income people received SNAP-Ed nutrition education. Participants included students, parents, families, adults, and senior adults. Lifestyle behaviors improved after participating in the program. For example, increased numbers from all age groups reported they exercised more, adult participants ate different kinds of fruits and vegetables more often, and children washed their hands more often before and after preparing foods or eating.

In addition, Kansas SNAP-Ed partners with city and regional planning groups, food banks and food pantries, human services organizations, schools and other relevant stakeholders to implement strategies such as:

- Establishing and improving standards for healthier eating across the organization
- Changing food purchasing towards healthier foods
- Changing menus to increase variety and serve healthier foods
- Collecting excess wholesome food to donate to charitable organizations
- Establishing and maintaining edible gardens

Marion County SNAP-Ed agent and educator play an important role to initiate and maintain this edible garden. Harvested fresh vegetables are to be donated to a local food pantry.

Agency Contact Information

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1DATA

Background

Kansas State University and the University of Missouri-Kansas City have established a partnership to develop 1Data, which leverages the strengths of our region to develop a platform to share human and animal health research data. Other organizations in the region were also part of the program development that began in 2016, including BioNexus, Children's Mercy Kansas City, University of Kansas Medical Center, Cerner and MRIGlobal. Together, this collaboration has enabled 1Data to develop the framework for the structured environment and begin to use big data in human and animal health to build computational approaches to significantly impact research that will improve the well-being of animals and humans.

Description

The long approval process to develop new drugs and therapeutics is a threat to those facing health challenges, and is impacting the pharmaceutical industry's willingness to invest in research for new drug discoveries for both humans and animals. The current system poorly integrates modern science into the regulatory process and does not optimally use available resources and established modern computational techniques. For example, when existing data is undocumented, animal studies must be repeatedly conducted to obtain controls. This repetition and fragmentation of biomedical data within and across human and animal sources have a negative impact on developing new and effective health care. Partitioning of data also prevents predicting population-based outcomes after a treatment is developed.

The 1Data program will enable algorithm development with real data and provide a virtual population of animals to assess how effective a new treatment might be. This will result in more efficient, long-term changes to the approval process and immediate, measurable gains in human and animal diagnosis. Better integration of human and animal health data makes zoonotic illness tracking feasible. Given regional assets in outcomes research, there is high potential for wide-ranging impact on numerous health conditions regionally.

1Data includes links to genomic data from public and proprietary sources, cladistics data, host-pathogen relationships and relationships that allow data from one species to inform and make use of incomplete data for other species within the structured environment. Thus, real data from several animal studies can be used to help predict simulated results in another animal or person. Human and animal clinical data become endpoints on a spectrum, allowing a view of potential interactions that enable a more complete evaluation of animal models for drug development. This decreases failed studies, decreases the use of animal models, and benefits human and animal health.

1Data is a regional collaboration, crossing the Missouri and Kansas state lines, and involves multiple disciplines. Together, this collaboration can take advantage of big data and the wealth of computational approaches to significantly impact research in animal and human health.

Relevance

The current approval process was developed to assure drugs and therapies were safe for humans; however, over time, it has not substantially changed to keep up with modern scientific methods. The current regulatory system poorly integrates modern computational science into the approval process in either a timely or efficient manner. Furthermore, it does not optimally use available animal/pre-clinical resources and well-established modern computational techniques. As a result, needless animal studies are often conducted to obtain controls when much better data exists — 1Data is capturing and making this data usable to researchers.

Data generated and analyzed can be used by researchers to:

- Develop applications to perform simulations with existing data, saving time and resources.
- Develop methods to integrate sparse and incomplete data sets to create usable in silico (via computer simulations) virtual animal populations to replace, reduce and refine animal use.
- Develop a platform to enable the use of curated and validated animal health data into the human health sphere and vice versa.
- Identify congruencies between human and animal diseases, and match and integrate animal and human data to predict functional information.
- Assist with efforts to integrate information on emerging zoonotic diseases and improve biosurveillance.

Agency Contact Information

U.S. Department of Agriculture

USDA-ARS Center for Grain and Animal Health Research (CGAHR)

Description

The Agricultural Research Service's Center for Grain and Animal Health Research, or CGAHR, is the only U.S. Department of Agriculture research laboratory in Kansas. The center is part of the Plains Area region of the Agricultural Research Service, with offices in Fort Collins, Colorado. Based in Manhattan, research conducted at CGAHR falls under seven national programs. The center is ideally located in the heart of the Great Plains, the nation's breadbasket and livestock center.

The mission of CGAHR is to conduct innovative research and develop new technologies to solve problems associated with arthropod-transmitted animal diseases, and in the production, storage and utilization of grain to ensure a safe, abundant and high-quality food supply.

CGAHR has four research units with unique missions and interacts with key customers and stakeholders. Also, the center is engaged in many collaborative research projects with Kansas State University. CGAHR scientists are recognized worldwide for innovative research and technology development.

1) The Arthropod-Borne Animal Diseases Research Unit studies animal diseases spread by arthropods and develops diagnostic tools, vaccines and other technologies to protect animal health.
2) The Hard Winter Wheat Genetics Research Unit finds and provides new genetic material to address hard winter wheat problems, including insect pests, diseases, and abiotic stresses.
3) The Grain Quality and Structure Research Unit investigates relationships between physical and chemical attributes and end-use quality for various wheat and sorghum products, and it develops rapid and precise predictive tests.
4) The Stored Product Insect and Engineering Research Unit develops new knowledge and methods for controlling insect pests in grain and food products, and it develops technology to measure and preserve grain quality.

Agency Contact Information

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College of Veterinary Medicine/Association of American Veterinary Medical Colleges

Background

Veterinary medicine is an integral and indispensable component of our public health system as well as our agriculture and agricultural biosecurity systems. In addition to their obvious role in maintaining animal health, veterinarians also protect human health by preventing and controlling infectious diseases, ensuring the safety and security of our food supply, promoting healthy environments, and providing health care for animals. Because of the threat that infectious diseases pose to both human and animal health, there is an immediate and urgent need to build national capacity in training of veterinarians with expertise in food animal medicine, public health and agricultural biosecurity. Rural veterinarians, engaged in food animal practice, are our nation's first line of defense in recognizing a foreign animal disease. It has become increasingly important for schools and colleges of veterinary medicine to provide high-quality training programs in agricultural biosecurity within the instructional program for veterinary medical students, and at a higher level for graduate veterinarians who seek advanced training in agricultural biosecurity. Such additional instructional programs are difficult to implement within the severe constraints of veterinary medical schools and colleges, placing a premium on programs that can assist the educational institutions in meeting a greatly expanded national need.

With only 30 veterinary medical colleges in the country, they do not have enough capacity to meet all of these needs. All of these schools are at the maximum number of students they can accept due to space limitations for teaching, diagnostics and research. Laboratories, teaching hospitals, veterinary research facilities, and animal diagnostic areas are built specifically for use with animals, including laboratory animals, livestock species and wildlife. This is space built with unique safety, restraint and handling requirements that are not commonly found on American campuses.

In addition to the projected need based on current assumptions about veterinary medicine, even more veterinarians will be needed due to other factors such as greater encroachment on animal habitat, resulting in increased human interaction with wild and exotic animals; changing climates and ecosystems, deforestation, dam building and irrigation leading to greater numbers of arthropod vectors of disease and greater contact between these vectors and humans; more and faster global travel and displaced human and animal populations, leading to rapid and wide dispersal of infectious diseases; and changing human behavior, such as consuming exotic foods and keeping exotic pets, which increases the risk of exposure to newly emerging infectious diseases.

To be successful, programs that seek to recruit and retain veterinarians in careers in food animal practice, public health and agricultural biosecurity must compete effectively with programs recruiting veterinarians to many other career options. A new graduate from an accredited U.S. veterinary medical school or college typically enters the profession with over $160,000 of educational debt. Consequently, graduates very logically examine the salary expectations, both at entry and over the long term, of a potential career choice, recognizing their need to repay their student loans even as they seek to establish a family and maintain a reasonable lifestyle. With such financial pressures and analyses, a career in food animal practice and agricultural biosecurity often pales in comparison to the salary potential of other, more lucrative career options. Consequently, measures to relieve a significant portion of debt, contingent upon entering and remaining in a career in food animal practice and agricultural biosecurity, are very important for the recruitment and retention of veterinarians to this area of national need.

The support of effective strategies to recruit and retain an adequate number of veterinarians in food animal practice, and to facilitate their training in agricultural biosecurity, are key elements in maintaining the security of our food supply and of our agricultural economy.

Measures to facilitate the recruitment and retention of veterinarians in food animal practice while simultaneously expanding the training of veterinarians in agricultural biosecurity are keys to maintaining the security of animal agriculture, our agricultural economy and our food supply.

Description

The Agriculture Act of 2014 (PL 113-79) contained provisions important to veterinary medicine. Section 7104 established a competitive veterinary services grant program to develop, implement and sustain veterinary services. Authorized at $10 million annually, this section would amend the National Agricultural Research, Extension and Teaching Policy Act of 1977 to direct the secretary of agriculture (USDA) to carry out a program with qualified entities to develop, implement and sustain veterinary services in the states. The program received initial funding in FY 2016 for $2.5 million. This program would allow recipients to: a) establish or expand veterinary practices or establish mobile veterinary facilities, b) recruit veterinarians, technicians and students, c) attend training programs in food safety or food animal medicine, d) establish or expand accredited education, internship, residency and fellowship programs, e) assess veterinarian shortage situations, and f) support continuing education and extension, including tele-veterinary medicine and other distance-based education.

The Veterinary Medicine Loan Repayment Program (VMLRP) Enhancement Act would amend the Internal Revenue Code to make VMLRP awards exempt from gross income and employment taxes. Awards are currently taxed at 39 percent, although those taxes are paid by USDA directly to the treasury on behalf of the award recipient. Tax exemption for VMLRP awards would result in one additional veterinarian for every three based on current appropriations.

College of Veterinary Medicine/Association of American Veterinary Medical Colleges

Support is requested for: 1) Provisions of the Agriculture Act of 2014 (PL 113-79) important to the veterinary profession, namely the Animal Health and Disease Research/1433 Formula Funds; Centers of Excellence, Food Animal Residue Avoidance Databank (FARAD), and the Competitive, Special and Facilities Research Grant Act, as well as the new funding for the Veterinary Services Grant Program (VSGP) to develop, implement and sustain veterinary services 2) tax exemption for awards made under the Veterinary Medicine Loan Repayment Program (VMLRP), and 3) passage of appropriations legislation that maintains or increases funding for the VMLRP, Animal Health and Disease Research/1433 Formula Funds, Agriculture and Food Research Initiative, FARAD, the VSGP, the National Animal Health Laboratory Network (NAHLN) as well as for the National Institutes of Health (NIH).

Aspirations for the appropriations for fiscal year 2020 should be to maintain or increase current funding levels for such critical programs as the Animal Health and Disease Research/1433 Formula Funds, Veterinary Medicine Loan Repayment Program, Agriculture and Food Research Initiative, the Agriculture Research Service (ARS), and the National Institutes of Health.

Relevance

Agriculture, and specifically animal agriculture, is vital to the Kansas economy. Training, recruiting and retaining enough veterinarians to meet the needs of agriculture and of agricultural biosecurity are important concerns of agriculture and related organizations. They are also natural issues of concern to the College of Veterinary Medicine at Kansas State University, one of only 30 such schools in the United States. As one of only 27 states with a College of Veterinary Medicine, Kansas would clearly benefit by increased federal investment in the training of veterinarians in agricultural biosecurity and food animal practice, as well as in their subsequent recruitment and retention.

The proposed federal investment would augment, not replace or diminish, the importance of funding from the state of Kansas. It will, however, multiply the impact of state funds and enhance the ability of Kansas State University and the College of Veterinary Medicine to meet the needs of the state and nation.

Leaders from the Kansas congressional delegation have lent their support to these important legislative efforts.

Agency Contact Information

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