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"Food for Thought: Efforts to Defend the Nation's Agriculture and Food"

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Thank you Chairman Donovan, Ranking Member Payne, and members of the subcommittee for the honor of addressing you today.

As the Dean of the College of Veterinary Medicine at Kansas State University, I am pleased to speak with you regarding Efforts to Defend the Nation's Agriculture and Food.

U.S. Agriculture: Strengths and Vulnerabilities

As first designated in 2003 through Homeland Security Presidential Directive 7, the Food and Agriculture Sector is one of 16 critical infrastructures whose assets, systems, and networks are considered to be so vital to the U.S. that its incapacitation or destruction would have a debilitating effect on security, the national and global economy, public health and safety, or any combination thereof.[i]

The U.S. Agricultural sector is a diverse, complex and highly integrated enterprise whose health and productivity is vital to the national economy. Agriculture in the U.S. is a $1 trillion business and this sector alone employs approximately 9.2% of American workers. In 2013, agriculture and agricultural-related industries contributed $789B to the U.S. gross domestic product (GDP), and in 2012 domestic animal agriculture (e.g., livestock and poultry production) produced approximately 1.8M jobs, $346B in total economic output, and $60B in household income.[ii,iii] Furthermore, in the U.S., consumers spend on average, approximately 6.4% of their annual expenditures on food. This percentage is extremely low when compared to other countries whose expenditures range from 11% (Switzerland) to 47% (Pakistan).[iv] U.S. farmers and ranchers work hard to keep food prices low and are only able to accomplish this through increased efficiencies in production, achieved through technological advancements in industrial food production. Threats that jeopardize our production and the security and affordability of the U.S. food system have the potential to disrupt our social structure and cause political instability.

The bulk of the agricultural enterprise is almost solely owned and operated by the private sector, and the U.S. is currently the world's leading exporter of food. When evaluating the impact on the economy, the food supply and the Nation's jobs, it is clearly evident why this industry is deemed a U.S. critical infrastructure. Any disruption to the daily operations and/or productivity of this enterprise would have significant impacts on Americans' livelihoods, our food supply, the economy and our public health. Simply said, U.S. agricultural security *is* national security.

Threats and Vulnerabilities of the U.S. Agricultural System

As I testify before you today, U.S. citizens reap the benefits of a robust agricultural industry that provides them with access to a safe, abundant and affordable food supply that is readily available on the shelves of grocery stores nationwide. This is indeed a privilege that as you well know, does not exist globally. However, the very elements that make the U.S. agricultural sector robust and productive also make it vulnerable to a natural or intentional introduction of a biological agent. In fact, perhaps now, more than anytime in our history, the agricultural industries are at risk from a variety of threats that have the potential to severely disrupt our economy, our food supply and cause great harm to our public health sector.

Threats to our U.S. agricultural sector can come in a variety of forms, to include a natural introduction of a foreign (transboundary) animal, emerging, and/or zoonotic disease or an intentional introduction of a biological agent (agroterrorism) into our agricultural systems. These threats would result in significant morbidity and/or mortality among livestock or poultry, cause great economic harm, adversely impact and/or disrupt our food supply and/or contribute to an adverse public health event. Many of these agents do not require weaponization, can be easily obtained, and exist naturally in areas where terrorist groups such as the Islamic State (ISIS), al-Qa'ida, al-Shabaab, Boko Haram, and others who intend to harm the U.S. operate. In addition, the risk from emerging infectious and/or zoonotic diseases continues to threaten our animal, plant, and public health sectors.

The U.S. agricultural and public health systems, while free from devastating diseases such as Foot and Mouth Disease (FMD, since 1929), African Swine Fever (ASFV), Rift Valley Fever (RVF), and other highly pathogenic livestock and zoonotic diseases, are becoming increasingly at risk for an introduction of these and/or other emerging and/or zoonotic diseases. Impacts resulting from an introduction of a high consequence disease, agro-terrorist and/or bioterrorist agent into U.S. agricultural systems have been studied and published in peer-reviewed journals. Studies indicate that the magnitude and severity of an introduction of a high consequence disease into U.S. livestock or poultry herds/flocks would be large. For example, the authors of a study recently completed by Kansas State University predicted that costs associated with an FMD outbreak in the Midwestern U.S. could result in a total of $188B in losses to the livestock and allied industries and up to $11B to the U.S. government.[v]

In addition to publications highlighting the economic and social impacts of a disease incursion, we have learned first hand from recent experiences that the social, economic, and political fall-out from emerging disease incursions can be devastating. Most recently, the U.S. has witnessed incursions of porcine epidemic diarrhea virus (PEDV) in our swine populations (2013) and highly pathogenic avian influenza (HPAI) in our poultry populations (2015), as well as Ebola

virus (EBOV; 2014) and Zika virus (2016) outbreaks in our public health sector. Each of these events further demonstrates our vulnerability to newly emerging and re-emerging pathogens that can be naturally or intentionally introduced.

In the case of PEDV, the cause and route of introduction into the U.S. swine population has still not clearly been elucidated. Nevertheless, over half of the U.S. sow population was infected with PEDV, and the industry lost 10% (7M) of the piglets born to these sows during this outbreak.[vi] More recently, the introduction of HPAI virus into the U.S. poultry population resulted in the destruction of approximately 7.5M (7.5%) of the U.S. turkey population and 41.1M (10%) of the commercial chicken population. The total indemnity cost for this outbreak was approximately $191M.[vii] The PEDV and HPAI outbreaks have reminded us that although we have made significant progress as a Nation and as a sector in preparing for both natural and intentional introductions of transboundary, emerging and zoonotic diseases, they remain continual threats to the U.S. agricultural system and we still have a tremendous amount of work to accomplish.

The increased risk of the above mentioned threats to the U.S. agricultural and public health systems can be attributed to several social, environmental, and economic factors. First, there is increased movement of people, animals, plants, and products globally. Global commerce and air traffic moves at speeds that defy the ability to detect and prevent movement of diseases from their source in the early stages before detection. Indeed, animals and people can move and travel prior to clinical signs of a disease, thus arriving in another country already infected and able to spread the disease to people or animals they may contact. Second, trends in livestock production in the U.S. have resulted in more specialized, intensive, and concentrated farming practices, where large numbers of animals are produced on a much smaller number of premises. These vertically integrated systems manage movements of animals and animal products to ensure a "just-in-time" delivery to the next location (e.g., feedlot, finisher, packer, and retailer) in the food production system. Our livestock production systems execute a large number of animal movements daily. As an example, it is estimated that approximately 1M swine and 400K cattle are in transit to the next location in the production system at any one time during the day. An introduction of an agent, either naturally or intentionally, into these intensive farming systems could lead to widespread distribution through these movements within hours of its introduction. Furthermore, in the event of a disease outbreak in which a "standstill" or quarantine of animal premises is implemented as the primary control strategy, maintaining business continuity through the controlled movements of animals is critical for food security and animal health and welfare.

Next, advanced technical capabilities are not required to obtain agents that can be utilized to promulgate an agro-terrorist event and/or a bioterrorist event against our agriculture and public health systems. Many of the agents on the list of those most likely to be utilized to execute an agro-terrorist and/or bioterrorist event (such as FMDV, ASFV, and Ebola) are readily available in countries throughout the world and do not need special handling or weaponization. As mentioned previously, these agents are readily available in countries in which terrorist groups such as the Islamic State (ISIS), al-Qa'ida, al-Shabaab, Boko Haram, and others who intend to harm the U.S. operate. Lastly but certainly not least, we must not overlook the natural occurrence and emergence of diseases whether agricultural or zoonotic. Factors that lead to the emergence of disease include changes in socio-economic, environmental and/or ecological

circumstances.[viii] It has been estimated that over 75% of all emerging pathogens are zoonotic and that zoonotic pathogens are twice as likely to be associated with an emerging disease than non-zoonotic pathogens.[ix] In addition, there are approximately 320,000 unknown viruses that infect mammals and that have not yet been identified and/or characterized.[x]

Over the last decade, members of the agricultural sector have made tremendous progress in preparing for a natural and/or intentional introduction of a transboundary, emerging and/or high consequence disease agent. Public and private partnerships have been forged that have paved the way for significant advancements in the development of countermeasures (vaccines, immunomodulators, and diagnostic assays) for high risk/high priority agro-terror agents. For example, through a public/private partnership led by the U.S. Department of Homeland Security Science and Technology Directorate (DHS S&T) Agriculture Defense Branch, a conditional U.S. license for the first FMD vaccine that can be manufactured in the U.S. has been obtained. In addition, we have developed, validated, and deployed (to the National Animal Health Laboratory Network [NAHLN]) molecular assays that are capable of supporting early detection and response for many of the high-risk agro-terror agents. And lastly, but certainly not least, federal, state, academic, and private partners have worked collaboratively to identify and prioritize risks, scan the global environment, perform comprehensive pathways analysis, and exercise disease outbreak response plans, all in an effort to enhance resiliency within each component of the sector.

While each of these accomplishments are noteworthy because of their ability to better position our sector to respond to an agro-terror event, they are perhaps more noteworthy because of the breadth of partners that were assembled and worked together collaboratively to accomplish each and every milestone. In the case of the FMD vaccine, DHS S&T, U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA APHIS) and Agricultural Research Service (USDA ARS), biopharma, the livestock industries, and academia were all essential players in ensuring development, transition, and ultimate licensure of this product. Indeed, many more of these unique partnerships are needed and are, in fact, critical to ensuring our success. We have enjoyed many successes, but still have much to accomplish if we are to be fully prepared when, not if, a devastating natural or intentional introduction of one of these agents occurs.

Public and Private Sector Prevention, Planning & Preparedness Activities: The Academic Role

Our ability to defend U.S. Agriculture and Food from the threat of intentional, unintentional or inadvertent introduction of high-consequence disease is heavily dependent on a coordinated, collaborative and comprehensive approach involving both state and federal government, law enforcement, industry (biopharma and animal producers) and academia. We must work together as members of the agricultural enterprise to leverage expertise, develop technologies and networks and/or systems that will ultimately produce a more resilient agriculture and food system.

Building on my previous roles with the federal government and academia, and in my current role as the Dean of the KSU College of Veterinary Medicine, I take the security of our livestock and poultry systems very seriously, and respect the role of academia in this broader partnership. Furthermore, I know that preparedness stems from true partnerships and collaborations across the enterprise and it is only through leveraging expertise throughout all levels of the sector that we will meet the challenge of securing our nation's agriculture and food supply.

Since the formation of DHS in 2002, and with the release of Homeland Security Presidential Directive 9: Defense of United States Agriculture and Food (HSPD-9), DHS has assumed the responsibility to coordinate the overall national effort to protect the critical infrastructure and key resources of the U.S., which includes agriculture. However, the USDA still has the primary responsibility for protecting the agricultural sector[xi] and does so with support from additional agencies to include the Department of Health and Human Services (DHHS), the Department of Interior (DOI), the Environmental Protection Agency (EPA), the Federal Bureau of Investigation (FBI), the Central Intelligence Agency (CIA), the Department of Defense (DOD), and the Attorney General (AG).

Academia, and in particular the Land Grant Universities, play a very unique and critical role in supporting the agricultural defense mission. Working with our stakeholders and federal partners (USDA, DHS and other state and federal agencies), we perform cutting edge and innovative research to develop countermeasures (e.g., vaccines, diagnostics, and immunomodulators), solutions, and technologies that can support our industry during peacetime, as well as in the event of a high consequence disease and/or agro-terror event. Furthermore, through our teaching and outreach missions, we work diligently to train the next generation workforce and educate producers, stakeholders and the public about novel technologies, policies, biosecurity practices, animal welfare, threats to the agricultural sector and much more. It is through these activities that our faculty and staff have developed strong relationships with producers, stakeholders, livestock owners, the allied industries and other national associations (e.g., National Pork Board, National Cattlemen's Beef Association). These relationships are built on trust and understanding and perhaps most importantly to homeland security and protection of the agricultural sector, provide a venue for a brokered, unbiased discussion and communication between the state and federal government and our agricultural sector. Academia is in a unique position to facilitate discussion between the public and private sector and oftentimes works to bridge the communication and trust gap so that solutions to complex challenges can be found. Simply stated, we are capable of acting as a "trusted partner" in what can sometimes be a complex relationship.

Since 2002, with the formation of DHS and the release of HSPD-9 (Defense of the United States Agriculture and Food) and HSPD-10 (Biodefense for the 21st Century), the role of academia in supporting the homeland security mission and, more specifically in protecting our agriculture and food sector from an agro-terror threat, has broadened. HSPD-9 not only called for DHS to accelerate and expand development of current and new countermeasures against the intentional introduction or natural occurrence of catastrophic animal, plant and zoonotic diseases, it also called for the Secretaries of Homeland Security and Agriculture to establish university-based Centers of Excellence (COEs) in agriculture and food security. As a result of this directive, there are two COEs within the DHS S&T Office of University Programs (OUP) that are focused on

agriculture and food security: the Zoonotic and Animal Disease Defense (ZADD), co-led by Kansas State University and Texas A&M University, and the Food Protection and Defense Institute (FPDI), formerly the National Center for Food Protection and Defense (NCFPD), led by the University of Minnesota. The primary mission of each of these Centers is to work across the agricultural enterprise to create novel solutions to homeland security challenges. Each of these Centers works closely with state and federal partners, as well as the industries to ensure portfolio alignment with nationally identified priorities. Each COE has a robust set of partner universities, national and international collaborators and stakeholders that are routinely brought together in multi-institutional, multi-disciplinary teams to address the complex challenges that face our industries today.

In light of the aforementioned roles and responsibilities, and in the context of a broadening academic presence in supporting homeland security, I would like to highlight a few instances in which academia has worked with other members of the agricultural enterprise to deliver products and/or technologies that have strengthened our nation's ability to respond to and recover from a potential agro-terror event. In addition, I would like to touch on several ongoing activities, each with a strong academic role, that demonstrate the power of partnerships and strength of a holistic approach to combatting a potential terror event.

Over the past decade, the University COEs have worked closely with DHS S&T, USDA (APHIS and ARS), State Animal Health Officials (SAHOs), biopharma and our livestock industries to identify and address national gaps in agriculture and food security. In particular DHS has sponsored multiple COE led workshops that have convened producers, livestock owners, national organizations, state and federal agencies, as well as industry and academia to identify and prioritize gaps, provide recommendations for addressing those gaps and help set national priorities for policy development and funding. For example, the agricultural screening tools workshops, designed to identify gaps in screening tools and diagnostics for high consequence agro-terror agents, helped develop and guide a robust program in diagnostic assay development. As a result of this program, multiple assays for early detection and/or recovery were developed, validated, and either accepted by the NAHLN for use during an animal disease event (FMD bulk tank milk assay), or transitioned to an industry partner for production and licensure (3B FMD ELISA). It was through intensive planning and partnership that each of the steps in development of these assays was accomplished. Academia, and in particular the COEs worked with DHS, USDA APHIS and ARS, the livestock industry and biopharma to lead the development and transition of each assay, working diligently to ensure the assays met each of their requirements.

The role that academia plays in the development, piloting and transitioning of veterinary countermeasures and/or technologies cannot be overstated. Our ability to work in each segment of the development pipeline makes us unique in our capability to support the homeland security enterprise. During the last six years, the ZADD Center has enjoyed tremendous success in working with our federal and state partners, biopharma, and the livestock industries to develop, transition, pilot, and ultimately license multiple products to aid in the detection or response to an agro-terror event. For example, the Center of Excellence in Emerging and Zoonotic Animal Diseases (CEEZAD), which is housed within the CVM at Kansas State University, is currently working with an animal health company to develop, test and evaluate a novel recombinant vaccine for Rift Valley Fever virus (RVFV), a high-consequence transboundary/zoonotic disease

agent. If successful, this product will be produced, licensed and available for purchase by the USDA APHIS National Veterinary Stockpile, should the need arise. CEEZAD's unique relationships with the biopharmaceutical industry allows for early input and buy-in regarding the products being developed within the Center. This increases the likelihood of acceptance, production, and eventual licensure of DHS S&T OUP sponsored research.

In addition, the DHS S&T Agriculture Defense Branch has engaged the COE at Texas A&M University, the Institute for Infectious Animal Diseases (IIAD), and tasked them with working to develop a template, obtain permits, and forge relationships that will allow for the first ever international field trial of the newly licensed FMD vaccine. If successful, this template will provide a robust guideline for performing a successful field trial, but more than that, it will provide a template, standard operating procedures, and solidify relationships that will be critical for supporting additional testing of future DHS S&T products in an international field-trial setting. Both of the aforementioned projects are excellent examples of how the DHS S&T Chemical and Biological Division (CBD) and DHS S&T OUP are working with a broad spectrum of partners, both individually and through academia, to enhance our nation's agriculture and food security.

Next, the USDA APHIS has worked closely with the Center for Food Security and Public Health (CFSPH) at Iowa State University to develop the Secure Food Supply Plans (eggs, turkeys, milk, pork and beef). In the event of an animal disease outbreak, our industries must be able to resume movements from disease free premises within a short amount of time. Any delay in this ability will result not only in product shortages but also in serious animal welfare issues. Supported by the USDA APHIS and led by an academic partner (CFSPH), the livestock and poultry industry, allied industries, state and federal partners, and other stakeholders worked cooperatively to develop and vet each individual sector-specific plan. This multi-partner effort has resulted in the development of robust templates and guidance documents that can be utilized by state animal health officials for permitting movements of animals and animal products from disease free premises in the event of an animal disease emergency.

In addition to the examples given above, DHS S&T, SAHOs and the USDA engage academia for expertise in epidemiology, modeling, surveillance, pathology, immunology, and many other fields. Our ability to provide subject matter expertise, perform research to address specific questions, and act as a hub for reach-back capabilities are just some of the attributes that make us a strong and vital partner.

Lastly but certainly not least, Colleges of Veterinary Medicine and Agriculture across the U.S. are playing what is arguably their most important role in homeland security, and that is: teaching, training, and preparing the next generation homeland security workforce.

The state of Kansas has a proud history of agricultural production, and it continues to be among the leading states in the Nation for crop and animal industry. For example, in 2014, Kansas ranked first among the states for production of sorghum for grain (200 million bushels), second for wheat (250 million bushels), third for commercial red meat production (5 billion pounds), and third in production of cattle and calves (6 million head).[xii] At K-State's College of Veterinary Medicine, we instill a respect for this agricultural enterprise and its relevance in

feeding our nation and the world among our students. The KSU CVM is one of the oldest veterinary colleges in the U.S., and has graduated more than 5,000 men and women veterinarians. As opposed to many other veterinary schools, where the majority of students pursue small animal medicine, KSU prides itself on a strong focus on production animal medicine, which is put into practice by our Department of Clinical Sciences. Indeed, these graduates understand the role of animal health in the success of the Nation's agricultural system, and further recognize that veterinarians serve as the first line of defense in identifying incursions of transboundary, emerging, and zoonotic diseases.

In the interest of developing the next generation of animal health professionals, the KSU CVM maintains a number of educational programs, including those in veterinary medicine, advanced clinical training, and research in animal health and related disciplines. The CVM's Department of Diagnostic Medicine/Pathobiology encompasses a number of research program thrusts that are directly relevant to defense of U.S. Agriculture. For example, a number of programs are focused on all aspects of infectious disease and include viral and bacterial pathogenesis of endemic and emerging diseases, vaccine and antiviral development and evaluation, diagnostic assay development and validation, epidemiology and ecology of infectious disease, and the study of vector borne diseases. Researchers within the CVM also work closely with the KSU Biosecurity Research Institute (BRI), a biocontainment research and education facility. The BRI supports comprehensive "farm-to-fork" infectious disease research programs that address threats to plant, animal, and human health. The BRI facilitates diverse and multidisciplinary research and training opportunities, with the capability for research on foreign animal diseases in both large and small animal models, and basic and applied research. Faculty at the KSU CVM are working collaboratively with the BRI on projects addressing many of the highest threat disease agents (e.g., Classical Swine Fever, African Swine Fever and Rift Valley Fever).

On a site adjacent to the KSU CVM and BRI, DHS is currently constructing the National Bio and Agro-Defense Facility (NBAF). This facility will serve to replace and augment the mission currently being performed by the Plum Island Animal Disease Center. The NBAF will "be a state-of-the-art biocontainment laboratory for the study of diseases that threaten both America's animal agricultural industry and public health… [offering capabilities] to conduct research, develop vaccines, diagnose emerging diseases, and train veterinarians."[xiii] Needless to say, close collaboration between the NBAF and the KSU CVM and its allied partner programs, presents inestimable opportunities to further strengthen local and regional resources for addressing threats to U.S. Agriculture and Food.

Conclusion and Recommendations

As I've described, addressing the threat posed by the intentional or unintentional introduction of a high-consequence disease is a collaborative process. The role of academia is only part of a much broader solution. Across the federal government, programs in agencies such as Health and Human Services (HHS), the Department of Defense, U.S. Agency for International Development, U.S. Geological Survey, and the Environmental Protection Agency must come together with USDA (APHIS and ARS) and DHS. Similarly, engagement of industry stakeholders from dairy, pork, beef and poultry, as well as the allied industries, must occur to

ensure that technological solutions and operational response measures are viable. Given the availability of high-consequence infectious agents abroad, a holistic approach to bio and agro-defense must also involve threat reduction at the global level. This should involve multi-national collaborators such as the Defense Threat Reduction Agency (DTRA), the Food and Agriculture Organization of the United Nations (UN FAO) and the World Organization for Animal Health (OIE) to name a few.

In addition to the need for collaboration there is also a need to allocate adequate resources to address the nation's vulnerability in this area. Considering the significance of agriculture to the American public's well-being, measures should be taken to correct the drastic imbalance in research and countermeasure funding for agriculturally-focused threats, versus human-centric ones. For example, during FY2014, 61% of federal funding for biodefense was allocated to HHS, while USDA received only 1%.[xiv] Similarly, the Strategic National Stockpile, which houses the Nation's repository of antibiotics, vaccines, chemical antidotes, antitoxins, and other critical medical equipment and supplies, received approximately $510 million, while the National Veterinary Stockpile received approximately $4 million. As further evidence of this imbalance, in 2007, the Laboratory Response Network, an integrated network of state and local public health, federal, military, and international laboratories that can respond to bioterrorism, chemical terrorism and other public health emergencies, had an annual budget of approximately $50 million[xv] while the NAHLN receives only $6 million dollars annually to support its operations.

There is also a need to increase emphasis on educational programs to further support U.S. Agriculture and Food. Efforts such as the DHS Centers of Excellence should receive additional resourcing, and U.S. veterinary curricula should emphasize the changing role of the veterinarian as part of a global defense against high-consequence transboundary, emerging and/or zoonotic diseases. Additional funds should be provided for agro-defense focused research, through avenues such as the USDA National Institute of Food and Agriculture (NIFA), the National Institutes of Health (NIH) and lastly but not least, through increased funding for programs that will be housed within the National Bio and Agro-Defense Facility (NBAF). Indeed, with construction of a state-of-the-art $1.25B facility, it is critical to ensure a stable and appropriate level of resources and funding for the research, training and diagnostic missions that will be housed within it. Currently, budgets for the USDA APHIS, ARS, and DHS S&T at PIADC do not account for the planned expansion of research/diagnostic/training programs that will occur in the new NBAF facility. I urge you to increase agency programmatic budgets for the NBAF mission, so that the full potential of the facility, and its DHS and USDA programs, can be achieved.

Preparedness for a natural or intentional introduction of a high-consequence agricultural event is dependent on a holistic, all-of-enterprise approach. Solving this sector's complex problems and supporting our industries will depend on a strong public/private partnership that is built on trust, collaboration and resolve.

Finally, Chairman Donovan, Ranking Member Payne, and members of the subcommittee, I want to thank you for this opportunity to speak to you regarding efforts to defend the nation's agriculture and food. I look forward to your questions.

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