Integrated Systems Approach to Human, Animal and Plant Health to Enhance Agricultural and Environmental Sustainability

Submitted by: Animal Science, Large Animal Clinical Science, UT Beef and Forage Center

The challenges facing agriculture are constantly changing, which emphasizes the importance of the land-grant system. The Grand Challenges for agriculture outline the need to proactively address societal needs in anticipation of greater disparity between resources and global population. The charge of the land-grant universities is to develop technologies that will improve the efficiency and sustainability of production systems, and then deliver these technologies through various educational outlets to ensure sustainability of communities. The Governor’s Rural Challenge recognized UTIA’s position in influencing agriculture with the development of the four major recommendations for further development of the agricultural sector’s impact on Tennessee’s economy.

1. Advance agriculture, natural resources and rural infrastructure as Tennessee business priorities.
2. Ensure a positive and predictable regulatory and policy environment for Tennessee agriculture and natural resources.
3. Expand marketing opportunities for Tennessee producers and encourage new production systems and agribusinesses.
4. Increase the scope and depth of a skilled and educated workforce through career, technical and higher education

One area of opportunity for UTIA to respond to this challenge is through its work in animal agriculture. Human health, animal health, livestock productivity, forage production and environmental stewardship are all key components of livestock production. In order to meet this challenge, it is proposed to develop a new priority program titled “Integrated Systems Approach to Human, Animal and Plant Health to Enhance Agricultural and Environmental Sustainability”.

Goal: This priority program will focus on developing and promoting new paradigm using a systems approach to improve the quality, quantity, and sustainability of animal production in Tennessee and the Southeast. This program will focus on a systems approach to the inter-related components including human, animal, plant, and environment to assess the inputs, including forage production, as well as outputs, including high quality animal proteins to achieve a novel method for integrated resource management.

This priority program will enable UTIA to better address several of the recommendations from the Governor’s Rural Challenge. It also aligns with several of the Grand Challenges developed in the APLU-ESCOP Science and Technology Committee report “A Science Roadmap for Food and Agriculture.” In this report, seven challenges were outlined as priorities for the future work in agricultural science. This program will directly address 4 of these grand challenges, including working to enhance the sustainability of the U.S. food system (Grand Challenge 1), mitigating the impact of climate change on food, feed, fiber and fuel systems (Grand Challenge 2), provide leadership to ensure a safe, secure and abundant food supply (Grand Challenge 4), and
heightening environmental stewardship through sustainable practices (Grand Challenge 6). This program will also impact Grand Challenge 5 (human health and nutrition) and Grand Challenge 7 (strengthen community development) through its effort to efficiently and sustainably producer high quality outputs from livestock systems.

**Current team:** UTIA has a dedicated group of personnel that currently work to make impacts in this area. The formation of the UT Beef and Forage Center has helped coordinate the research and educational activities within UTIA. The UTBFC is becoming recognized across the state and region as a resource for information on livestock and forage production practices. Below are UTIA personnel that contribute to this work.

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Appointment</th>
<th>Expertise</th>
<th>Department</th>
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<tbody>
<tr>
<td>Justin Rhinehart</td>
<td>100% E</td>
<td>Beef cattle reproductive management</td>
<td>Animal Science</td>
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<tr>
<td>Jason Smith</td>
<td>85% E 15% T</td>
<td>Beef cattle nutrition, management</td>
<td>Animal Science</td>
</tr>
<tr>
<td>Ky Pohler</td>
<td>80% R 20% T</td>
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<tr>
<td>Philip Meyer</td>
<td>85% R 15% T</td>
<td>Rumen microbiology</td>
<td>Animal Science</td>
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<tr>
<td>Peter Krawczel</td>
<td>70% R 30% E</td>
<td>Applied ethology; animal health &amp; well being</td>
<td>Animal Science</td>
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<tr>
<td>Augustin Rius</td>
<td>60% R 40% T</td>
<td>Ruminant nutrition (Dairy)</td>
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<tr>
<td>Travis Mulliniks</td>
<td>100% R</td>
<td>Beef cattle nutrition / energy utilization</td>
<td>Animal Science</td>
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<tr>
<td>Neal Schrick</td>
<td>34% R 33% T 33% E</td>
<td>Reproductive physiology</td>
<td>Animal Science</td>
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<tr>
<td>David Kirkpatrick</td>
<td>100% E</td>
<td>Beef Cattle Breeding and Genetics</td>
<td>Animal Science</td>
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<tr>
<td>David Anderson</td>
<td>80% Admin; 20% R</td>
<td>Livestock Welfare, infectious disease, pain, behavior</td>
<td>Large Animal Clinical Sciences</td>
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<tr>
<td>Marc Caldwell</td>
<td>70% T 30% R</td>
<td>Infectious disease, immunology, beef production medicine</td>
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<tr>
<td>Brian Whitlock</td>
<td>70% T 30% R</td>
<td>Reproduction, dairy production medicine, infectious disease, beef genetic selection</td>
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<tr>
<td>Name</td>
<td>Percentage</td>
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<tr>
<td>Sarel van Amstel</td>
<td>80% T; 20% R</td>
<td>Reproduction, beef cow/bull fertility</td>
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<tr>
<td>Ricardo Videla</td>
<td>70% T; 30% R</td>
<td>Genetics, lameness, livestock welfare, dairy welfare, behavior</td>
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<tr>
<td>Lew Strickland</td>
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<td>Infectious disease, livestock welfare, small ruminant production</td>
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<tr>
<td>Andrew Griffith</td>
<td>100% E</td>
<td>Livestock Marketing</td>
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<tr>
<td>Karen Lewis</td>
<td>75% R/25% T</td>
<td>Livestock Economics</td>
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<td>Chris Boyer</td>
<td>80% R/20% T</td>
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<tr>
<td>Gary Bates</td>
<td>75% E / 25% Admin</td>
<td>Forage production</td>
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<tr>
<td>Renata Nave</td>
<td>100% R</td>
<td>Forage quality</td>
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<tr>
<td>Neil Rhodes</td>
<td>100% E</td>
<td>Forage weed control</td>
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<tr>
<td>David Butler</td>
<td>75% R/ 25% T</td>
<td>Plant Sciences</td>
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<tr>
<td>Dwight Loveday</td>
<td>25% 4HALEC /38%E/37%T</td>
<td>Meat Teaching and Extension</td>
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<tr>
<td>Qixin Zhong</td>
<td>78% R/ 22% T</td>
<td>Encapsulation Tech</td>
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<tr>
<td>Faith Critzer</td>
<td>70% E / 30% R</td>
<td>HACCP and Food Safety</td>
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<tr>
<td>Doris D’Sousa</td>
<td>85% R / 15% T</td>
<td>Molecular detection</td>
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<tr>
<td>Francine Hollis</td>
<td>75% T / 25% R</td>
<td>Sensory Evaluation</td>
<td></td>
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<tr>
<td>Pat Keyser</td>
<td>60% R/40% E</td>
<td>NWSG management</td>
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**Needed Personnel:** Although there have been significant impacts from UTIA personnel in this field, there are several areas that need to be further investigated to improve the production practices and sustainability for Tennessee producers. In order to develop UTIA as a national leader in human/animal/plant health and environmental sustainability, there are several faculty positions that can contribute to the advancement of knowledge and production techniques.
ANIMAL SCIENCE

Beef Cattle Health and Welfare

Brief Description: The focus of this position is beef cattle health and welfare for Tennessee’s beef industry (cow-calf, stocker/feeder, seedstock). Areas of emphasis could include: infectious disease control, food safety, manure management, animal welfare, beef quality assurance, or beneficial management practices consistent with sustainable agriculture.

Expected Outcomes/Goals: The position in beef cattle health and welfare is critical for providing a wide range of animal health research and teaching services to the Tennessee and US beef cattle industry, essential for herd health, food safety, export markets, animal welfare, and the economic viability of beef cattle enterprises. The overall goal is to maintain delivery of essential research and teaching services with respect to beef production throughout the state and US.

Approximate Appointment: 85% R, 15% T

Production-Based Genomics

Brief Description: Education and production implementation of genomic discoveries in agricultural systems for breeders and producers

Expected Outcomes/Goals: To increase public and private stakeholder knowledge about genetic and genomic technologies available for supporting agricultural production and to advise basic research faculty on translation of discoveries to field application. This position would also meet the demands for our beef cattle extension specialist in beef cattle genomics.

Approximate Appointment: 100% E

Beef Cattle Endocrinology

Brief Description: Utilizing molecular and systems biology approaches to evaluate and study the mechanisms of action of hormones and related molecules as they pertain to beef cattle production.

Expected Outcomes/Goals: This position is critical for meeting the demands of research and teaching in the area of beef cattle endocrinology. Areas of emphasis could include: All aspects related to sustainable beef production such as reproduction, nutrition, genetics and health.

Approximate Appointment: 85% R, 15% T

Plant Sciences
Forage ecology and sustainability

**Brief description:** There are several topics within the forage production arena that need to be investigated to further this area of understanding for Tennessee producers. There has been an increased focus on soil health issues nationally, as well as the importance of efficient nutrient utilization to minimize input costs and decrease the negative environmental influence that can be seen with inappropriate timing or level of fertilization. This position would study the impact of various production techniques on plant nutrient uptake, and methods to utilize forage species and production practices to improve soil health characteristics while minimizing any environmental impact.

Training the next generation of producers and consultants is also an important role of UTIA. There are currently no faculty with forage expertise that have a teaching appointment. With the large number of students majoring in some component of animal/plant production in CASNR, this position would also be responsible for graduate and undergraduate training in sustainable forage production practices.

**Expected outcomes/goals:** Work from this position will provide information needed to address several of the grand challenges, especially those dealing with environmental issues and food productivity. This position is the connection between the production of high quality protein from livestock and environmental/land resource utilization.

**Approximate appointment:** 80% R/20% T

Large Animal Veterinary Medicine

**Assistant Professor in Dairy Production Medicine and Behavioral Research (LACS)**

**Brief Description:** The focus of this position if dairy cattle health and welfare (Calves, Replacement Heifer, Lactating Cows, Genetics, Productivity). Areas of research emphasis could be immunology, infectious disease, genetics, milk quality/mastitis, soundness/lameness, production medicine and management, cow comfort/welfare/pain management, dairy cow behavior.

**Expected outcomes / Goals:** This position will provide a critical support for dairy producers and veterinarians to ensure wholesome milk production and consumer protection. The candidate is expected to develop an extramurally funded program in support of the Tennessee dairy industry and in collaboration with practicing veterinary serving these operations. This position will aid in stabilizing the dairy industry in Tennessee and identify areas for expansion. This faculty member would be integrally involved in teaching veterinary professional students, will offer instruction of animal science students, will mentor graduate students (MS and PhD) as a committee member
and graduate advisor, will develop outreach programs with extension agents targeting livestock producer groups and veterinarians.

**Approximate Appointment**: 50% R; 30% T; 20% E

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**Assistant Professor in Infectious Disease and Epidemiology (LACS)**

**Brief description**: The focus of this position is to improve the health and productivity of livestock in Tennessee. This position will assume a leadership role in detection and surveillance of infectious disease and to provide epidemiologic data to animal health industry professionals and regulators. The goal is to increase the value of Tennessee livestock, develop programs to ensure sustainable farms and ranches, and to increase productivity and longevity of livestock operators. This position will focus on beef cattle programs but will assist in advancement of other livestock industries.

**Expected outcomes / goals**: This position will provide a critical link to human health professionals, animal health professions, and state regulatory and service agencies for the type, distribution, and epidemiology of infectious disease outbreaks. This faculty member is expected to develop advanced disease models for predicting impact, designing prevention strategies, and assessing effectiveness of intervention strategies. This faculty member would be integrally involved in teaching veterinary professional students, will offer instruction of animal science students, will mentor graduate students (MS and PhD) as a committee member and graduate advisor, will develop outreach programs with extension agents targeting livestock producer groups and veterinarians.

**Approximate appointment**: 50% R; 30% T; 20% E

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**Assistant Professor in Reproduction and Genetics (LACS)**

**Brief description**: This faculty member will provide vital support for improving the value of Tennessee livestock through creation of management strategies for genetic merit: genetic improvement through elimination of genetic inferiority and advancement of meritorious genetic traits. This faculty member will aid in the development of farm reproductive programs to improve fertility, conception rate, pregnancy rate, birthing rates, and weaning rates in such a way as to improve productivity, vigor, and value.

**Expected outcomes / goals**: This individual will develop programs to advance the value of Tennessee livestock through genetic selection. The faculty member will work with animal scientists, livestock producers, and veterinarians to advance reproductive strategies to improve breeding programs and selection of seed stock. The faculty member
would be expected to develop an extramurally funded research program in genetics or reproductive physiology. This faculty member would be integrally involved in teaching veterinary professional students, will offer instruction of animal science students, will mentor graduate students (MS and PhD) as a committee member and graduate advisor, will develop outreach programs with extension agents targeting livestock producer groups and veterinarians.

**Assistant Professor in Cow-Calf and Small Ruminant Production and Immunology (LACS)**

**Brief description:** Tennessee has diverse and substantial beef cattle and small ruminant industries. There has been erosion of the number of farms substantially involved in the production of beef market cattle and market lambs and kids. This position will be a resource for profitability, productivity, and sustainability of existing farms and serve as a resource to assist development of new livestock operations. This position will assist in development of production medicine programs including business management programs.

**Expected outcomes / goals:** This faculty member will be expected to develop extramurally funded research programs, including development of industry partnerships, with the goal of advancing the livestock industry in Tennessee. This faculty member would be integrally involved in teaching veterinary professional students, will offer instruction of animal science students, will mentor graduate students (MS and PhD) as a committee member and graduate advisor, will develop outreach programs with extension agents targeting livestock producer groups and veterinarians.

**Approximate appointment: 50% R; 30% T; 20% E**

**Agricultural and Resource Economics**

**Economics of the Livestock Food System**

**Description:** The livestock industry contains an advanced and highly competitive business environment. Feed and health inputs are significant cost components and impact the industry from the cow/calf operation through the retail level. Environmental regulations and management have been a growing area of concern for producers and processors. Product safety for consumers is a vital component for society. Therefore, research on three areas of concern could yield valuable results for producers, processors, consumers, and students.

1) Input (animal feed and health) management.
2) Environmental economics of livestock and forage production.
3) Meat and byproduct safety.

Expected Outcomes/Goals: The faculty member in this position will develop a research program based on the Economic, Environmental, and Consumer Safety areas of the Livestock Food System. The research program will result in peer reviewed publications, external grants to help support the research, and research-based curriculum to teach in the classroom.

Appointment: 75%R/25%T

Food Science and Technology Department

Meat Quality Scientist

Brief Description: Production of wholesome, fresh and processed meat products are a high priority for the industry. This position would examine strategies for enhancing meat quality and nutritional value as well as pre- and post-harvest meat safety. The position would collaborate with existing faculty having expertise in microbiology, ruminant nutrition, reproduction, and genomics. The candidate could also improve UTIA relationships with production, processing, and marketing segments of the meat industry.

Expected goals and outcomes: The main goal would be to improve the quality, nutritional value, and safety of meat from animals raised in TN. Collaboration with other UTIA faculty that examine animal genetics and alternative diets or feeds would be essential to meeting this goal.

Approximate Appointment: 70% R/30% E

Food Safety Parasitologist

Brief Description: Parasitic diseases are of considerable public health significance. While many parasitic infections are transmitted directly through the fecal-oral route, an increasing number are indirectly transmitted through consumption of fecally-contaminated water, or fresh produce. Parasites can also significantly affect the production efficiency of plants and animals that are used as food for humans. This position would assist in providing plant and animal food for an increasing human population with reduced risk of parasitic diseases through development of new methods for detection, separation, and inactivation of foodborne parasites. A fundamental understanding of molecular and cellular biology, genetics and physiology would be essential for this position.

Expected Outcomes/Goals: The main goal would be to reduce the impact of parasites on the production efficiency, quality, and safety of edible plants and meat animals grown in TN. Collaboration with other UTIA faculty that study alternative management/production strategies or breeding/genetics and their potential effects on parasite infestation would be essential to meeting this goal.

Approximate Appointment: 70% R/30%T
**Dairy Foods Processing Specialist**

**Brief Description:** Dairy products processing is one of the top food manufacturing industries in TN. This position would support the area of dairy product processing and unit operations with specialization in an area such as dairy product quality, analysis, and/or characterization. The position would serve a critical role within the state as UTIA’s representative to the TN Dairy Products Association. In this extension role, the position would support small and large processors in the state, organizer for an annual TN dairy products competition, TN dairy industry day, and even 4H and FFA dairy products judging contests.

**Expected Outcomes/Goals:** The main goal would be to improve the quality of dairy products from Tennessee and assist the state’s industry. Collaboration with other UTIA faculty that study methods of improving TN milk quality, food safety and quality would be essential to meeting this goal.

**Approximate Appointment:** 60% R/40% E

**Cereal and Legume Food Chemist**

**Brief Description:** Whole grains and legumes are major staple foods whose consumption has been associated with positive health benefits. In Tennessee, corn and soybeans are among the top 10 crops and contribute significantly to its agricultural economy. This position will focus on the effects of processing and storage on the digestibility and availability of nutrients and phytochemicals in food products and animal feeds from corn and soybeans. The overall goal is to improve efficiency and effectiveness of delivering improved health promoting compounds using novel products developed from corn and soybean products. This position will be expected to collaborate with others in nutrition and gut microbiome to examine interactions due to changes in diet.

**Expected Outcomes/Goals:** The overall goal is to improve efficiency and effectiveness of delivering improved health promoting compounds (for humans or livestock) using novel products developed from corn and soybean products. This position will collaborate with others in nutrition, plant sciences, animal and plant genetics, and gut microbiology to examine the chemistry of new products and their impacts in animal or human foods.

**Approximate Appointment:** 70% R/30% T