Portfolio Annual Report: 2008
Animal Systems

United States Department of Agriculture
Cooperative State Research, Education, and Extension Service
Office of Planning and Accountability

November 2008

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Section I: Animal Systems Overview

The Animal Systems portfolio is broad and reflects the mission of the agency as well as the needs of our partners and stakeholders. The portfolio encompasses basic and applied research, education, and extension activities across animal species and commodities. The products of these animals represent billions of dollars in farm-gate sales and several times that in retail sales.

The CSREES research, education, and extension portfolio for Animal Systems is defined and classified into Knowledge Areas (KAs): 301-308; 311-315; 721-722 (see individual sections below); and the extension programs that relate to and support those knowledge areas. Also included in the portfolio are the National Animal Health Laboratory Network, the Extension Disaster Education Network, and the National Veterinary Medical Loan Repayment Program. Animal Systems does not include KAs directly related to food safety, processing, storage, or marketing; however, the animal production portfolio indirectly supports and complements research, education, and extension programs included in those related KAs through interdisciplinary and collaborative efforts among university faculty, cooperating scientists, and educators.

Animal Systems Planning

Animal Systems Mission: Within CSREES, the Animal Systems team promotes animal production and protection systems that are efficient, economically competitive, environmentally sound, and socially acceptable through research, education, and extension programs.

Animal Systems Vision: The Animal Systems vision is to be the respected national entity that advances high-quality, innovative, and relevant agricultural animal research, extension, and education programs through partnerships with public and private organizations and agency counterparts.

Animal Systems Introduction: The continuing imperative of Animal Systems' work is to develop partnerships that deliver high-quality, objective, relevant, timely, and accessible research and education programs on priority issues outlined in the departmental, agency, unit, and Animal Systems goals and objectives. Many Animal Systems activities have relevance to more than one goal and objective. The goals and objectives in the Animal Systems roadmap are consistent with the goals and objectives of the Department and the Agency as well as the levels of agency appropriations for all activities.

Short- and Long-term Goals

Animal Systems shares the goals described below with other units and agencies in the Research, Education, and Economics (REE) mission area. In relation to the USDA and CSREES strategic plans, concurrence is as follows:

USDA Goal 2: Enhance the Competitiveness and Sustainability of Rural Farm Economics.

- This goal is supported by CSREES' Objective 2.2: Provide research, education, and extension to increase the efficiency of agricultural production and marketing systems.

USDA Goal 4: Enhance Protection and Safety of the Nation's Agriculture and Food Supply.

- This goal is supported by CSREES' Objective 4.2: Develop and deliver research, education, and extension programs to reduce the number and severity of agricultural pest and disease outbreaks.

Based on these USDA and CSREES goals, the Animal Systems team is developing its strategic plan. The team's short-term and long-term goals are consistent with USDA and CSREES strategic plans. Specific objectives for Animal Systems are listed in its draft strategic plan and are described as follows:

Enhance the competitiveness and sustainability of rural and farm economies by:

Increasing the efficiency of domestic agricultural production and marketing systems.

Animal System Objectives:

- Improve production efficiency and profitability of animal systems to maximize competitiveness in a global market
- Enhance reproductive performance in animal production systems
- Facilitate improved understanding of agricultural animal genomes
- Refine animal feeding for precision
- Improve efficiency of nutrient utilization in animal systems
- Examine novel ways of increasing nutritive value of traditional and nontraditional feeds
- Improve the quality and composition of animal products
- Generate means to explore and apply genetic improvement of food animals
- Ensure animal production systems are environmentally sound

Enhance protection and safety of the nation's agriculture and food supply by:

Reducing the number and severity of agricultural pest and disease outbreaks.

Animal Systems Objectives:

- Improve coordination and information sharing on disease and pest issues among animal production systems
- Develop, deliver and apply information on reducing stress in animal production systems
- Reduce potential for disease and pest spread

In addition to the programmatic goals listed above, the Animal Systems team's draft strategic plan contains supporting operational goals and objectives intended to ensure that program elements are supported and carried out strategically.

Monitor and assure far-reaching delivery of federally funded information, research results, educational programming and decision support tools and improve accountability of Extension and Research by:

Identifying opportunities and means to improve delivery of knowledge, tracking activities, and to document impacts.

Animal Systems Objectives:

- Identify, create, and contribute to activities that deliver knowledge to producers, such as eXtension, the National Animal Identification System Web Resource Center, and others
- Secure representation from partners for planning and decision making regarding tracking activities

Identify and engage diverse and contributing participants of distinction and achievement, with demonstrated commitment to the promotion and improvement of agriculture and natural resources and that are broadly based in agriculture and related sciences by:

Expanding our reach.

Animal Systems Objectives:

- Actively seek both established and new investigators as well as underrepresented populations for participation in all activities
- Involve undergraduates and their instructors in national animal systems programs and activities
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Recruit, motivate, mentor, maintain, and reward a stable, high-quality diverse staff with the experience and core competencies necessary to effectively support, manage, and lead national programs and activities by:

Encouraging and facilitating staff growth and development.

Animal Systems Objectives:

- Actively support and participate in efforts of program development, management, and dissemination
- Develop a cohesive and active working relationship among all agency staff members to ensure quality and efficiency in the group's work

Maintain effective communications with stakeholders and improve public awareness and understanding of our activities by:

Informing partners and others of our accomplishments, services, and issues affecting their work.

Animal Systems Objectives:

- Develop informational publications and implement activities that enhance our visibility and that demonstrate our impact

Priorities

Animal Systems' priorities stem from strategic planning and stakeholder input. Animal agriculture that is designed to maximize production also needs to address influences, both positive and negative, of this production. This is a strong message conveyed by stakeholders and consumers. Priorities for Animal Systems in terms of increasing efficiencies are described in detail above and in the outcomes, performance measures, criteria, and actionable strategies below. Equally important, and woven into each of the objectives above are Animal Systems' priorities to provide a healthful diet for consumers that focus not only on quantity, but also on quality and diversity of animal products and their inputs; to improve the resilience, safety, and security of food supply; to improve competitiveness and sustainability of animal agriculture; and to reconceive animal agriculture as a positive contributor to the solution of environmental problems like climate change rather than continue to speak of agriculture in terms of simply reducing impacts. To address these programmatic priorities, the Animal Systems leadership has set operational priorities to redefine position descriptions that reflect a contemporary

view of agriculture and to improve mechanisms of communication and outreach that will better inform our stakeholders and customers.

Public Benefit

The ultimate beneficiaries of our programs are the American people, whose well-being is improved by innovation and science.

Portfolio's Contribution to the Agency

- Are we moving in the right direction?

  The Animal Systems portfolio appears to be responsive to emerging issues. Our ability to move in specific directions is somewhat constrained by the rigid mechanisms in place (e.g., Hatch formula funds) for allocation of funding for priorities. Nevertheless, competitive programs and other efforts guide the Animal Systems work in critical issues and formula-funded research has resulted in significant advances in our knowledge and application of research results.

- Do we have the right balance of resources?

  Animal Systems resources include financial and human resources. Although financial resources are not discussed until later in this document, the Animal Systems team believes that those resources, although not adequate to accomplish everything stakeholders desire, are leveraged in the right balance to ensure successes and continual progress in relevant Knowledge Areas. Human resources are not currently adequate or balanced in Animal Systems. Several key National Program Leader positions are vacant. Practical agricultural and extension experience is limited and institutional knowledge is dwindling.

<u>Linkage to CSREES Strategic Plan</u>

This portfolio supports strategic goals "Enhance the Competitiveness and Sustainability of Rural and Farm Economies" and "Enhance Protection and Safety of the Nation's Agriculture and Food Supply."

The Agency's strategic goal "Enhance the Competitiveness and Sustainabilty of Rural and Farm Economies" supports numerous research and extension activities to enhance the competitiveness and sustainability of rural and farm economies, ranging from the development of new products to improvements in productivity and financial management. Education programs strengthen the foundation for this goal by building capacity in the agricultural research and extension system and training the next generation of scientists and educators.

The Agency's strategic goal "Enhance Protection and Safety of the Nation's Agriculture and Food Supply supports the development and distribution of scientific-based information, technology and practices to producers, manufacturers, the work force and regulatory agencies to help ensure the safety of agriculture and the food supply to

domestic and global consumers. Education programs strengthen the foundation for this goal by building capacity in the agricultural research and extension system and training the next generation of scientists and educators.

Supported CSREES Strategic Objective: This portfolio supports objectives "Provide Research, Education, and Extension to Increase the Efficiency of Agricultural Production and Marketing Systems" and "Develop and Deliver Research, Education, and Extension to Reduce the Number and Severity of Agricultural Pest and Disease Outbreaks."

The Agency's objective entitled "Provide research, education, and extension to increase the efficiency of agricultural production and marketing systems" supports research, education and extension programs to develop and transfer technology, practices, and skills to support economically viable farms and ranches of various size and scale. This work reduce per unit and overall production costs; improve quality and yields, reduces environmental impact, improves marketing and management decisions, develops new products and uses for by products, and finds new ways of adding value to traditional crops and products. Research ranges from using genomics to develop hybrids requiring fewer chemical inputs, to systems for more informed decision making, to new precision technology and nanotechnology to improve management of crops and animals.

The Agency's objective entitled "Develop and deliver research, education, and extension to reduce the number and severity of agricultural pest and disease outbreaks" supports research and analysis is a primary source of information on pests and diseases that impact the food and fiber system. CSREES sponsors work on the investigation, understanding and control of zoonotic diseases that pose human health threats, which results in methods and practices to prevent or control outbreaks of exotic, native and foreign pests and diseases, including invasive pests.

CSREES Strategic Plan Performance Measures Progress Table

Key Long-Term Outcomes:
Increased knowledge and efficiency of animal production systems through the expansion of information to model animal feed utilization, further understanding of the biological role of gene sequences in animals, and strengthened graduate-degree-level courses in animal agriculture, and increased minority participation in education and the workforce. Expanded science-based information and technologies and reduced number and severity of agricultural pest and disease outbreaks through connection and data exchange among national animal disease diagnostic networks.

Performance Measures:
No performance measures for animal agriculture have been proposed in the CSREES Strategic Plan with the exception of measuring numbers of high-consequence pests, bacterial, parasitic, and vital pathogens and disease threats detected by the National Animal Health Laboratory Network. The Animal Systems portfolio team proposes to adopt measures in the future that will reflect the number of practices and technologies developed or applied that result in an increase in efficiency of production; an increase in animal-health and biosecurity resources and prevention and preparedness programs; a decrease in emissions of N, P, and CH4; and an improvement in the pre-harvest quality of animal products as it relates to safety, nutritional value, and consumer preference.

Performance Criteria:
- Increase and improve reproductive performance of animals
- Enhance understanding and improve application of animal nutrition
- Develop and apply information and technology for genetic improvement of animals.
- Map and understand the genome of agriculturally important animal species
- Improve understanding of fundamental animal physiological processes
- Mitigate or reduce animal environmental stress
- Develop and implement comprehensive animal production management systems
- Increase knowledge of composition of animal products, quality factors, and consumer preferences
- Reduce adverse impacts of and improve the management of animal diseases that represent a threat to animal production, biosecurity, or public health
- Reduce adverse impacts, increase knowledge and improve management of pests, external parasites, including insects, ticks, mites and other parasitic arthropods that reduce animal productivity
- Reduce adverse impacts of, and increase knowledge to control internal parasites such as worms, flukes, and protozoa to reduce losses due to mortality, reduced yield, and condemnation of meat, feed wastage and cost of drugs
- Reduce losses in livestock, poultry and farmed aquatic species due to toxic chemical, petsicides, poisonous plants, predators, ingestion of foreign bodies, and other hazards
- Develop and implement effective animal care and use methods and systems contributing to the welfare, well-being and humane treatment of food animals
- Increase knowledge and impact of insects, ticks, mites, and other pests that are a

threat or annoyance to human health and develop safe, effective and economical control measures
- Identify, understand and control animal diseases and parasites that pose threats to human health

Actionable Strategies:

- Expand the knowledge base and provide information to enable producers and policymakers to make informed animal production management and marketing decisions to increase the profitability and competitiveness of animal agriculture
- Increase outreach and education supporting the broad view of animal agriculture from the rural community to the consumption of products thereby gaining communication and input from all stakeholder groups in animal agriculture
- Support the recruitment, retention, training, graduation, and placement of the next generation of research scientists, educators, and practitioners in animal agriculture
- Sponsor science-based work to increase producers' knowledge and understanding of the disciplines involved in providing products that strengthen the rural community, support the sustainability of animal production and create a richer wealth of products for the health, welfare and satisfaction of consumers
- Support research, education, and extension efforts to improve understanding of animal nutrition for improved efficiency, performance, health, and well being of animal sand to optimize resources use while delivering environmental benefits
- Sponsor efforts to preserve, conserve, characterize, and make available animal genetic resources for research and development
- Integrate new science-based knowledge, technologies, decision-support systems and best management practices to optimize efficient, economical and environmentally sustainable animal production systems appropriate in size and scale
- Sponsor analyses of the benefits and costs of agricultural and environmental policies to compare the effects of alternative production and management systems
- Support research, education and extension to better understand and address consumer needs, tastes and preferences; inform consumers; and provide continuing professional development throughout animal agriculture
- Sponsor research and extension efforts to use animal genomic sequences in addition to population approaches to improve the efficiency, quality, and sustainability of animal production
- Assist the Animal and Plant Health Inspection Service in supporting the development, validation, and deployment of new identification devices and test that are operationally robust, can rapidly detect pathogens, toxins, and other contaminants that threaten livestock, poultry, and food and can be used by producers, processors, veterinarians, diagnosticians, and regulatory agencies
- Sponsor research, education, and information transfer on the transmission and epidemiology of animal diseases to rapidly develop and apply strategies to control disease outbreaks
- Intensify research, education, and extension efforts to rapidly identify pests and diseases that enter the United States
- Support development and increase capacity and capability of national diagnostic

laboratory networks for crops and livestock that can rapidly detect pathogen outbreaks, and support work with APHIS to more effectively prepare for, prevent, and respond to, and recover from animal disease outbreaks

- Support and increase in scientific monitoring for a broader array of emerging agricultural pests and diseases
- Support the strengthening of surveillance systems for animal pests and diseases to minimize spread beyond the original area of introduction and minimize economic and environmental risk
- Support the development of a national pathogenic control and prevention program targeting avian influenza
- Support the development and dissemination of scientific information to protect animals from pests, diseases, and other disease-causing entities that impact animal and human health
- Sponsor research, education, extension, and dissemination of results on the role of genes, proteins, and nutrients in the immune systems of animals and plants, vaccinology, microorganisms, pathogens, and toxins that can contaminate food, advanced molecular, biologic and immunologic studies of the effects of pathogens on vulnerable animal species, advanced, rapid, accurate, and cost-effective diagnostics, protections, treatments, and monitoring technologies, and improved management practices to improve the management, control, and prevention of pests and diseases
- Support the development of rapid, economical, environmentally sound and human methods of euthanasia for animals and the large-scale disposal of animal carcasses, tissues, or environmental contaminants should an emergency occur
- Sponsor research, education, and extension on effective real-time cleaning and disinfecting technologies to limit or contain the spread of infectious materials, and isolate and contain potential outbreaks
- Support recruitment, retention, training, graduation, and placement of the next generation of research scientists, educators, and practitioners in the food and agricultural sciences
- Sponsor research and education on the use of antimicrobial agents in the food production chain and their effects on the development of antimicrobial resistance

Animal Systems Portfolio Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Situation: With recognition of animal agriculture as a major part of a critical national infrastructure, the interest and scrutiny of issues in animal production, health, protection, and well being have increased significantly. Improvement in each of these areas requires continued efforts that span the realm from basic and applied research, to technologic development, professional education, and outreach to producers, industries, policy makers, and the public.	**Funding Sources:** •CSREES: Formula, Competitive, Special • Other Federal • State • Other **Human Capital:** •CSREES NPLs Administrative Support • Faculty Researchers Extension practitioners Teachers • Para-professionals • Stake holders (Industry, etc.)	Related to Research, Extension, Education: •Expand animal sciences knowledge base • Improve production methods • Train animal sciences workforce • Expand diversity in animal sciences • Share knowledge •Collect and analyze stakeholder input • Enhance experiences among producers • Increase science and education capacity	New fundamental or applied knowledge Scientific publications Patents New methods and technologies New animal-food products and animal feeds Science based knowledge for policy and decision makers Information, skills, and technology for individuals, communities, and programs Educational materials	Changes in: • knowledge • attitudes • skills • motivation • decisions • management Regarding: • new discoveries • new animal production approaches & methods • animal-based economic opportunities **Example:** Scientists in Iowa are using candidate gene or fine-mapping approaches to further evaluate QTL regions in swine (Hatch Multi-State NC-1004;	Changes in: • behavior • practices • management • use of inputs That: • improve animal production • improve products • improve economic opportunity • change the way producers live and work **Example:** Extension Disaster Education Network has conducted three of six regional Animal Agrosecurity Workshops involving CE Agents and State and Federal Regulatory and Emergency Management Officials (Food and Agriculture Defense Initiative)	• Improved economic opportunity for producers and communities • National animal-production related problems solved • Animal-related public-health risks reduced • Animal-related environmental-risks reduced **Example**: The National Beef Cattle Consortium has incorporated new genetic evaluation methodologies into beef cattle selection, enabling U.S. beef producers and industry to be more economically viable and competitive on a global basis. (Special Research Grant; 0195268)

Assumptions - Continued funding and administrative support of CSREES by Congress and the Executive Branch for extramural animal agriculture research, education, and extension activities.	**External Factors** - Variable funding; scientific advancements; changing priorities; producers' and consumers' attitudes; natural disasters; economic conditions; coordination and cooperation with other government entities; public policy

Animal System Inputs

Animal Systems Level Funding Table and Bar Chart

Relatively little change has occurred in total CSREES budget for Animal Systems budget over the period of 2003-2007 (Table 1, Figures 1 & 2). Excluding extension funding that was not retrievable until FY2007, the budget has increased in nominal dollars by approximately $11 million (from $101 million in 2003 to $112 million in 2007) over that period, but in real dollars (constant 2003 dollars) this actually represents a decrease of approximately $1 million. In terms of overall funding for animal systems, which includes CSREES and other sources both federal, non-federal, state, and private sources, funding has increased in nominal dollars by approximately $680 million (from $454 million in 2003 to $1.13 billion in 2007); however, in real dollars (constant 2003 dollars), this represents an increase of approximately $622 million.

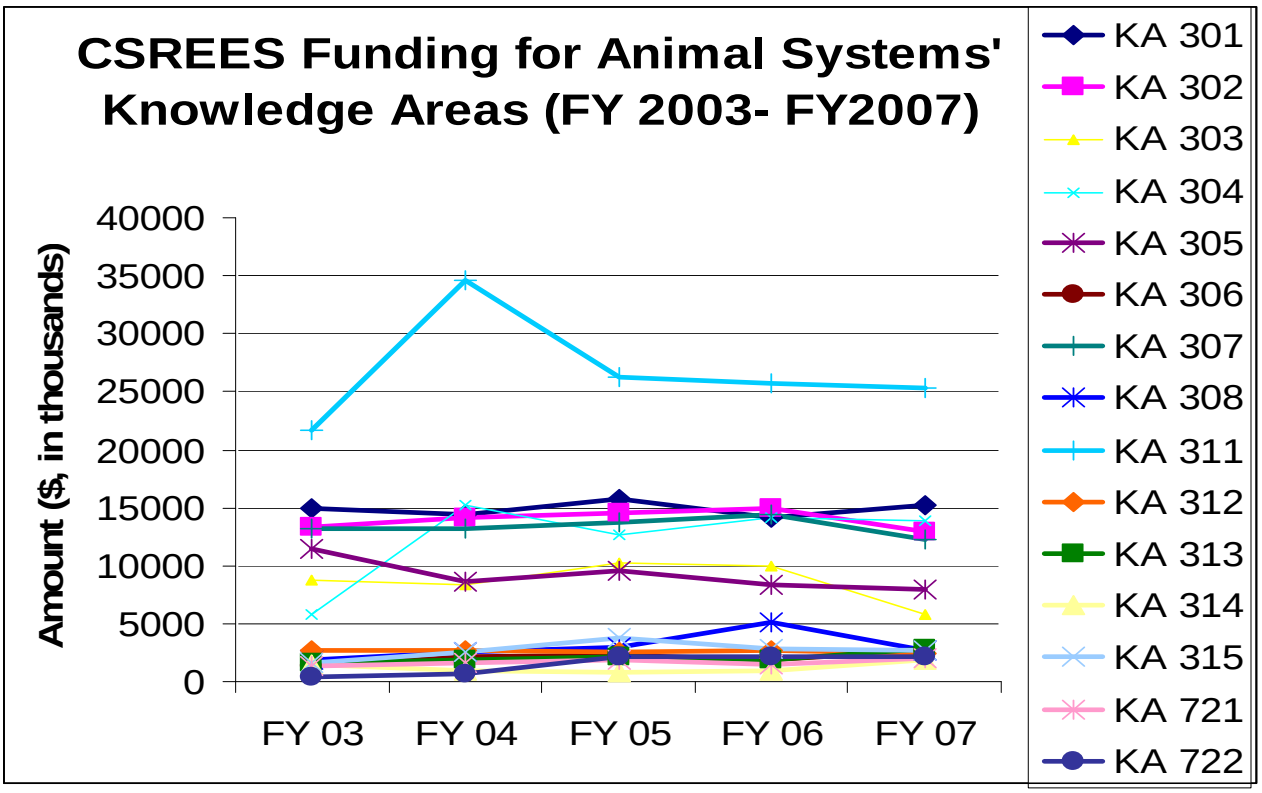
Table 1. Animal Systems funding data for fiscal year 2007 were collected from the Current Research Information System (CRIS) and the Plan of Work (POW) annual report. Fiscal year 2007 funding data includes Smith-Lever 3(b), (c), and (d) and 1890 extension funding (totaling $25,849), which were not otherwise accounted for in FY 2003 – 2006. Agency funding data for fiscal years 2003 through 2006 were collected from CRIS only. This table is a summary table; detailed funding tables by KA are part of Appendix B (CSREES funding only) and Appendix C (overall funding).

Table 1: Animal System Portfolio Summary Funding Table for Knowledge Areas for FY 2003 - FY 2007

	($ in the Thousands)					
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Total CSREES Funding	$101,392.00	$123,968.00	$121,443.00	$120,756.00	**$138,024.00	**$580,314.00**
Total Non-CSREES Funding	$454,494.00	$469,698.00	$784,503.00	$501,035.00	$1,134,533.00	$3,344,263.00
Total Funding	$555,886.00	$593,666.00	$905,946.00	$621,791.00	$1,272,554.28	$3,949,843.28
Percentage of CSREES Funding	18%	21%	13%	19%	9%	15%

Figure 2 provides a graphic representation of CSREES investment in all Animal Systems' Knowledge areas, demonstrating changes over the past five years. These data clearly demonstrate the relatively flat nature of funding over the past five years for all Knowledge Areas; the increase in funding for Knowledge Area 311 in 2004 is an artifact of the accounting system used by the agency and does not represent an actual increase, but rather it represents 2003 awards that were made in 2004.

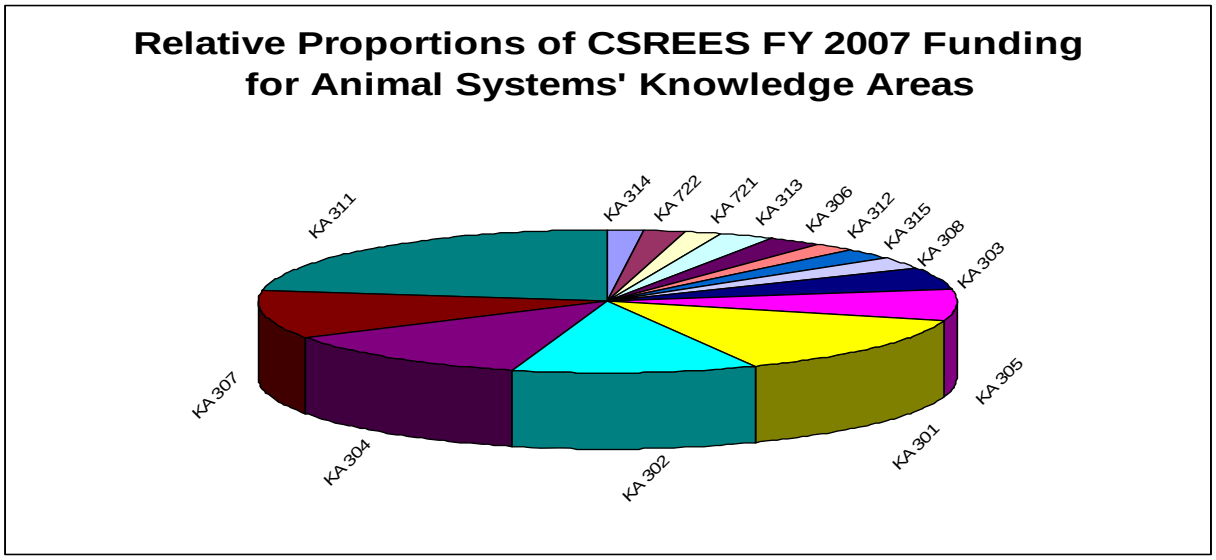
Figure 2: CSREES Funding for Animal Systems



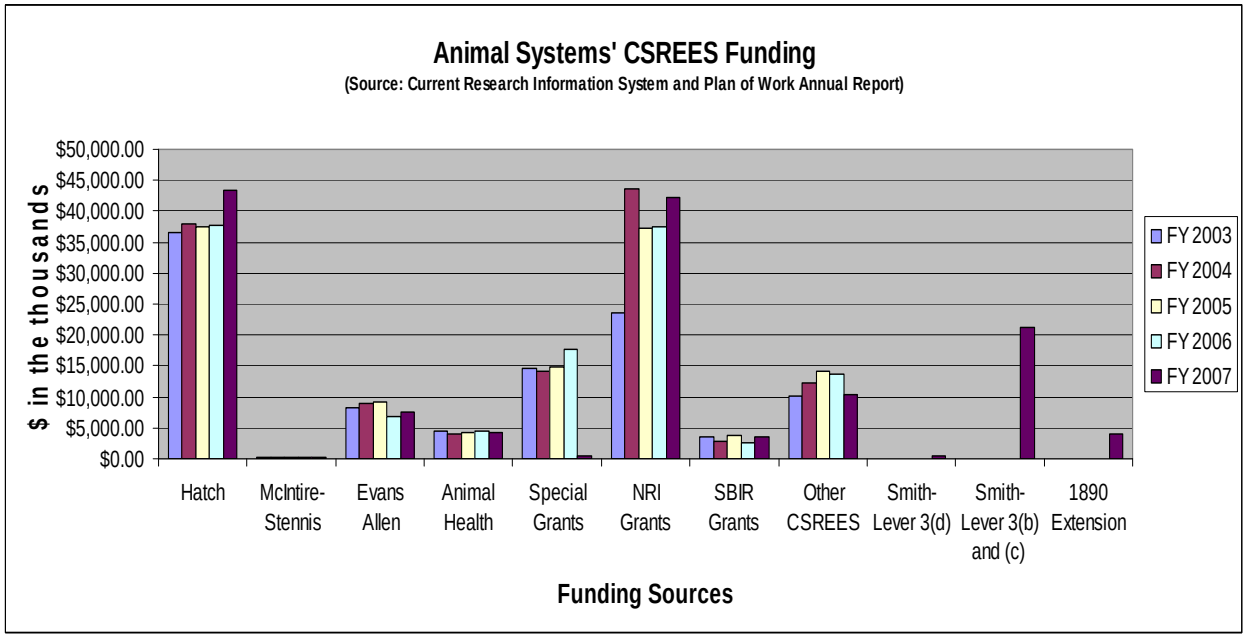
Source: Current Research Information System and Plan of Work Annual Report

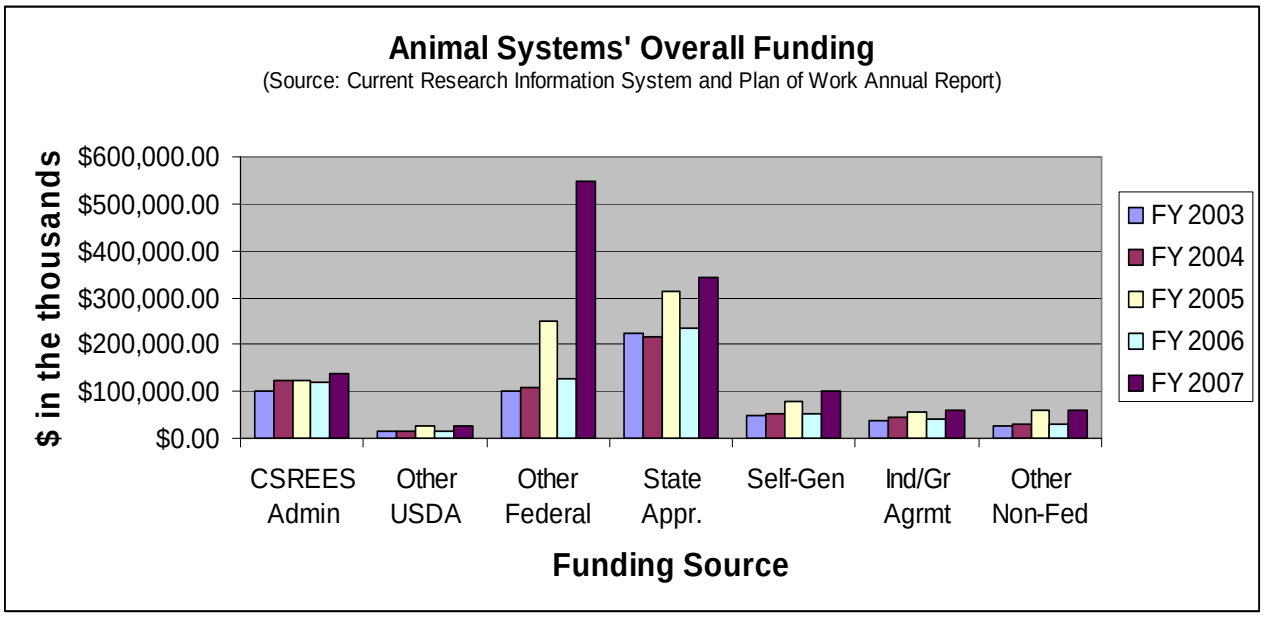
Figure 3 provides a graphic representation of the relative size in terms of percent of total portfolio investment of each Knowledge Area comprising the Animal Systems portfolio in the current reporting year. Clearly, animal diseases (Knowledge Area 311), Reproductive Performance of Animals (Knowledge Area 301), Nutrient Utilization (Knowledge Area 302), Animal Genomics (Knowledge Area 304), and Animal Production Management Systems (Knowledge Area 307) are the largest focus areas of the Animal Systems portfolio in terms of investment.

Figure 3: KA Proportions of CSREES FY 2007 Animal Systems' Funding



Source: Current Research Information System and Plan of Work Annual Report





Animal Systems Results

Animal Systems Outcomes

Each Knowledge Area represents a portion of the collective work of Animal Systems and the relative investment in each Knowledge Area can vary significantly (Figure 3). Regardless of the size of investment, significant outcomes can be seen in each area. Several key representative outcomes from the Animal Systems portfolio are described below.

Sterilization vaccine for cattle: The U.S. feedlot industry feeds approximately 33 million cattle per year. Thirteen million of these animals are heifers, of which 15 percent are pregnant when they enter the feedlot. The cost of pregnant heifers to the feedlot industry is $250 million per year. Researchers at Washington State University developed a vaccine to prevent estrous cycle activity and pregnancy in heifers. The vaccine effectively blocks reproduction in heifers, bulls, and mice. Washington State University has two patents on this vaccine which may be useful for sterilization of domestic animals, pets, and wild species. (NRI; CRIS Accession Number 0196368)

Strides made in improving understanding of male fertility in livestock: Despite huge economic significance of male fertility in cattle, horse and pig, present knowledge regarding genetic factors governing it is very limited. This necessitates the initiation of research targeted to isolate and analyze male fertility genes present on the Y chromosome of the three important animal species. The scientists at Texas A&M University have developed partial comprehensive gene maps for the cattle, horse and pig Y chromosomes that include detailed information on the structural, functional and comparative organization of the chromosome in each species. The knowledge will be of economic significance to the livestock industry where fertility and reproduction are important economic traits (NRI; CRIS Accession Number: 0209979).

Optimizing milking frequency to enhance mammary development and milk production efficiency: Efficient milk production is crucial to the economic success of dairy farmers and reduces the environmental impact of dairying. Investigators at the University of Vermont used a unilateral frequent milking protocol to demonstrate that effects of frequent milking during days 1-21 of lactation are localized to the mammary gland. Milk yield responses were significant and persisted throughout the lactation. Other milking intervals did not give as great a response. Thus, frequent milking during the first 21 days of lactation is an effective management tool for increasing milk production efficiency. The estimated economic value is nearly $300/cow/lactation. Dairy producers will use this information to implement management practices that will increase farm profitability and reduce environmental impacts. (Hatch and NRI; CRIS Accession Numbers 0201951 and 0210261, respectively)

Horse genome sequence assembly improved: The support for second assembly of the horse genome sequence was a major activity in horse genome group under the NRSP-8 program. The fish mapping of clones was done at the request of the Broad Institute in support of determining an accurate second assembly. The availability of the horse genome map and the horse genome sequence made it possible to use the information for investigation of problems and hereditary traits in horses. These included investigation of equine laminitis based on gene expression of potential therapeutic targets; genetics of epidermolysis bullosa in American Saddlebred horses; genetics of lordosis in American Saddlebred horses; the genetics of dwarfism in miniature horses; genetics of inversion that appears to be responsible for tobiano hair color patterns; genetics of dominant white among different horse breeds. These efforts also identified chromosomal translocations that resulted in reduced fertility of mares. The completed horse genome sequence makes it possible to make predictions about the organization and function of horse genes based on previous work with the human genome. The cytogenetic work identifying translocations was of immediate benefit to the horse owners who were attempting to use affected mares as breeding stock. For a broader application, the work demonstrated the importance of considering translocations in cases of reduced fertility. Work on gene expression in association with laminitis and arthritis will lead to prognostic tests and therapeutic treatments (Multistate NRSP-8; CRIS Accession Number: 0202732)

Integrated analysis of gene networks controlling feed intake and energy metabolism in chickens: Researchers at the University of Delaware conducted an integrated analysis of transcriptional snapshots taken during a major metabolic perturbation—a single cycle of fasting and re-feeding in newly hatched chicks and market age broilers. These genome-wide gene expression scans were used to develop a blueprint of the basic gene networks that control feed intake and energy metabolism in broiler chickens. Fasting of neonatal chicks and refeeding for 4, 24, or 48 hours caused differential expression of genes in the hypothalamus that are associated with metabolism and feed intake. Knowledge generated from these studies will be used to tackle many of the problems associated with intensive genetic selection of poultry for production traits (e.g., excessive fat deposition, skeletal abnormalities, and metabolic disorders). Ultimately, poultry management practices will be improved by controlling feed intake and nutrient utilization via different metabolic pathways. (NRI; CRIS Accession Number 0202031)

Portfolio Leadership and Management

The Animal Systems leadership team consists of a section director, national program leaders, program specialists, and support staff. National Program Leaders and supporting staff use input from stakeholders and partners to identify develop, and manage programs to support university-based and other institutional research, education, and extension in animal systems. They strive to provide fair, effective, and efficient administration of federal assistance implementing research, education, and extension awards and agreements such as formula-funded projects, special research grants, federal administration grants, and National Research Initiative (NRI) and other competitive grants.

In the management of the Animal Systems Portfolio, formal and informal processes are used to gather stakeholder input, including, but not limited to, stakeholder listening sessions, workshops, symposia, peer-panel recommendations, RFA solicitations, white papers, Presidential Directives, and regulatory policies. The above listed interactions ensure relevancy of programs that address critical needs at the local, regional, and national levels; however, CSREES and the land-grant university system do not make up a straight-line agency mechanism whereby federal desires are dictated to state and local personnel. Programs require cooperation and collaboration that is based upon networking and feedback throughout the federal, state, university, and cooperative extension system. Critical national needs and priorities are generated and identified through an aggregation of problems and issues first identified at the local or state level.

The Portfolios are targeted to address critical national needs, issues, and priorities relevant to animal agriculture. Research and extension programs must also demonstrate relevancy in terms of science. The Animal Systems team utilizes a variety of processes and networks to solicit feedback in terms of relevancy to the industry and relevancy within a field of science. The Animal Systems National Program staff members have many effective links to the research community, professional societies, county agents, extension specialists, farmers and ranchers, Experiment Station and Extension leadership, commodity organizations, consumer groups, advocacy organizations, advisory committees, other federal agencies, OSTP, and Congress. All serve to provide feedback either directly or indirectly to assist CSREES in identifying needs and establishing priorities to assure the relevancy of programs within the Portfolios.

The Animal Systems Team supports strong program linkages with USDA's Agricultural Research Service (ARS). It is clear that the animal agriculture industries and the American consumer are best-served by closely linked and integrated programs administered by CSREES and ARS. A strong university-based research, education, and extension system, linked to the in-house research programs of ARS, help ensure a globally competitive animal industry. The Animal Systems Team works closely with our counterparts in ARS in program planning and implementation, ensuring that these programs are complementary.

The process for obtaining stakeholder input and using it for planning purposes is relatively straightforward. Stakeholders including other agencies, producers, industries, nongovernmental organizations, state and local governments, and the scientific community are invited to provide input on priorities either through face-to-face group and individual meetings or through electronic means. Often, these invitations are issued jointly between ARS and CSREES. National program staff determine relevance of priorities and integrate priorities into program

planning cycles as appropriate (e.g., development of competitive grants requests for applications, critical issues solicitations for proposals, and development of new program activities). Priorities are then addressed through partnerships with the Land Grant system and others who actually perform the work. Quality of the completed work and adequacy of performance is assessed by the National Program Leaders, and the information is disseminated, which is the final step in the program planning and evaluation cycle.

As science evolves, it is critical that the animal production portfolio keep pace with emerging opportunities and advancements in science. The current portfolios are dynamic to address national needs consistent with cutting-edge science. Program descriptions, progress reports, and requests for applications, reflect and demonstrate this responsiveness within the portfolios.

The Animal Systems Team values the annual portfolio reporting process as a leadership and management tool and views it as a multi-faceted endeavor with impacts in several areas. The Annual Portfolio Report should serve the needs of both the program leadership and the planning and accountability functions of the agency. Annual reporting will help assure that programs are aligned with the agency's strategic goals and address critical national needs. The annual report will also help to demonstrate how we make a difference by documenting program accomplishments and impacts. The process will optimize the time and effort of NPLs and program specialists in achieving our performance leadership goals. The annual performance reporting will be integrated into the team's regular business/performance management cycle allowing for a more orderly approach to program planning and performance tracking. Emphasis will be placed on improving performance through enhanced performance leadership. Finally, the annual reports and the five-year external reviews will be used to set appropriate directions and justify changes when needed.

Programmatic and Management Shortcomings

Staffing and Organizational Capacity

The most pressing issue facing Animal Systems is workforce succession planning. As is the case with many CSREES units and other federal agencies, Animal Systems is experiencing, and will continue to experience, the retirement of employees in key positions who have years of institutional knowledge as well as the turnover of productive and highly sought-after individuals. The unit director is beginning to emphasize management and leadership skill building as attempts are made to prepare up-and-coming supervisors and managers. Steps also are being taken to become more creative about being competitive in our recruitment efforts since the section has experienced difficulty in recruiting qualified candidates for NPL positions due to uncompetitive salary levels.

Faced with these challenges, the Animal Systems section is assessing its administrative and operational capacity. The assessment will address staff organization and the capacity of the current organization to effectively meet the short-term mandated agency responsibilities. In the future, new animal systems staff will likely have:

- A combination of capabilities to contribute to multiple areas of team activity both within Animal Systems and throughout the new Institute
- Complementary capabilities with other team members
- A core specialization
- Applied research and extension experience

In summary, the Animal Systems team operates in a highly competitive hiring environment. The high level of academic training required for NPLs and the need to employ a diverse workforce mean that Animal Systems will continue its emphasis on recruitment, retention, student employment, and career enhancement.

Key Future Activities and Changes in Direction

At the same time the Animal Systems section is facing workforce challenges, the section must prepare to address several new opportunities and initiatives generated by mandated internal changes. These include the changes outlined in the Food, Conservation, and Energy Act of 2008 (Farm Bill) that require the entire agency's transition to the National Institute of Food and Agriculture, the implementation of a veterinary medicine loan repayment program involving multiple units of the agency, and the section's contributions to the new Agriculture and Food Research Initiative competitive grants program.

In terms of external current and future trends that will shape the direction of Animal Systems work, these include changing world agriculture with increased demand for biobased products and energy, continued rapid advances in technology, increasing public health and environmental concerns related to food production, and agriculture's responsibility to deliver safe, nutritious food and protect the food supply. As animal agriculture systems continue to change, the work of the Animal Systems section must keep pace and help lead that change, which is why job descriptions for new hires are, and will continue to be, written to reflect contemporary challenges of agriculture and to require knowledge of alternative and emerging animal agriculture systems.

The success of the agency's animal agriculture efforts is determined by the role that the Animal Systems team plays as the respected national entity for research, education, and extension activities related to animal agriculture. Policy makers and program managers are increasingly called upon to assess the efficiency and equity consequences of public policies, regulations, and programs. The demand for more and better information is accelerating in today's knowledge-based and increasingly complex society. The Animal System's role in informing public policy options is therefore growing in importance.

Outreach

Animal Systems is being asked to do more with stagnant or declining real and human resources. Essential to an effective response to these demands are telecommunication and electronic technology developments that can enhance capabilities and improve communication with customers and partners. The Animal Systems team recognizes that conveying its messages, and getting research results and analyses to key customers in the form they want and at the right time matches the importance of doing excellent work on relevant topics. The Animal Systems team

will continue to invest in integrating useful new information technologies such as Webinars, Breeze conferencing, Wiki environments, and topical web-based resources into its operations. Innovation is key to Animal System's ability to do more with fewer staff and financial resources.

Changes in the larger policy context in which Animal Systems operates will influence the content and orientation of projects supported in this portfolio. The increasing scale and concentration of agricultural activities have raised environmental issues pertaining to waste management and issues about the role of producers. Rapidly changing economic, social, and medical environments have raised challenging questions about the nutritional quality and costs of good diets and food safety and their implications for individuals, society, and the food industry. International trade agreements are shifting the focus of trade disputes away from tariffs and toward issues relating to technical barriers to trade such as labeling of genetically engineered products and sanitary and phytosanitary measures that are not science based. And continued evolution of the demographic, economic, and industrial structure of rural areas will change policy debates regarding the well-being of rural people and communities. As was demonstrated in the discussion of Animal Systems legislative mandates, the unit has always been expected to anticipate and respond to events and changing national concerns. Through its contacts with academic experts, as well as the recognized expertise of its staff, Animal Systems expects to keep pace with change as and before it occurs.

What are Others Doing

Being knowledgeable about what other agencies and organizations are doing is important to ensure complementarity of programs, to avoid duplication of efforts, and to prevent unnecessary overlap in activities. The Animal Systems' leadership prides itself on being knowledgeable of what others are doing in all sectors that address animal agriculture and uses that awareness in planning and integrating its programs. Based on the knowledge of what others are doing in the animal production and health landscape, Animal Systems NPLs initiate efforts, participate in cooperative endeavors, and conduct joint programming. Examples are provided below of how Animal Systems leverages its resources with what others are doing, how Animal Systems complements and supports what others are doing, how Animal Systems links its priorities to what others are doing, and how Animal Systems integrates its unique strengths into what others are doing. One of those unique roles is CSREES' being the primary agency within USDA to provide extramural funding for research, education and extension programs. The focus on extramural funding that supports solutions for Animal Systems problems clearly separates CSREES from other USDA agencies, such as ARS that focuses on complementary intramural research (but not education or extension), or APHIS that provides leadership for regulatory activities. The Animal Systems portfolio is based on a dynamic and vibrant relationship with a wide breadth of partners and stakeholders. For example, National Program Leaders link to university researchers, educators, and extension experts, Federal, State and Local agencies, professional societies and organizations, commodity organizations, consumer groups, advisory committees, farmers and ranchers, Experiment Station and Extension leadership, the Office of Science and Technology Policy (OSTP), and Congress. All serve to provide direct or indirect feedback that assists in identifying needs and establishing priorities to assure a high relevancy of programs within the Portfolio.

Examples of what others are doing and how Animal Systems leverages, supports, links, and integrates with those activities.

1. ARS-CSREES Animal Health Team:
   National Program Leaders, and others working in animal health, from both ARS and CSREES meet monthly (rotating between Beltsville and Washington, DC) to coordinate portfolios. Frequent phone and email contact occurs in between monthly sessions.

2. ARS and CSREES Joint Stakeholder Workshops:
   The Animal Systems portfolio conducts joint workshops with ARS for all of its program areas. For example, every five years, two day National Stakeholder Workshops are convened to help inform program direction at both agencies for the subsequent 3-5 years (Aquaculture Stakeholder Workshop (2008; 2003); Animal Disease Stakeholder Workshop (2005); and, Animal Production Stakeholder Workshop (2006)). In between the five year workshops, ARS and CSREES partner to conduct smaller, more focused workshops or discussion on various topics and also with commodities (e.g., National Pork Board and National Pork Producer Council Stakeholder Meeting: November 19-20, 2008).
3. ARS-APHIS-CSREES Animal Health Executive Team:
   In 2007, an ARS-APHIS-CSREES Animal Health Executive Team was established. Prior to this, good coordination existed among the three agencies; however, no formal mechanism for interactions throughout the year, and that covered all of APHIS' program diseases, was in place. This team convenes quarterly to coordinate all three portfolios relative to APHIS research priorities. In addition, the team sponsors an annual two-day APHIS Research Priorities Animal Health Conference for program and field staff from the three agencies. The purpose of the meeting is to update, prioritize, and plan future research that directly supports APHIS regulatory programs and develop research plans that are responsive to the needs of animal agriculture and our stakeholders. The outcome of the meeting is not only a list of research priorities, but the development of concrete plans for maximizing the impact of current and future research projects that support APHIS regulatory programs. For example, ad hoc teams have been established for APHIS program diseases that include representatives form ARS, APHIS, and relevant university partners.

4. Through leadership on Interagency Working Groups (IWGs), Animal Systems National Program Leaders articulate agricultural priority needs, while working to leverage CSREES resources with other agencies to respond to intersecting mission areas. For example:
   a. The Subcommittee on Foreign Animal Disease Threats (Office of Science and Technology Policy (OSTP), National Science and Technology Council (NSTC)) includes members from USDA-ARS, USDA-CSREES, USDA-APHIS, DHS, DOD, EPA, HHS, NSF, Dept. of Interior, and Dept. of State. Development of documents such as "Protecting Against High Consequence Animal Diseases: Research & Development Plan for 2008-2012" enables partner agencies to better synergize resources towards common goals. Thus far, a direct result was the initiation of a joint NSF-DHS-USDA competitive program that launched a $16 million dollar National Institute for Mathematical and Biological Synthesis (NIMBioS) at the University of Tennessee-Knoxville in 2008. NIMBioS will bring together small "working groups" of researchers from mathematics, agriculture, biomedicine, economics, statistics, molecular biology, bioinformatics, social

sciences and other fields to approach very specific issues that face the country, including foreign animal disease threats. It is anticipated that more than 600 researchers each year will travel to Knoxville for working groups or conferences hosted by NIMBioS.

b. The Experimental Program to Stimulate Competitive Research (EPSCoR) Interagency Working Group consists of representatives from USDA, NSF, NIH, EPA, DOD, and DOE. The EPSCoR program exists to ensure that states that have not been as competitive with various Federal agencies have opportunities to improve competitiveness. By sharing evolving best management practices for each agency's programs, and sponsoring a joint annual meeting for stakeholders, individual agencies are able to maintain unique characteristics for each of their stakeholders while learning from others' experiences.
c. The Interagency Working Group on Domestic Animal Genomics (Committee On Science, NSTC).consists of USDA (ARS and CSREES), DOE, HHS, DHS, USAID, FDA, NSF, as well as OMB and OSTP representing the Executive Office of the President. Individual agencies share their efforts and interest in utilization of animal genomic information and resources for improving animal production, animal health, and for using domestic animals as models for biomedical research. The "Blueprint for USDA Efforts in Agricultural Animal Genomics: 2008-2017" (http://www.ars.usda.gov/SP2UserFiles/Place/00000000/NPS/APP/USDABlueprintProofs7-27-07.pdf), for example, is guiding strategic investments by ARS and CSREES and allowing other federal agencies to complement those activities where mission areas overlap.
d. USDA Avian Influenza working group. This group brings together different mission areas of USDA to ensure a consolidated effort to counter the threat of avian influenza, both domestically and at a global level. CSREES is represented and has participated on two avian influenza missions to Bangladesh through FAO and USAID.
e. Knowledge of what others are doing internationally is exemplified by the International Science and Technology Memorandum of Understanding with the Government of Pakistan. CSREES is a member of the USDA leadership team that coordinates several work groups related to science and education collaboration in agricultural and animal health science with the Government of Pakistan. Animal vaccine development workshops in Pakistan were organized, as well as placement of Pakistani research scientists in various USDA labs for trainings in avian influenza and other communicable disease of animal and public health relevance.
f. APHIS, NOAA, USFWS, CSREES, Land Grant Universities, and state agencies collaborated to develop a National Aquatic Animal Health Plan. The Plan fosters an interagency approach through key state and local partnerships on aquatic animal diseases of significant importance to the aquaculture industry and native fisheries. This Plan was prepared by an interagency National Aquatic Animal Health Task Force under the auspices of the Joint Subcommittee on Aquaculture (JSA) chaired by CSREES. The JSA functions under the Committee on Science of the National Science and Technology Council. Of particular interest to CSREES are sections of the Plan that address disease management, prevention and control; research and development; and outreach and education.
g. CSREES took a lead role in mobilizing national expertise and providing rapid response through applied research to gain critical knowledge about a new strain of viral

hemorrhagic septicemia (VHS) that has caused widespread mortalities of numerous fish species of economic importance in the Great Lakes region, including several that are farm-raised. This pathogen is considered by many nations and international organizations to be one of the most important viral pathogens of finfish. Three CSREES Regional Aquaculture Centers have coordinated research and extension education programs to address critical regional needs. CSREES is also collaborating with ARS, USGS and APHIS, a professional organization, and numerous Land Grant Universities to coordinate research projects aligned with a common national VHS strategic research plan. Lastly, CSREES was a catalyst to create the VHS Education Alliance to assist APHIS plan and implement a national public education campaign to combat the spread of this pathogen. The Alliance partners include Land Grant Universities and Sea Grant institutions, state natural resource agencies, and several federal agencies with education and outreach missions. The Alliance has proven its effectiveness and APHIS plans to use it as a model for public education needs related to other animal diseases.

h. The Prion Science Interagency Working Group (Office of Science and Technology Policy (OSTP); Subcommittee on Science, National Science and Technology Council (NSTC)) includes members from USDA-ARS, USDA-CSREES, USDA-APHIS, DHS, DOD, HHS-FDA, HHS-CDC, HHS-NIH, USGS, VA, NSF, and EPA. The Prion Science IWG is addressing several prion disease-related issues including 1) nature of the agent and determinants of transmissibility, 2) potential treatments and clinical science, 3) pathobiology and diagnostics, 4) environmental persistence and decontamination and 5) epidemiology and surveillance. CSREES serves on four of these five task force groups, along with colleagues from other federal agencies.

i. The European Commission(EC)-US Animal Genomics & Bioinformatics Taskforce (http://ec.europa.eu/research/biotechnology/ec-us/workinggroup_en.html) is a transatlantic group, of which CSREES is a member, whose annual meetings and focused workshops bring European and American researchers closer together from the world of biotechnology to strengthen collaborative activities.

5. NIH and CSREES are collaborating on a Joint Funding Opportunity for Dual Use/Dual Benefit Animal Models for Agricultural and Biomedical Research. Since 2004, Program Staff at CSREES and NIH have been working with stakeholders, including academic scientists and administrators to raise awareness of the important role that domestic animals play in biomedical research. Stakeholder workshops were conducted at Michigan State University and on the NIH campus. A white paper was developed (http://adsbm.msu.edu) and published (*J Anim Sci* 2008 86:2797-2805). Editorials describing diminishing resources for research with domestic animals at land grant universities were also published (*J Anim Sci* 2008 86:2445-2446; *Biol Reprod* 2008 79:789). Efforts are in progress to offer a joint funding opportunity in FY2010 that will support research with domestic animals that will benefit agriculture.
6. The National Oceanic and Atmospheric Administration (NOAA) in partnership with the U.S. Department of Agriculture (USDA) ARS and CSREES launched the Alternative Feeds Initiative in 2007 to accelerate the development of alternative feeds for aquaculture. The purpose of the NOAA-USDA Alternative Feeds Initiative is to identify alternative dietary ingredients that will reduce dependence on fishmeal and fish oil in aquaculture feeds while maintaining important human health benefits of farmed seafood.

USDA – Animal and Plant Health Inspection Service (APHIS)

Animal Health:
http://www.aphis.usda.gov/animal_health/index.shtml

APHIS works to protect and improve the health, quality, and marketability of our nation's animals, animal products, and veterinary biologics. Below are a few APHIS animal health programs:

- *Animal Health Report*
  The Animal Health Report is an overview of domestic animal health in the United States. It contains information on livestock, poultry, and aquaculture commodities, as well as the programs and strategies used to ensure their continued health in the U.S.
- *Animal Diseases **and** Animal Diseases by Species*
  Veterinary Services protects and improves the health, quality, and marketability of our nation's animals, animal products and veterinary biologics by preventing, controlling and/or eliminating animal diseases, and monitoring and promoting animal health and productivity.
- *Laboratory Information and Services*
  APHIS provides a variety of laboratory services providing or facilitating animal disease testing.
- *Veterinary Biologics*
  Veterinary biologics include vaccines, antibodies, diagnostic kits, and certain immunomodulators.
- *Monitoring and Surveillance*
  The National Animal Health Surveillance System and provides links to key animal health monitoring and surveillance issues, programs, and information sources.
- The *National Poultry Improvement Plan (NPIP)* is a cooperative Federal-state-industry program through which new diagnostic technology can be effectively applied to the improvement of poultry and poultry products throughout the country. This program was developed to prevent or control certain egg-transmitted, hatchery-disseminated poultry diseases. NPIP identifies states, flocks, hatcheries, and dealers that meet disease control standards so that customers can be sure that they poultry they buy has tested free of certain diseases.

Animal Welfare:
http://www.aphis.usda.gov/animal_welfare/index.shtml

In the area of Animal Welfare, APHIS provides leadership for determining standards of humane care and treatment of animals. APHIS implements those standards and achieves compliance through inspection, education, and cooperative efforts. Below are a couple of examples:

- *Horse Protection*
  http://www.aphis.usda.gov/animal_welfare/hp/index.shtml

The Horse Protection Act (HPA) prohibits horses subjected to a process called soring from participating in exhibitions, sales, shows, or auctions.

- *Investigative Enforcement Services (IES)*
  http://www.aphis.usda.gov/ies/

  The Investigative and Enforcement Services (IES) staff aims to ensure the health and care of the animals and plants under its jurisdiction. IES helps the animal and agricultural industries achieve compliance with APHIS regulations.

USDA – National Agricultural Library

Animal Welfare Information Center (AWIC)
http://awic.nal.usda.gov/nal_display/index.php?info_center=3&tax_level=1

The *Animal Welfare Information Center (AWIC)* is mandated by the Animal Welfare Act (AWA) to provide information for improved animal care and use in research, testing, teaching, and exhibition.

USDA Missing Pet Network (MPN)
http://www.missingpet.net/

The MPN is a group of volunteers sponsored by the USDA Animal Care Office, who help people find missing pet animals.

United States Department of Health and Human Services

NIH's Office of Laboratory Animal Welfare (OLAW)
http://grants.nih.gov/grants/olaw/mission_statement.htm

The Office of Laboratory Animal Welfare (OLAW) provides guidance and interpretation of the Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals, supports educational programs, and monitors compliance with the Policy by Assured institutions and PHS funding components to ensure the humane care and use of animals in PHS-supported research, testing, and training, thereby contributing to the quality of PHS-supported activities.

USDA _ Agricultural Research Service (ARS)

- *Animal Health National Program*
  http://www.ars.usda.gov/research/programs/programs.htm?NP_CODE=103

  ARS carries out animal health research and delivers effective solutions to prevent and control animal diseases that impact agriculture and public health. The Animal Health National Program conducts innovative cutting-edge research, which delivers effective and practical solutions to agricultural problems of high national priority.

- *Animal Health Systems Research*
  http://www.ars.usda.gov/Main/docs.htm?docid=13328

  The Animal Health Research Unit seeks to understand the interactions between infectious agents and domestic livestock that result in disease and loss of production. Reducing the impact of infectious diseases, thus improving animal and public health, is the primary goal of their research programs.

- *Aquatic Animal Health Research*
  http://www.ars.usda.gov/AboutUs/AboutUs.htm?modecode=64-20-15-00

  To meet the needs for continued growth of the catfish industry and to increase its profitability, biological control strategies are being developed that will prevent large economic losses in the catfish industry caused by diseases and parasites. The research objectives of the unit's prevention program are development of vaccines, rapid diagnostic tests and fish diets that will enhance disease resistance to infectious bacteria and parasites.

- *Aquatic Animal Health Research Laboratory*
  http://www.ars.usda.gov/Main/site_main.htm?modecode=64-20-15-00

  The Aquatic Animal Health Research Laboratory conducts research in the areas of bacteriology, parasitology, pathology, nutrition and immunology to solve problems in aquaculture that diminish productivity and quality of warm-water fish, primarily catfish, tilapia and hybrid striped bass.

Private Industry

Alternatives to Animal Testing (Atlweb)
http://altweb.jhsph.edu/

Altweb, the Alternatives to Animal Testing Web Site, was created to serve as a gateway to alternatives news, information, and resources on the Internet and beyond.

Altweb assist scientists and others seeking to conduct a search for alternatives methods; serves as a CRP--"central reference point"--for alternatives information, publications, databases, calendars, and other resources; supports the creation and maintenance of new alternative resources as needed; facilitate communication and collaboration among members of the alternatives community, in particular those who work in database or information management.

Food Animal Health Research Program
http://www.oardc.ohio-state.edu/fahrp/overview/mission.html

The Food Animal Health Research Program, Ohio State University, conducts basic and applied research, provides graduate training, and supports the animal industries in their objective to economically produce adequate food and fiber. Their research efforts focus on the causes, prevention and control of livestock and poultry disease with major emphasis on economically important infectious diseases of food producing animals.

American Dairy Science Association (ADSA)
http://www.adsa.org/
The American Dairy Science Association provides leadership in scientific and technical support to sustain and grow the global dairy industry through generation, dissemination, and exchange of information and services. ADSA publishes research, reviews and timely information in the official ADSA publication, the *Journal of Dairy Science*, the highest ranked general dairy research journal in the world.

American Humane
http://www.americanhumane.org/about-us/program-summary/

The American Humane organization works to ensure safe and humane treatment of all animals. They have a wide range of effective programs to protect animals, assist shelters and support the professionals and volunteers who have dedicated their lives to helping animals (i.e., Animal Emergency Services and Shelter Services).

Animal Welfare Institute (AWI)
http://www.awionline.org/farm/

The Animal Welfare Institute (AWI) is a non-profit charitable organization founded in 1951 to reduce the sum total of pain and fear inflicted on animals by humans. This institute aims to abolish factory farms, improve the housing and handling of experimental animals, end cruel methods of controlling wildlife populations, preserve and protect wildlife in international trade, and to encourage animal-friendly science teaching.

Section II: Primary Knowledge Areas

Knowledge Area 301: Reproductive Performance of Animals

KA 301: Reproductive Performance of Animals' Narrative Introduction

Reproductive efficiency is a major factor that affects profitability of many livestock production systems. For example, the fertility of domestic ruminants, even under optimal conditions, is only about 50%. In dairy cattle and broiler-breeder populations, fertility has declined significantly over the past several decades. This decline in fertility is associated with increased genetic selection for increased milk production in dairy cattle and increased growth rates in poultry. Reducing infertility in agriculturally important females is of major importance for efficient and profitable animal production. Likewise, inhibiting reproductive activity in some production systems (e.g., feedlot heifers or bulls) or generating monosex populations of aquatic species is also desirable.

Molecular, cellular, systems, and whole-animal studies have been conducted to obtain new knowledge regarding the mechanisms underlying ovarian follicular development and ovulation, fertilization and conception, semen metabolism and preservation, the factors associated with embryonic/fetal mortality, placental function, and the effects of stress on reproduction. Advances in our understanding of reproductive endocrinology and reproductive biology are being used to develop new methods to control estrus and ovulation, reliably diagnose pregnancy within days after conception, and increase the success rate of assisted reproductive technologies including sperm or embryo sexing, artificial insemination, embryo transfer, and somatic cell nuclear transfer (cloning). Basic knowledge has also been translated to various animal production systems to reduce the age of first breeding in females, improve libido, control the sex of offspring, improve spawning efficiency in fish and shellfish, and enhance larval rearing in fish and shellfish.

KA 301: Reproductive Performance of Animals' Key Activities

Priorities include: 1) improved pregnancy rates in breeding populations; 2) increased numbers of offspring from genetically superior females and males; and 3) improved methods for sterilization or generation of monosex populations.

The *short-term goals* of this area include: 1) increased understanding of the basic mechanisms that regulate fertility and 2) development or improvement of technologies for assisted reproduction, sterilization, or generation of monosex populations. The *medium-term goals* of this area include: 1) increased numbers of offspring from genetically superior males and females; 2) dissemination of knowledge and information to end users and the public; and 3) increased adoption of reproductive technologies. The *long-term goals* of this area include: 1) increased fertility in livestock and poultry; 2) increased efficiency from animal production systems; 3) enhanced environmental quality; 4) increased profitability for producers; and 5) product cost benefits to consumers. *Public benefits* include: 1) increased profitability for producers; 2) enhanced environmental quality; and 3) product cost benefits to consumers.

KA 301: Reproductive Performance of Animals' Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Fertility in dairy cows has been decreasing at the rate of ~1% per year since ~1970; Relatively few (<10%) beef producers use artificial insemination to take advantage of genetically superior sires; Seasonal infertility is an increasing problem in swine; Low fertility persists in the broiler breeder industry; Methods are needed to: determine if females are pregnant early in the first trimester; identify sperm with high fertility; sterilize food-producing animals or generate monosex populations (without surgery or hormones); and cryopreserve gametes.	*What CSREES invests:* • Financial Resources • Human Capital • Infrastructure • Knowledge and Experience • Time	*What CSREES does:* • Provide leadership and Coordination • Fiscal • Management • Partner with • Stakeholders • Collect and Analyze Stakeholder Input • Ensure quality, relevance, and performance of funded projects	Research, education and extension output vetted by scientists and educators submitted to CSREES • Research findings disseminated • New Techniques/Methods • Publications • Citations • Disclosures • Patents • Best management practices • Curricula Designed • Undergraduate and graduate students graduate • Training provided to producers	• Increased understanding of the basic mechanisms that regulate fertility • Develop or improve technologies for: assisted reproduction; sterilization; and generation of monosex populations **Example:** **A vaccine was developed to prevent estrous cycle activity and pregnancy in heifers. The vaccine blocks reproduction in heifers, bulls, and mice and may be useful in domestic animals, pets, and wild species. Two patents were issued to Washington State University for this vaccine. (NRI; 0196368)**	• Increased numbers of offspring from genetically superior males and females • Dissemination of knowledge and information to end users and the public • Increased adoption of reproductive technologies **Example:** **Methods were optimized for gynogenesis and sex reversal using environmental manipulations of the culture environment to produce sex-reversed (XX) males for breeding. When XX males are mated to normal XX females, a population of all female fingerlings is produced. (SBIR; 0206470)**	• Increased fertility in livestock & poultry • Increased efficiency from animal production systems • Enhanced environmental quality • Increased profitability for producers • Product cost benefits to consumers **Example:** **A timed artificial insemination protocol (OvSynch) was developed for dairy cattle that allows all artificial inseminations to be performed on one day of the week thereby improving labor efficiency and consistency. OvSynch is now used throughout the world. (Hatch 0207377)**

Assumptions - Researchers will take advantage of livestock and poultry genome sequences and new genomic technologies to increase knowledge about reproductive processes	**External Factors** - 1) Funding for basic and applied research in animal reproduction will remain flat or decrease across federal, state, and industry sources; 2) Consumer demand for natural/organic (i.e., hormone free) and socially acceptable production systems is increasing; 3) There is a lack of industry support to pursue FDA approval for novel endocrine-based approaches to estrous synchronization, sterilization, or generation of monosex populations.

KA 301: Reproductive Performance of Animals' Outputs and Outcomes

Methods to increase reproductive efficiency in cattle: As milk production has continued to improve in U.S. dairy cattle, there has been a dramatic decline in reproductive efficiency. Reproductive efficiency in dairy cattle is suboptimal due to non-cycling cows, poor fertility, and poor detection of estrus. Scientists at the University of Wisconsin developed a reproductive management protocol (Ovsynch) for timed artificial insemination of dairy cattle. This protocol allows dairy producers to perform all of their artificial inseminations on one day of the week thereby improving labor efficiency and consistency on dairy farms. The Ovsynch protocol is now utilized throughout the world. (Hatch; CRIS Accession Number 0195068)

Enhancing the efficiency of an artificial insemination in dairy cattle through a modified systematic breeding protocol: The U.S. dairy industry loses greater than $300 million annually as a result of reproductive inefficiency, primarily due to the failure to detect estrus, the misdiagnosis of estrus, and inappropriate timing of artificial insemination. Scientists at the University of Idaho showed that there is clearly an advantage to performing daily heat detection of cows enrolled in a systematic breeding protocol. Nearly 11% of enrolled cows exhibited spontaneous heat, received immediate artificial insemination, and achieved an acceptable conception rate. Consequently, dairy producers should consider including heat detection in all systematic breeding programs when cows are not pre-synchronized. (Hatch; CRIS Accession Number 0191896)

Methods to increase reproductive efficiency in cattle: Within the beef industry in the US, approximately $198 million are lost annually due to problems with rebreeding and synchrony of estrous cycles. As ethanol production expands in the Great Plains region, greater opportunity will exist to incorporate dried distillers grains in the diets of replacement heifers. Scientists at the University of Nebraska demonstrated that utilizing dried distillers grains as a source of protein and energy in heifer development resulted in enhanced conception and pregnancy rates following artificial insemination. (Hatch; CRIS Accession Number 0207377)

The use of reproductive technology to improve flounder growth: Landings of Atlantic flounders decreased from 90,000 mt in 1984 to 25,000 mt in 1994. The high cost of production is currently impeding the development of flounder culture in North America. If a breeding program could improve growth rate two-fold over a period of years, the cost of production would drop from $2.80 to only $2.00 per pound. Females show a two-fold growth advantage relative to males of this species. Scientists at Great Bay Aquaculture, LLC optimized methods for gynogenesis and sex reversal using environmental manipulations of the culture environment to produce sex-reversed (XX) males for breeding. When XX males are mated to normal XX females, a population of all female fingerlings will be produced for commercial growing. Development of genetically superior, faster growing all female fingerlings of summer flounder will profoundly alter the economics of commercial aquaculture of this species, virtually cutting the cost of production in half. (SBIR; CRIS Accession Number 0206470)

Follicle selection and development in chickens: Ovarian follicle growth and development is aberrant in broiler breeder hens when compared to laying breeds of hens where egg production is not optimal. Scientists at Cornell University studied the effect of anti-mullerian hormone (AMH)

on egg development in adult hens. The smallest ovarian follicles (<1mm diameter) contained the largest concentrations of AMH. In addition, AMH expression was higher in ovarian follicles from broiler breeder hens compared to laying hens which have better egg production. Expression of AMH was also greater in ovarian follicles from full-fed broilers compared to feed-restricted broilers. This increased expression of AMH in full-fed broilers was associated with increased disruption of the normal pattern of ovarian follicular development. These results will help poultry producers select broiler hens that naturally have a lower concentration of AMH and may make these hens less prone to excessive ovarian follicular development. (NRI; CRIS Accession Number 0196260)

Development of large-scale sperm cryopreservation techniques for striped bass aquaculture: Hybrid striped bass aquaculture has become the fourth largest form of U.S. finfish production. Scientists at Kent Seatech Corporation developed standardized protocols and techniques for collecting, extending, and shipping sperm from white bass and striped bass. These technologies will greatly reduce the time, cost, volume constraints, and variability in post-freeze sperm viability that often are associated with tedious and inconsistent hand straw-filling and cryopreservation methods currently used in laboratory-scale approaches. In addition, development of these large-scale cryopreservation techniques for striped and white bass sperm could lead to facilitated hatchery production of hybrids, archival of important lines, enhancement of selective breeding, and development of economic opportunities involving the commercial-scale cryopreservation of striped bass sperm for the entire striped bass culture industry. (SBIR; CRIS Accession Number 0204120)

Goat producers learn about artificial insemination techniques: Artificial insemination has long been used in the dairy cattle industry; however, limited opportunities exist for goat producers to acquire the necessary skills associated with artificial insemination. Scientists at Langston University instituted a practical workshop for educating goat producers about anatomy and physiology of the female goat; estrus detection; semen handling and storage; and artificial insemination. In 2007, more than 60 goat producers attended these workshops. All producers reported an increase in knowledge and indicated future plans for using artificial insemination in their goat herds. Increased use of artificial insemination by goat producers will lead to improved genetics in goats used for meat and milk production in the U.S. (Langston University FY2007 Annual Report of Accomplishments)

Production of fingerling hybrid catfish: Hybrid catfish grow fast with an excellent feed conversion ratio. However, the cost of fingerlings must be reduced to improve the profit margins for producers. Improving the efficiency of hybrid catfish fingerling production will make this technology more affordable and more available to catfish producers. Scientists at the University of Arkansas Pine Bluff used luteinizing-hormone releasing hormone (LHRH) implants to induce ovulation in female catfish. The optimal dose of LHRH has been determined and implemented into the decisions for artificial spawning of channel catfish. These data were also used by the U.S. Fish and Wildlife Service to apply for an investigational new animal drug (INAD). (University of Arkansas at Pine Bluff FY2007 Annual Report of Accomplishments)

Xenografting of testis tissue in agricultural animals: Scientists at the University of Pennsylvania used the approach of testis tissue xenografting to study and manipulate spermatogenesis in farm

animals. Results indicate that treatment of host mice to modulate the endocrine environment of the grafted tissue results in detectable effects on donor-derived spermatogenesis. Testis tissue xenografting can be employed to devise strategies to improve male fertility and study the effects of substances to enhance or suppress spermatogenesis in large animals without having to perform extensive experiments in these large animals. These studies also provide a novel model for studying gene function during spermatogenesis in livestock. (NRI; CRIS Accession Number 0195915)

Knowledge Area 302: Nutrient Utilization in Animals

Knowledge Area 302: Nutrient Utilization in Animals' Narrative Introduction

The focus of animal nutrition and nutrient utilization in agricultural animals has changed over time in response to emerging issues and changing national needs. Traditional animal nutrition studies were focused on improving feed efficiency to convert feeds into low-cost, high-quality food and to deliver an adequate food supply. More recently, in response to changing national priorities, the science of nutrient utilization has shifted emphasis from minimizing nutrient excretion from the animal to refining the biological processes for extracting, utilizing and responding to nutrients from traditional and novel feed sources. Today, the major focus in animal nutrient utilization is centered in five important areas: animal production and feed processing, animal and human health, biosecurity, environmental quality, food safety and quality.

Animal Production and Feed Processing

Performance of livestock and poultry is continually being improved to enhance economic efficiency. Increasing use of co-products and alternative feeds could have effects (both positive and negative) on profitability.

Animal and Human Health

The nutritive value of animal products is directly related to the quality and composition of nutrients provided to agricultural animals. Refining animal feeding to enhance healthful components can have positive impacts on both human and animal health.

Biosecurity

Animal feeding operations represent one sector of the food system in which contaminants, toxins, and other undesirable elements can be introduced. Technologies to detect potential feed-related threats to animal and human health can be useful biosecurity tools.

Environmental Quality

Concentration of phosphorus and nitrogen losses from livestock and poultry production are major challenges facing the animal agriculture industries. Nutritional and management strategies that lower P excretion, improve manure P distribution, and lower N volatilization losses from feedlot operations can improve positive contributions of animal agriculture to environmental challenges. Improving nutrient management practices can be accomplished by manipulating the diet and improving utilization of feed products.

Food Safety and Quality

During the last decades research in the field of feed and food safety has contributed to a considerable decrease in many undesirable substances in foods of animal origin.

Knowledge Area 302: Nutrient Utilization in Animals' Key Activities

Priorities include: 1) improved nutrient utilization, 2) decreased nutrient excretion, and 3) improved methods, technologies, and models to predict nutrient requirements and fate.

The *short-term goals* of this area include: 1) enhanced understanding of the fundamental concepts of nutrition and 2) increased options for alternative feeds. The *long-term goals* of this area include: 1) improved quality of animal products; 2) increased efficiency of animal production systems; 3) enhanced environmental quality; 4) increased profitability for producers; and 5) product cost benefits to consumers.

Public benefits include: 1) improved nutritive value of animal products, 2) increased profitability for producers, 3) enhanced environmental quality, and 4) a safer, more secure food system.

Portfolio's contribution to the Agency: As one of the larger focus areas of the Animal Systems portfolio (Figure 3), this Knowledge Area represents a scientific discipline that serves as the foundation for addressing challenges in animal production. For example, much of the research on improving environmental quality centers around improving animal nutrient utilization. Similarly, the rapidly emerging issues of bioenergy production that the agency is currently addressing hinge on the successful incorporation of the vast amount byproducts of the bioenergy industry in animal feeds and the identification of alternative energy sources for animal diets. As demands for healthier foods continues to increase, the feeding of animals will continue to be refined to deliver these improved products.

Are we moving in the right direction? The portfolio has moved slowly in the direction of meeting the needs of stakeholders and consumers; however, the breadth of issues to which animal nutrition research, education, and extension serves as a solution (e.g., energy, environment, human health, animal welfare) is not reflected in the size or scope of currently administered programs or in trends in CSREES investment.

Do we have the right balance of resources? Animal nutrient utilization is addressed through several mechanisms including competitive grants, multi-state committees, and other formula-funded activities. The resources are not small, and appear to be balanced across resource mechanisms.

Knowledge Area 302: Nutrient Utilization in Animals' Outputs and outcomes

Condensed tannins in animal diets reduce greenhouse gas emissions: Activities undertaken at Langston University have contributed to a better understanding of the effects of condensed tannins on methane emissions by ruminants. Effects of condensed tannins on ruminal methane emission are similar among sources and between forms of forage. Effects on methane emission per unit of condensed tannins decreases with increasing dietary level of condensed tannins. These outcomes may lead to dietary incorporation of condensed tannins to minimize methane emission for increased efficiency of energy utilization and less agricultural emission of a greenhouse gas. (*Other grants; CRIS Accession Number 0200781*)

Dietary management results in animal products tailored to consumer desires: A series of cattle feeding experiments have been conducted at the Ohio State University to assess the effects of breed, weaning age and post-weaning diet on cattle health, growth rate, efficiency of gain, and carcass and characteristics. Results of the experiments have shown that there are differences in carcass characteristics and efficiency of growth due to the age at which cattle are started on high-

grain diets. This research identified how management and diet can be used to produce beef for different consumer groups, and how it is possible to use management to identify an expected date of harvest to make marketing more economically manageable, as carcass prices vary by month, due to demand and supply. (*Hatch; CRIS Accession Number 0195484*)

Education and outreach in husbandry and feed management changes producer behavior: Programs conducted in 2007 at Texas A&M University aimed at changing producer behavior to improve animal production included Texas Beef Quality Producer, Beef 101, 706, 2010, Bull Selection, Drought Management, Horse 101, Mare/Foal Workshops, Dairy Outreach, Youth Programs:35th Summer Horsemanship Schools, Lamb/Goat Camps and Judging Camps. From measures including those from beef, meats, dairy, horse, and sheep/goats, 54%-100% of participants reported adoption of at least one best management practice, 56%-90% reported elimination of non-productive practices, 61% developed financial plans, 70% implemented hay analysis, and 92% reported cost/lb for alternative feedstuffs. (*Texas A&M Plan of Work, 2007*)

KA 302: Nutrient Utilization in Animals Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Farmers face increasing demands to feed animals in management systems that result in high-quality, safe, and healthful animal products; that are economically competitive and efficient; that promote and ensure animal health and wellbeing; and that deliver environmental and consumer benefits.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	- Provide leadership and coordination - Fiscal management - Partner with stakeholders - Ensure quality relevance and performance - Collect, analyze, and integrate stakeholder input	Research, education and extension output vetted by scientists and educators submitted to CSREES - Research findings disseminated - Publications - Citations - Disclosures - Patents - Best management practices - Curricula Designed - Undergraduate and graduate students graduate - Training provided to producers	- Greater understanding of nutrient interactions, needs, and functions - Enhanced knowledge of dietary modulation of animal performance, health, and well being - Increased awareness of agriculture's ability to efficiently deliver consumer, animal, product quality, and environmental benefits via nutrition **Example**: Scientist have demonstrated that the impact of feeding brown midrib silage rather than conventional silage to dairy cows results in a reduction in manure output of about 5%, equal to -7lbs/cow/day (Hatch: 0190139 and NRI 0201790)	-Use of improved models of nutrient needs and other nutritional husbandry tools - Application of new knowledge for advances in animal nutrition - Adoption of better feeding strategies that improve resource use and potential benefits **Example:** An economic model has been developed to predict returns from use of byproducts in beef cattle diets, based on performance and economics, and allowed feedlot producers in Nebraska to make informed decisions in terms of biology, economics, to be more competitive (Hatch: 0195447)	- Production systems with increased efficiency, market opportunities, and profitability - Healthier animals that produce safer, higher-quality, and more nutritious products - Improved natural environment **Example:** Lactation performance of dairy cows in being improved to enhance economic efficiency increasing use of co-products has effects on profitability. Feeding distillers grains to dairy cattle improves feed efficiency by increasing yields of milk, protein, and fat while decreasing intake. (Hatch: 194032)

Assumptions – About how the program will work, the effect of people, the environment and the way we think it will work	**External Factors** – Funding, scientific and technological advancements, changing national priorities, producer and consumer views, economic and market conditions

Knowledge Areas 303 and 304: Genetic Improvement of Animals (303); and Animal Genome (304)

Knowledge Area 303: Genetic Improvement of Animals' and Knowledge Area 304: Animal Genome's Narrative Introduction

Situation: Agricultural animal research has been successful in developing technology and methodologies that have enhanced production efficiency of the beef, dairy, swine, poultry, sheep, and aquaculture industries. Excellent examples of the changes that have taken place over the last ~50 years are: 1) The dairy industry's coupling of genetic selection and efficacious use of artificial insemination has more than doubled the annual milk yield per cow while reducing the size of the national dairy herd by about 50%; 2). The genetic improvement has been responsible for over 50% of the total improvement observed in milk yield. Genetics, nutrition and other management changes resulted in a "modern day" broiler that requires approximately one-third the time and over a threefold decrease in the amount of feed consumed to produce a market-age broiler; and 3) The pounds of feed needed to produce a pound of pork is estimated to have been halved. While quantitative genetics continues to be successful in improving production traits, genomic technology has potential to lead to more accurate and rapid animal improvement, especially for phenotypic traits that are difficult to measure (such as disease resistance, animal well-being, feed efficiency, product quality). In order to fully realize the potential of genomic tool box, the agricultural research community has achieved historic milestones by completing the draft genome sequences of *Gallus domesticus* (chicken) in 2004 and *Bos taurus* (cattle) in 2008. The swine genome sequencing efforts are currently underway (completion by December 2009). Furthermore, the horse genome sequence was completed in 2007 and currently several aquaculture species are almost ready to get into the genome sequencing pipeline.

Current Efforts: The two CSREES knowledge areas (KAs) that address the animal genetics and genome efforts are KA 303 "Genetic Improvement of Animals" which focuses on broader issues ranging from estimation of genetic parameters to the incorporation of molecular and genomic information into applied genetic improvement programs; and KA 304 "Animal Genome" which includes research efforts with a focus on gene mapping, structure and function, regulation of gene expression, and the genetic contribution to phenotypic variation along with bioinformatics that lead to a complete understanding of the genomic organization and function of animal genome of agriculturally important animal species. The ultimate goal of these two KAs is to provide fundamental and mission orientated information important to genetic-based improvements in animal production. For the purpose of brevity and because of significant convergence of genetics research, these two KAs will be presented in a combined portfolio of the animal genetics and genome focus areas. Combining genomics with conventional genetic breeding approaches is crucial to optimize production, quality, and value-factors necessary for sustainability of our nation's food and fiber production. The current CSREES portfolio in animal genetics and genomics has positioned itself to accommodate such shifts in genetics research. For example, emphasis on identification and mapping of DNA segregation markers, including quantitative trait loci (QTL), will remain an active area of investigation; however, newer approaches in "functional genomics," such as tissue-specific gene expression, proteomics, metabolomics, and bioinformatics, are now included for research and funding consideration in KA 303 and 304 and are also complementary to the NRI RFA. As a result, a clear change is

evident in animal breeding and genomic research, education, and extension by the multitude of projects in CSREES' portfolio that are evaluating many genetic traits and mechanisms in addition to single traits that were primarily studied in the past.

Short-term Goals: The short-term goals of genetic improvement and animal genome programs are to develop an understanding of genes and gene functions by utilizing computational and biological tools in order to accelerate performance-based animal genetic improvement programs.

Long-term Goals: The long-term goals of these KAs are to identify genetic regions and related mechanisms to ensure improved animal health, product quality, and production efficiency.

Priorities: The animal genetics portfolio is now being aligned with the priorities identified in the recently developed *Blueprint for USDA Efforts in Agricultural Animal Genomics 2008 – 2017.* The *Blueprint* is built on a vast array of stakeholder input and is designed as a pyramid, with *Science to Practice* at the top supported by fundamental and mission oriented research in *Discovery Science,* and is based on a solid foundation of *Infrastructure.* The goals and recommendations of the *Blueprint* are consistent with the President's American Competitiveness Initiative (2006) which stresses the importance of targeting "..investments toward the development of deeper understanding of complex biological systems..".

Briefly, *Science to Practice* priorities include the addition of animal genomics technology to quantitative genetics programs for the purpose of: 1) Whole genome-enabled animal selection; 2) Prediction of genetic merit; 3) Designing precision mating and management systems and 4) Traceability. *Discovery Science* will focus on filling knowledge gaps in areas such as: 1) Identification of genes and gene products; 2) Understanding mechanisms of gene regulation in a system biology framework; 3) Genes and gene variation-based influences on phenotypes and phenotypic variations; and 4) Host-pathogen interaction.. *Infrastructure* priorities will include: 1) Genomic tools such as high resolution genome maps and assembled and annotated genomic sequences, 2) Data bases and bioinformatics tools that integrate genomic, phenotypic, and experimental information for each species, 3) Availability of genetic resources (e.g., animal, germplasm, DNA/RNA, cell lines, etc.), 4) Education and training of students and scientists and additional emphasis on extension and outreach.

Public Benefit: Our stakeholders, especially major breeding companies, are now active participants in our species-based genetic research, education, and outreach programs. The technologies and tools being developed by our scientists are being applied to studies of marker-assisted selection. This is benefiting the public through the development of higher quality, more disease-resistant and more economical animal products, due to more rapid breeding progress. At a more fundamental level, we are now moving closer to understanding the cause of phenotypic variation that is relevant to agricultural use of animals. Furthermore, our deeper understanding of animal systems biology will greatly benefit human health as several animals (e.g., pig, chicken, cattle) are important biomedical models.

Contribution to the Portfolio: In line with the significant commitment to domestic animal genomics at the federal level the animal genetics and genomics effort is organized as a Multi-state Research Project, National Research Support Project-8 (NRSP-8) under the National

Animal Genome Research Program. Currently, over 100 scientists and industry representatives from poultry, swine, cattle/sheep, horses, aquaculture species, and database committees are participants in this project. This project has recently been renewed for another five year term (2008 – 2013) at a budget of $500,000 per year. In addition, CSREES's competitive Animal Genome, Genetics and Breeding program continues to provide science-based knowledge and technologies to generate new or improved high-quality products/processes and to promote the efficiency of agricultural production systems. Approximately $10 – 11$ million are available per year for this effort through the NRI programs. There are several multistate research committees (n =~18) based in every region as well as special grants (n=6) which address animal breeding and genetics efforts aligned with the KA 303 and 304. With the completion of draft genome sequences of most of the live stock species there are increasing efforts to utilize the sequence information in selecting animal phenotypes with improved genetic-based production potential. In addition, "animal genomics for animal health" is a new thrust for application of genomics information in fine tuning host-pathogen interaction. The sequencing of animal genomes clearly has the potential to provide sophisticated strategies for understanding mechanisms of disease and the biological complexities of host-pathogen interaction.

Knowledge Area 303: Genetic Improvement of Animals' and Knowledge Area 304: Animal Genome's Key Activities

Gene organization and function in bull fertility: Scientists at Penn State University are focusing on the contribution of Y-chromosome-related genes in bovine spermatogenesis and fertility. One of the critical components of the reproductive process is bull fertility. In beef industry, it was estimated that as high as 18% of beef bulls used in natural service are reproductive deficient. Therefore, subfertility/infertility is a significant problem. However, this problem has not been studied at a molecular level because of the lack of molecular genetic markers and diagnostic tools, which have prevented the identification of high fertility, subfertile or infertile sires at an early age. Since very few autosomal genes that are associated with measures of germ cell defects in mammals have been identified, the Y-chromosome "testis genes" become the most important source for molecular study of male fertility/infertility. This study provides details of the organization and function of these Y-related genes in bovine spermatogenesis and fertility and additional markers (SNPs) that allow these researchers to haplotype high fertility, low fertility and subfertile/infertile bulls. It is expected that this information will significantly improve the design of new marker assisted selection (MAS) strategies using Y haplotypes as an aid in selecting sires at an earlier age prior to entering a breeding program and eliminate potential genetic defects associated with reduced fertility (NRI; CRIS Accession number**:** 0212472)

Genetics of aflatoxin resistance in turkeys: Utah State University scientist is leading a multi-institutional team working on a hypothesis that intensive selective pressure may have resulted in the loss of "protective traits" such as glutathione S-transferases needed to detoxify epoxide forms of aflatoxin. They are determining whether resistance traits are present in wild turkeys and other progenitor strains that posses greater genetic diversity than commercial turkeys, with the long-term goal of restoring greater genetic diversity than commercial turkeys. By cloning various species of cytochrome P450 which bioactivates AFB1, new mechanisms were discovered in understanding of how various P450 enzymes are more active in converting AFB1 into an active compound. Increasing resistance in poultry to aflatoxicosis will help the industry through

improvements in animal health, increases in productivity, and by providing a safer product for consumers (NRI; CRIS Accession Number: 0209399).

Efficient means of developing transgenic chickens: The current methods to develop transgenic poultry are inefficient. Scientists at North Carolina State University are developing more efficient means of developing transgenic chickens. Several Primordial Germ Cell (PGC) lines were established with one line designated 1529 in continuous culture for over 10 months. Cell lines have been established from both male and female embryos as well as white Leghorn and barred Plymouth Rock embryos. PGC cultures have been frozen and recovered. When injected into stage X embryos, PGCs from early passages (~3 months) and late passages give rise to germ line chimeras. However, some cell lines give rise to germ line chimeras better than others. Individual cells lines were labeled with a vital dye that allowed the cells to be traced after injection into recipient embryos. Variability between lines was observed for the ability of cell lines to migrate to the gonads. PGC cell lines are now available for research purposes. The culture of avian PGCs from male and female embryos will have significant applications in reproductive biology, developmental biology, cell biology and transgenics.(HATCH; CRIS Accession Number: 0198606).

Zebrafish as biomedical model for research: Researchers at Purdue University are using cell-mediated gene transfer in fish to demonstrate that primordial germ cell (PGC) cultures will enable targeted genetic alterations in Zebrafish. Results from the work conducted over the past year will make it possible to establish long-term cultures of zebrafish PGCs. This project will result into new knowledge to identify and study the function of genes that control embryo development. This research will unquestionably increase the value of the zebrafish as a model for biomedical research. The research could also be applied to improve the efficiency of aquaculture production systems (HATCH; CRIS Accession Number: 0185499)

Reduced breeding seasonality and development of parasite-resistant lines of sheep: Scientists at Virginia polytechnic Institute are working towards development of sheep genetic resources with reduced seasonality of breeding, and to evaluate and further develop two hair sheep composite breeds (the Dorper and the Katahdin) for a broad spectrum of production, health, fitness, and meat quality characteristics. Is was desired to improve the ability of the selected ewes to lamb more frequently than once per year. Results of the 2006 and 2007 studies involving rapid spring rebreeding of lactating ewes demonstrated that rapid rebreeding with establishment of pregnancy is possible in spring-lambing, lactating ewes of the selected line. However, these very early matings are accompanied by relatively high levels of embryonic and fetal losses. Optimal spring fertility would likely be achieved by delaying matings to an average of 70 to 90 days postpartum, a time schedule that is still consistent with average lambing intervals of 7.5 months. A lambing interval of 7 to 8 months is consistent with most programs developed for accelerated lambings, so the performance of the selected ewes documents that selection can be used to develop sheep that are adapted to frequent lambing programs, provided that a reasonable period is allowed between lambing and first mating. Results regarding resistance to gastrointestinal nematode infection in hair sheep demonstrate that resistant animals possess a rapid and robust Th2-type immune response, characterized by decreased IFN, and increased expression of interleukin-13 and immunoglobulin E. Differential regulation of Th2 cytokines between breeds may be partially responsible for differences in parasite resistance. These differentially expressed genes in infected

animals are candidates for further study. Identification of favorable mutations in these genes and their incorporation into breeding lines may hasten development of parasite-resistant lines of sheep (HATCH; CRIS Accession Number: 0195350).

Knowledge Area 303: Genetic Improvement of Animals' and Knowledge Area 304: Animal Genome's Outputs and Outcomes

Reducing abdominal fat in broiler chickens: Excess abdominal fat is a problem leading to poor performance in broiler chickens. Few genetic markers are available for selecting broiler breeding stock for reduced abdominal fat in a Marker-Assisted Selection program. Researchers at the University of Maryland have discovered that Gly1 in the Glypican gene is associated with fat yield and fat weight; Syn1 in the Syndecan gene is associated with fat weight and AKR1 in the Aldo-keto reductase gene is associated with fat yield and fat weigh. These findings may be useful in future marker-assisted selection programs for improvement of production efficiency in broiler chickens (HATCH; CRIS Accession Number: 0210640)

Genes associated with inflammatory bowel diseases: Inflammatory bowel diseases (IBDs), including Crohn's Disease and ulcerative colitis, are devastating chronic inflammatory conditions that affect millions of people worldwide. Researchers at University of Missouri have discovered that there is likely a mouse 'IBD' gene or genes responsible for the differences in susceptibility of mouse strains to H. hepaticus-induced inflammation. Findings from this study have provided critical information about two chromosome segments containing novel susceptibility genes in a mouse model of inflammatory bowel disease. The knowledge gained from this model system will help understand mechanism of inflammatory disease affecting livestock and poultry (STATE, CRIS Accession Number: 0209857).

KA 303: Genetic Improvement of Animals' Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
The completion of genome sequencing of most livestock, poultry, equine, and aquaculture species will present opportunities to identify candidate genes and genetic markers for better understanding of whole organismal biology	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	*What CSREES does:* • Provide Leadership and Coordination • Fiscal Management • Partner with stakeholders • Ensure quality relevance and performance • Collect and analyze Stakeholder Input	*Who CSREES reaches:* • Scientists • Educators • Industries • Producers • Consumers • Policy makers • Public and Private Institutions and Organizations • Students and trainees	*What the short term results are:* • Increase knowledge of economically important traits • Increase knowledge of quantitative and molecular genetic controls of component traits **Example:** Scientists in Iowa are using candidate gene or fine-mapping approaches to further evaluate QTL regions in swine (Hatch Multi-State NC-1004; 0194414).	*What the medium term results are:* • Generation of Haploytype maps for QTL fine mapping • Generation of tools and technology for gene transfer within and across species • Development of minimum bioinformatics infrastructure to facilitate access to genomic data **Example:** Oyster researchers have developed new DNA genetic markers and linkage maps for Eastern and Pacific oysters, which has led to new avenues of gene identification and function in aquaculture species (Hatch Multi-State NE-186; 0183940).	*That the ultimate results are:* • Whole genome selection for complex quantitative traits • Support animal production for improved animal health, well-being and resistance to disease and food safety **Example:** The National Beef Cattle Evaluation Consortium has incorporated new genetic evaluation methodologies into beef cattle selection, enabling U.S. beef producers and industry to be more globally economically viable and competitive (Special Research Grant; 0195268).

Assumptions - Timely availability of genome-enabling tools and reagents for precision genetic management system	**External Factors** - Trained manpower in quantitative genetics; availability of financial and genetic resources; social, ethical and legal constraints on precision genetic management system

KA 304: Animal Genome Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Situation: The completion of genome sequencing of most livestock, poultry, equine, and aquaculture species will present opportunities to identify candidate genes and genetic markers for better understanding of whole organismal biology	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	*What CSREES does:* • Provide Leadership and Coordination • Fiscal Management • Partner with stakeholders • Ensure quality relevance and performance • Collect and analyze Stakeholder Input	*Who CSREES reaches:* • Scientists • Educators • Industries • Producers • Consumers • Policy makers • Public and Private Institutions and Organizations • Students and trainees	*What the short term results are:* • Generation of genomic (ESTs, DNA microarrays) and computational tools • Identification of genes and characterization of genes / gene families function **Example:** Scientists at NC State University have identified putative QTL(s) which affect several production traits in dairy cattle (Hatch; 0198930).	*What the medium term results are:* • Development of high-resolution BAC-based physical maps Example: Researchers at the University of Illinois constructed a radiation hybrid map of the porcine genome composed of nearly 2,350 markers, including ~350 ESTs and ~2,000 porcine BAC-end sequences. This radiation hybrid map has the highest resolution of any porcine genome map to date (NRI Competitive Grant; 0192060).	*That the ultimate results are:* • Integration of genomics, transcriptional, proteomic and metobolomic approaches toward better understanding of biological mechanisms underlying economically important traits **Example:** Coordination of research, education, and outreach effort under NRSP-8 has made genome-enablement possible for all animal species (Hatch Multi-State NRSP-8; 0163681).

Assumptions - The genome sequencing efforts will result in the generation of high quality sequences of genes and genetic variation information for improvement in performance and health.	**External Factors** - Cost in personnel and infrastructure of doing discovery and developmental research

Knowledge Area 305: Animal Physiological Processes

Knowledge Area 305: Animal Physiological Processes' Narrative Introduction

The overall productivity, efficiency, and well-being of animals used for the production of food and fiber are determined by numerous complex and interactive biological processes. Efforts in this area include work on the fundamental physiological processes within the animal at the organismal, organ system, cellular, and molecular level. Areas of work include: (a) chemical and structural organization of animal cells and their specialized properties and functions, including enzymatic machinery and biochemical conversions; (b) organization, structure, and function of organ systems, including endocrine, circulatory, urinary, nervous, muscular, and skeletal systems, sensory organs, the common integument and its derivatives, and body fluids; (c) physiology of vital life processes and mechanisms of function and control; (d) neural, hormonal, or other chemical messengers that serve as regulators of physiologic processes and perform integrative functions in the animal; (e) prenatal, neonatal, and postnatal development and growth of animals, including genetic control mechanisms and accretion, deposition, and degradation of proteins and fats in animal tissues, and (f) lactation physiology, including alveolar development and involution, milk synthesis, secretion and ejection, milk composition, and patterns of lactation.

Knowledge Area 305: Animal Physiological Processes' Key Activities

Priorities include: 1) increasing efficiency of protein deposition in skeletal muscle (meat); 2) increasing the ratio of lean to fat by reducing fat deposition, particularly inter-muscular fat; and 3) increasing the quality and nutritional value of animal products by focusing on reducing fat content, increasing content of beneficial fatty acids (e.g., omega-3 fatty acids, omega-8 fatty acids, and conjugated linoleic acid), and increasing content of specific minerals (e.g., calcium).

The *short-term goals* of this area include: 1) increased knowledge regarding the overall understanding of physiological processes associated with skeletal muscle growth, fat deposition, and milk production and 2) develop or improve technologies to optimize growth and lactation. The *medium-term goals* of this area include: 1) improved rates of lean muscle growth in food producing animals; 2) improved uniformity and quality of products from food animals; 3) increased quality and quantity of milk from lactating females; and 4) dissemination of knowledge and information to producers and the public. The *long-term goals* of this area include: 1) increased productivity from fewer animals (i.e., increased efficiency), which will increase profitability for producers, provide product cost benefits to consumers, conserve natural resources, and enhance the environment and 2) increased uniformity and quality of animal products leading to increased world-wide consumption of more nutritious animal products that are produced in the U.S.

Public benefits include: 1) increased profitability for producers; 2) improved uniformity and consistency of food animal products to meet consumer demands; 3) product cost benefits to consumers; 4) increased world-wide consumption of more nutritious animal products that are grown in the U.S.; and 5) conservation of natural resources and enhanced environment.

KA 305: Animal Physiological Processes' Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Current efforts to enhance efficiency of animal production systems focus on improving rates of growth or increasing the quality and quantity of milk from lactating females. The primary physiological processes being studied include: increasing efficiency of protein deposition in skeletal muscle (meat); increasing the ratio of lean to fat by reducing fat deposition (particularly inter-muscular fat); increasing the quality and healthiness of animal products by increasing the content of beneficial fatty acids, minerals, etc.; and increasing the amount of milk produced/cow/lactation.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	•Provide leadership and coordination • Fiscal management • Partner with stakeholders • Collect and analyze stakeholder input • Ensure quality, relevance, and performance of funded projects	Research, education and extension output vetted by scientists and educators submitted to CSREES • Research findings disseminated • New Techniques/Methods • Publications • Disclosures • Patents • Best management practices • Curricula Designed • Undergraduate and graduate students graduate • Training provided to producers	•Increased understanding of the basic mechanisms that regulate the physiological processes controlling growth and lactation. • Develop or improve technologies to enhance growth and lactation. **Example:** Activation of arginine synthesis enhances growth of sow-reared piglets. (NRI; CRIS Accession Number 0196620)	• Increased quality and quantity of milk from lactating females • Improved rates of lean muscle growth in food-producing animals • Dissemination of knowledge and information to end users and the public **Example:** A low energy, high-bulk diet rich in straw or other slowly digestible roughages prevents inflammatory changes in liver and adipose around the time of calving. Dairy producers are advised to change their nutritional management of dairy cows. (Animal Health; CRIS Accession Number 0208497)	• Increased efficiency of animal production systems • Enhanced environmental quality • Increased profitability for producers • Product cost benefits to consumers **Example:** Frequent milking during the first 21 days of lactation increases milk production efficiency. The estimated economic value is nearly $300/cow/lactation.(Hatch; CRIS Accession Number 0201951)

Assumptions - Researchers will take advantage of livestock and poultry genome sequences and new genomic technologies to increase knowledge about the physiological processes that control growth and lactation.	**External Factors** - 1) Funding for basic and applied research in animal physiological processes will remain flat or decrease across federal, state, and industry sources; 2) Consumer demand for natural/organic (i.e., hormone free) and socially acceptable production systems is increasing; 3) Increased costs of feed, fuel, and fertilizer are posing serious economic problems to livestock producers. Animals with increased efficiency are desired.

Knowledge Area 305: Animal Physiological Processes' Outputs and Outcomes

Improve growth of sow-reared piglets by enhancing arginine synthesis: Sows' milk contains low levels of arginine, an essential nutrient for young mammals. Because of a low ability to make arginine from amino acids present in proteins, 7-21 day old pigs are deficient in arginine. An arginine deficiency is a major factor limiting ammonia detoxification and maximal growth of young pigs. Researchers at Texas A&M University demonstrated a marked decrease in intestinal N-acetylglutamate synthase activity, which was responsible for reduced intestinal production of arginine in normal baby pigs. Oral administration of N-carbamoylglutamate increased arginine concentrations and reduced ammonia concentrations in plasma and increased muscle protein synthesis. Thus, activation of arginine synthesis is effective in enhancing growth of sow-reared piglets. (NRI; CRIS Accession Number 0196620)

Developmental dynamics of pig intestinal responses to bacterial colonization: A paradox in animal production is the fact that while there is presumably a normal gut microbiota that optimizes intestinal health, maintenance of this population becomes part of the nutrient requirements of the host and thereby affects whole body growth efficiency. Investigators at the University of Illinois showed that the intestinal epithelium has evolved to maintain a physiological state of inflammation with respect to continuous microbial exposure, which serves to sustain a tight intestinal barrier while preventing overt inflammatory responses that would compromise barrier function. Results have generated an expansive and novel database on the impact of normal gut bacteria on regulated gene expression during intestinal development in the pig. Specifically, a large proportion of the nutritive costs incurred in the GI tract support the innate defense functions of epithelial cell renewal and mucus production. As such, molecular mechanisms have been identified that might be developed into unique biotechnological strategies to improve animal growth efficiency through manipulation of the host and its resident microbiota. (NRI; CRIS Accession Number 0193400)

Key proteins integrating the myofibrils within developing and adult muscle cells: Scientists at Iowa State University provided a major improvement in understanding the key muscle cell proteins and the specific mechanisms underlying the overall cytoskeletal integration within muscle cells that are necessary for growth and development of muscle in meat producing animals. They discovered that the alpha synemin protein has the unique ability to link all of the contractile myofibrils within mammalian striated muscle cells. They also showed how striated muscle cells are constructed in developing and adult muscle cells. New knowledge was generated regarding how the cytoskeleton of developing and mature muscle cells links all of the major structures (e.g., myofibrils and sarcolemma) within muscle. The myofibrils and associated structural components comprise over half of the total protein in muscle, which in turn is responsible for most of the desirable eating qualities and nutritional qualities of meat. (NRI; CRIS Accession Number 0194168)

Phosphoregulatory events controlling myogenesis: Various growth factors and cytokines are responsible for the proper formation and function of skeletal muscle in livestock. Transmission of information from membrane-localized receptors to the nucleus involves the induction of multiple kinase signaling cascades including components of the Raf/MEK/ERK axis. Investigators at the University of Florida demonstrated that IGF-1 treatment of muscle cells

results in a noticeable increase in the size of mature myocytes and a significant increase in the amount of muscle proteins. In addition, ERK2 can enhance IGF-mediated muscle growth and differentiation. Modification of the levels of ERK2 in muscle cells will improve their ability to respond to hormones and growth factors and may lead to improvements in deposition of lean muscle mass in livestock. (NRI; CRIS Accession Number 0202100)

Investment in cow comfort improves profitability: Investments that improve cow comfort on dairy farms can often result in increased productivity that can result in increased profitability for the farm operation. Formal educational programs on cow comfort were conducted in the Central New York region. A recent one-on-one consultation resulted in the installation of new stalls on an area dairy farm. The 110 cow farm reported a 10 pound increase in production per cow, of which at least 50% of the increase was attributable to the new stalls. Under current economic conditions this would equate to around $45,000 additional annual income for this herd. After accounting for additional feed intake, this farm will likely add $30,000 - $35,000 of net income to their bottom line. (Cornell University Annual Report of Accomplishments)

Knowledge Area 306: Environmental Stress in Animals

Knowledge Area 306: Environmental Stress in Animals' Narrative Introduction

KA 306 is part of USDA/CSREES Strategic Goal 2, "Enhance the Competitiveness and Sustainability of Rural and Farm Economics", Objective 2.2, "Provide Research, Education, and Extension to Increase the Efficiency of Agricultural Production and Marketing Systems", and Performance Criteria 2.2.12, "Mitigate or Reduce Animal Environmental Stress". The "environmental stress in animals" problem area includes research on stresses from the effects of climate, handling, and other environmental factors that decrease productivity. Extremes in temperature, humidity, air movement, and noise may lead to lower reproduction, reduced feed efficiency, anorexia, reduced disease resistance, and increased mortality. Because the effects of environmental stress yield compromises in animal performance via multiple pathways, many of these research projects interface with other problem areas in the animal production portfolio.

All stresses are additive but some stress is essential for life. Researchers are attempting to identify and mitigate the effect of environmental stresses on food animals. Environmental stress may be weather-related, result from temperature or cleanliness conditions within a building, or that found in the transport vehicle. Environmental stress also encompasses challenges to the animal's well-being associated with management techniques (e.g., beak trimming poultry or dehorning cattle) and psychological stresses (e.g., fear; weaning piglets or calves). Stress conditions may also be improved by proper rations for existing conditions. Multi-state research committees such as W-1173 are concerned with weather-related stresses (heat or cold) with considerable attention being paid to excessive heat and the interaction with livestock coat color and various cooling methods. Prediction and prevention of overheating events has saved the animal industries millions of dollars related to morbidity, mortality, and lost quantity and quality of production. Proper techniques used for necessary invasive techniques such as beak trimming, castration, tail cutting, and dehorning are essential to reduce stress related reductions in performance or increases in morbidity or mortality also save the industries millions of dollars. Biotechnological techniques such as embryo transfer has been used to ameliorate the effects of high temperature on dairy cattle conception rate which can decline to less than 10% in warm months versus the 30 – 50% rate in cooler months which represents significant improvement in profit.

Multi-state research committees have been formed to create cooperative experimental protocols for projects that address critical issues summarized under KA 306. KAs may overlap, as may multi-state research committee projects. Many CRIS reports do not provide the dollars saved or created, yet there is abundant circumstantial evidence that tax dollars are being wisely spent on research within the KA 306 area. Research reported under this KA is wide-ranging, from hatchery management to cattle coat color and presence of shade in the ability of animals to survive temperature extremes. It is clear that research projects are providing financial and animal welfare benefits that far exceed the financial requirement to conduct the research.

Knowledge Area 306: Environmental Stress in Animals' Key Activities

Short-term goals: Increase knowledge of environmental stressors that negatively impact animal production.

Long-term goals: Develop management strategies to monitor and reduce, if not eliminate, environmental stress on production animals.

KA 306: Environmental Stresses in Animals Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Situation: Animal producers are faced with the challenge of understanding, managing, and eliminating environmental stressors because environmental stress on production animals impacts animal health and wellbeing, economic profitability and production efficiency.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	- Provide leadership and coordination - Fiscal management - Partner with stakeholders - Ensure quality relevance and performance - Collect, analyze, and integrate stakeholder input	Research, education and extension output vetted by scientists and educators submitted to CSREES - Research findings disseminated - Publications - Citations - Disclosures - Patents - Best management practices - Curricula Designed - Undergraduate and graduate students graduate - Training provided to producers	**-** Greater understanding of how animals interact with their environment - Enhanced knowledge of animal response to management and husbandry practices - Increased awareness of psychological and physical environmental stressors and indicators of stress - Better information on effect of stressors on animal nutrition, health, performance, and welfare **Example:** Research committee 1173 uses a multidisciplinary evaluation of heat stress in food animals (shade, coat, color, evaporative cooling, ventilation, fans, adrenal function and stress monitoring) (Hatch: 0191233).	- Use of improved stress-outcome prediction models - Application of improved technologies and management systems that reduce potential for environmental stress **Example:** Scientists are using Fuzzy Systems Analysis 9other also use Chaos Theory) in biological systems to better understand heat stress in feedlot cattle by developing models and neural networks models to look at interactions of phenotype, genotype, environment and other factors to predict heat stress. This research has application to other research in other food animal species. (hatch: 0182136)	- Production systems that eliminate stressors - Animals that are not stressed and are able to respond positively to management practices - Improved animal production environment **Example:** Researchers reported the importance of cleaning and disinfecting nursery pens between pig groups when feed is free of sub-clinical levels of antibiotics. Use of spray-dried plasma protein in phase 1 diets is not essential due to compensatory growth in later nursery phases. Removal of this protein from weanling pig diets could save up to 40 cents per weanling pig. (Hatch: 0205886).

Assumptions - Environmental stress in animals is a complex issue requiring coordination, and cooperation among public and private sectors to resolve stress-related problems. External factors will serve as catalysts for science-based change. Information on animal stress as it relates to health, welfare and performance is required for informed decision making.	**External Factors** - Funding, scientific and technologic advancements, changing national priorities, producer and consumer views, economic and market conditions

Knowledge Area 306: Environmental Stress in Animals' Outputs and Outcomes

A photoelectocatalytic device for removing ammonia from water: This small business grant purpose was to develop and commercialize a photoelectrocatalytic oxidizer for removing ammonia from water for aquariums and aquaculture. Studies have demonstrated that ammonia can be converted by photoelectrocatalysis directly into nitrogen gas. These initial studies indicated ammonia is successfully converted to nitrogen gas and released from the water. The work has widespread potential applications in addition to the use in purifying commercial fishery waste waters that thus reduce the stresses on fish raised for human food.

Stress factors of farm animals and their effects on performance (from W1173): Multi-state research project 1173 continues this title, and includes collaborative research between the University of Hawaii and other universities to identify strategies to develop and monitor measures, assess genetic components, and develop management tools for control of stress and improved well-being. Researchers used a multi-disciplinary approach to study the impact of heat stress on depression of milk production, reproductive failure, and death of dairy cattle, with application to all livestock. Heat wave-related loss of production and deaths of 16,000 cows in California in 2006 resulted in over $1B in economic loss. Management alternatives addressed included maintaining normal temperature using a water-cooling model. (*Hatch; CRIS Accession Number 0158220*)

Use of embryo transfer to improve fertility of heat-stressed dairy cows: University of Florida research documented that heat stress is responsible for a large decline in pregnancy rates in dairy cattle throughout Florida and the Caribbean. The pregnancy rate per insemination of lactating dairy cattle can decline to less than 10% in warm months, compared to rates of 30 - 50% in cool months. Embryo transfer can provide a solution to summer infertility in cattle. This research attempts to solve some limitations of embryo transfer using *in vitro*-produced embryos for the practical application of the procedure for dairy farms. (*Special Research Grant, terminated; CRIS Accession number 0200686*)

Relationships among physiological parameters and their critical levels in broiler embryos and chicks across incubation and brooding: Researchers at Mississippi State University will identify critical and predictive performance parameters in broiler embryos and post-hatch chicks from very young hens. Optimizing chick quality, performance, viability, and welfare is vitally important to the broiler (and turkey) industry. A 0.25% improvement in chick mortality may result in over $5M savings in chick costs to the US industry alone. Increased growth from improved performance may result in improved profits totaling over $20M. (*Hatch; CRIS Accession Number 0201942*).

Knowledge Area 307: Animal Production Management Systems

Knowledge Area 307: Animal Production Management Systems' Narrative Introduction

Knowledge Area 307, Animal Production Management Systems, incorporates all of the components of modern animal agricultural knowledge, scientific advances, and production practices acquired throughout the millennia. Fields of science, animal groups, production system infrastructure, and BMPs involved are quite diverse and far-reaching and includes but are not limited to: the total operation cycle and goals of selective breeding and reproduction including broodstock and larval rearing for aquatic animals, birth and lactation in the traditional mammalian models, growing, feeding and finishing, handling, disease prevention, and food safety management of beef cattle, dairy cattle, swine, sheep, goats, poultry, aquatic animals, horses, and exotic animals. Also included, is the production of marketable animal products such as milk, meat, eggs, animal fibers, and biopharmaceuticals, etc.

Biotechnology, though currently not as widespread as in plant productions systems, is currently viewed as absolutely necessary for the global animal food production sector to be able to fulfill future global food needs. As these new technologies develop and become standard practice, much greater attention is being paid to reducing the environmental footprint of animal production systems utilizing these new technologies.

Advances in computer modeling and database management technologies have become an increasingly valuable tool in almost all aspects of animal production agriculture. Linking these new technologies to traditional methods have resulted in hybrid systems that have become cheaper, faster, and more environmentally friendly thereby reducing production and environmental costs and reducing the need for *in vivo* testing.

With these new, rapidly advancing technologies, come new concerns from traditional farming communities in that there may be a significant lag time between discovery and on-farm implementation. Timely and accurate dissemination of new, science-based information is critical for on-farm profitability in the short-term and could have lasting implications for the long-term viability of the industry.

While efficiency of production per unit is still very important to profitability, increased emphasis is being placed on those segments of the production system that impact the environment, quality of food produced, and welfare of the animals. The increase in average size of animal production operations has also had an influence, with greater emphasis being placed on animal comfort and compatibility within the rural communities. Some increases may also be seen in efforts addressing small farms, sustainability, and economically disadvantaged family farms.

Examples of outcomes and impacts of the KA 307, Animal Production Management Systems Portfolio highlighted herein represents but a brief snapshot of projects across a broad portfolio of research, education, and extension projects addressing various topics on animal production agriculture including applied and basic research and education

components related to nearly every phase of animal production. The unifying characteristic of each project highlighted is its role in the overall system of production, including the relationship with other segments of the

Knowledge Area 307: Animal Production Management Systems' Key Activities

- Regions of concentrated animal production are prone to suffer from long-term water quality problems associated with application of manure to land adjacent to the production facilities. The purpose of this project is to improve the ability of growers to manage animal waste by identifying optimal system designs through engineering testing, analysis, modeling and simulation. Particular emphasis will be placed upon design of systems for alternate uses of poultry litter that protect the environment. OBJECTIVES: (1) To monitor, characterize and evaluate existing methods of collection, storage, treatment and utilization of manure from animal production facilities in Arkansas. (2) To design and evaluate new methods of waste management based on new technology and science with criteria of environmental protection, economic feasibility and worker safety. UNIVERSITY OF ARKANSAS (*ACCESSION NO:* 0175815)
- In Arkansas, most calves produced annually are sold in the fall, at market price generally lower than in the spring. Additionally, rising costs of fuel and fertilizer continue to reduce the producer's net profit. This project will evaluate alternative grazing programs, forage production systems, and feeding systems under controlled scientific studies. Data will be utilized to develop an enterprise budget approach that may assist cattle growers in achieving greater profitability. OBJECTIVES: 1. Develop and evaluate forage based production systems for stocker cattle in Arkansas. 2. Develop and evaluate feeding systems for growing weaned calves on byproduct based total mixed diets 3. Provide economic analyses of production systems for growing cattle. UNIVERSITY OF ARKANSAS (ACCESSION NO: 0212279)
- Losses of market-weight pigs during transport from the farm to the packing plant (dead and non-ambulatory animals) represent a substantial economic loss to the U.S. swine industry as well as being a major animal welfare concern. This project investigates the climatic conditions during transportation on typical trailers used for market-weight pigs under the range of weather conditions typically experienced by pigs in the U.S. Understanding the conditions on the trailer experienced by pigs during journeys will allow the development of recommendations on trailer design and management to improve the welfare of pigs and reduce losses during transportation. OBJECTIVES: The overall objective of this project is to provide an understanding of environmental conditions experienced by market-weight pigs during transport from the farm to the packing plant under the range of weather conditions typically experienced in the U.S. This objective will be achieved by addressing the following sub-objectives: i. Equip a trailer of a typical current design with instrumentation for detailed monitoring of the environmental conditions on the trailer. ii. Monitor environmental conditions on the trailer during transportation of market-weight pigs under different weather conditions (spring, summer, fall, and winter). iii. Based on the findings of i and ii

above, develop industry recommendations for the design and management of trailers to optimize conditions during transport and minimize the incidence of transport losses. UNIVERSITY OF ILLINOIS (*ACCESSION NO: 0210671)*

- Evaluate the effect of feeds and feeding practices on water quality in channel catfish ponds. Evaluate the use of algicides to manage water quality in channel catfish production ponds. Evaluate the potential use of polyculture as a biological control measure for noxious phytoplankton blooms. Develop improved methods for harvesting and size-grading pond-raised channel catfish. APPROACH: The management of phytoplankton blooms and water quality will be studied by controlling phytoplankton abundance, phytoplankton community structure, and water quality by modifying the diet or feeding practices to reduce nutrient input, by the use of algicides, or by using planktivorous fishes in polyculture with channel catfish. These studies will be conducted using controlled comparisons in earthen ponds with fish stocked at rates that reflect those used in commercial culture of channel catfish. New approaches to harvesting and grading, including the use of acoustics and electrical fields, will be examined in pilot scale. Technology and approaches that demonstrate potential improvements in fish capture efficiency will be incorporated into commercial-scale equipment and evaluated in controlled comparisons in large research ponds. (Mississippi State University (*ACCESSION NO: 0175649)*

KA 307: Animal Production and Management Systems Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Situation: In a global marketplace, advanced production technologies are needed for the American farmer to compete. Research is needed in two primary areas: 1) addressing the food needs and economic viability of US farms and rural communities; and 2) develop these new technologies while maintaining a healthy environment.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	*What CSREES does:* • Provide Leadership and Coordination • Fiscal Management • Partner with stakeholders • Ensure quality, relevance, and performance • Collect and analyze stakeholder input • Ensures compliance with applicable statutes •Monitors reporting requirements •Network	Products of CSREES funding for Research, Education and Extension vetted by scientists and educators submitted to CSREES • Research findings disseminated • Publications • Citations • Disclosures • Patents • Best management practices • Curricula Designed • Undergraduate and graduate students graduate • Better coordination among partners • New science-based knowledge resulting from federal investment	• Improved understanding of interactions among disciplines and technologies in animal production • Scientific publications; • Patents and licenses • Research methods and technology • Updated course content • Trained professionals • Educational techniques • Teaching/training materials	• Increased adoption of recommended production models • Research methods and technology adopted • Course content improved • Research support staff increased • Highly capable Extension field staff • Production and business enterprise models for demonstration and teaching •Change	• Improved stability and sustainability of animal enterprises • Developmental research advanced • Well trained personnel for research, teaching, Extension positions • Improved quality of research and education • Improved efficiency profitability and quality of products of animal origin

Assumptions - Additional public, state, and local funding and private funding is often available. Cooperation across states and institutions. Political milieu will remain unchanged.	**External Factors** - Regulations, weather, decreased funding, markets, public concerns, changes in public

Knowledge Area 307: Animal Production Management Systems' Outputs and outcomes

Science-based knowledge and education is needed to improve the management of soil, air and water resources by improving nutrient management programs on dairy farms and to enhance the environment. This project examines the effectiveness of the various manure and nutrient management practices and available technologies on dairy farms in order to address nutrient balancing and enhance the environment. OBJECTIVES: The overall objective is to improve farm profitability while minimizing the impact dairy operations have on the environment. The specific objectives for this project are: 1) to provide an overall assessment of five existing on-farm dairy manure treatment systems by a) determining their efficacy in meeting the system's goals and farm needs, b) determining the capital and operating costs and calculating the estimated system total annual costs/benefits and c) quantifying the impact on the farms' nutrient management plan (research); 2) communicate findings to all New York dairy producers while stimulating discussion on how to deal with nutrient excesses (extension); 3) use project findings to determine the best next steps to take to achieve our program's overall goals. During the 10/1/06 to 9/30/07 reporting period the outcomes / impacts were the development of digester performance information from the collected data that was used by the digester owners and also by dairy producers considering anaerobic digestion. Digester owners are able to better understand how effective their digester was at stabilizing manure and converting biogas to electrical energy and heat. This information allowed them to assess the performance of their system and identify opportunities for changes that may result to performance improvements. Likewise, dairy producers considering anaerobic digestion are now better able to use the information to become better educated about anaerobic digestion and in turn make better informed business decisions with respect to determining if anaerobic digestion is right for them and if so what specific technology may be best for their specific needs. Work was also conducted on these farms to assess the impacts of manure solid-liquid separation on nutrient separation and overall whole-farm nutrient balance impacts. We also analyzed the effects of anaerobic digestion on the transformation of organic nitrogen and phosphorous to ammonia nitrogen and ortho phosphorous. Understanding these nutrient form transformations is important at the farm level so producers understand the side effects of anaerobic digestion and implications on their comprehensive nutrient management plan (CNMP) and concentrated animal feeding operation (CAFO) permit. ACCESSION NO: 0209786

Significant baby pig mortality limits profitability in pork production. Many of these cases are due to mastitis in sows. The purpose of this research is to gain a better understanding of the mechanism by which mastitis impedes milk yield, so we can reduce baby pig losses. **O**BJECTIVES: 1. To quantify the changes in total protein, B-casein, lactoferrin and albumen in milk soon after parturition; as well as in response to intramammary treatment with endotoxin. 2. To determine the effects of exogenous oxytocin to increase milk secretion in healthy sows, to affect recovery of sows from mastitis, and to enhance litter performance. 3. To further investigate interactions among lactogenic hormones and inflammatory cytokines on mammary metabolism in vitro. OUTPUTS: The changing concentrations of immunoglobulins, albumen, chloride and caseins in colostrum and milk of sows were characterized and described over the three weeks after parturition.

Furthermore, the acute phase response to intramammary challenge with endotoxin was determined. This included change in serum albumen, immunoglobulin G, Beta-casein, chloride, and tumor necrosis factor-alpha after infusing mammary glands with bacterial endotoxin in order to simulate a spontaneous case of mastitis. Finally, we quantified the effects of this model on milk production by the sow, as well as the growth of the baby pigs nursing inflamed glands. Results show that the effects of mastitis on sow productivity are very significant and probably affect pig performance by increasing the number of days to attain market weight. IMPACT: This research demonstrated previously undefined physiological responses of lactating sows to an intramammary infection, as well as the long tern negative impact of an infection on the growth of the pigs. That information is useful to quantify the value of preventive measures to prevent future mastitis cases, as well as to provide mechanistic information to develop better treatments for mastitis. The swine industry will eventually benefit from this knowledge by having new management tools or strategies. The animals will benefit by improved animal welfare, and the general public will benefit with the knowledge that safe and humane standards are used in pork production. ACCESSION NO: 0198596

Scientists at the University of Arkansas at Pine Bluff conducted research on the many constraints in the culture of channel catfish and how the interactions of many individual constraints interact to affect the profitability of channel catfish farming. The project developed detailed, comprehensive models that attempt to address the complex management issues faced by catfish farmers. The project developed catfish farm models, verified them, and used them to analyze alternative management scenarios, effects of changing policies, and effects of external economic shocks to the profitability of catfish farming. Specific objectives of the project included: 1) develop mathematical programming models of commercial catfish farms; and 2) identify economically optimal management strategies for a range of different farming and marketing objectives. Mathematical programming models were developed based on standard modeling techniques (McCarl and Spreen 1996; Dantzig 1963). The models were built in a successive fashion, adding in additional experimental data in additional sub-matrices to add complexity, new decision variables and new production alternatives. Each model estimated economically optimal management strategies given the set of production alternatives specified. Additional pond studies were conducted throughout the project to fill in critical data gaps as identified in each successive model. Of the stocker alternatives included, stocking a 114-g stocker was the most feasible. Sensitivity analyses suggested that the results were robust to changes in catfish prices, levels of capital, market prices of fingerlings, harvesting cost and feed cost. The results however were sensitive to varying levels of feed conversion ratio, growth rates, and to some extent survival rates of stockers. Stockers were selected as the profit-maximizing alternative only at very high survival rates of stockers. The study showed that stocking 12.7-cm fingerlings into final growout is the optimal production choice. While some farms have experimented with a three-phase system that includes a stocker phase of production, this analysis indicated that multiple-batch production with 12.7-cm understocked fingerlings maximized profits on catfish farms. (ACCESSION NO**:** 0205676)

Knowledge Area 308: Improved Animal Products (Before Harvest)

Knowledge Area 308: Improved Animal Products' (Before Harvest) Narrative Introduction

Research efforts are being made to improve the composition and quality of animal products to reflect consumer preferences. Information is continually needed to determine what animal product qualities are desired by consumers. Efficiency of production is an inherent concern of this and other KAs. In KA 308, efficiency is less of an issue than the emphasis on quality and safety of animal products prior to harvest.

Areas of effort for this program include but are not limited to:

- the study of the physiology and biochemistry of fats, proteins, and flavor components of animal products
- factors responsible for development of flavor and other components of product quality
- the reduction in undesired fat in animal products and improving wool, hides, and other non-food animal products
- determination of consumer preferences and factors influencing product acceptability

Knowledge Area 308: Improved Animal Products' (Before Harvest) Key Activities

The research represented in this portfolio has recently emphasized improvements in product quality, addressed diet/health issues, reduced animal product wastes, and increased the efficiency of producing high-quality animal products. The amount of fat in animal products has decreased dramatically over the past two decades. Products have increased in consumer acceptability and positive linkages have been made to diet and health issues and food safety. Research programs related to food safety, food science, animal health, growth and development, and value-added products also link to and complement efforts related to improving animal products. Provided below are examples of accomplishments:

Nutritional modifications to improve beef and pork quality: University of Arkansas research focused on the effect of various nutrients and management factors on the quality of beef and pork carcasses and quality shelf life of various cuts during storage or retail display. Industry leaders are using magnesium in their late-finisher swine diets to improve pork color, and pork quality shelf-life may be enhanced by 24 to 36 hours by feeding diets supplemented with manganese. (Hatch; CRIS Accession number 0190564).

Lipid metabolism: implications for swine and poultry: Purdue University experiments evaluated the levels and types of fats needed to ensure the firm carcass quality required for bacon trimming, and still allow inclusion of Dried Distillers Grains with Solubles (DDGS) and waste oils or greases in the swine ration. Conjugated Linoleic Acids (CLA) are polyunsaturated fatty acids and make carcass fat firmer. DDGS and waste oils can be

used at 20% of the ration if 1% CLA is used in the diet. An innovative proposed project is to use the coloring agent marigold extract in the ration of table-egg layers to initiate a culling program. If only 5% of 1 million layers are culled prior to molt (or otherwise), 50,000 less hens would mean 5.5 tons feed saved/day or $825/million hen capacity flock/day. Thus the total for the approximately 250M national flock would be $206,250 saved/day (about $75.3M/year). Reduced demand for grain is one benefit with cost savings and increased space per bird being others. (Hatch; CRIS Accession number 0174359).

Pre-harvest management methods to reduce bacterial loads on goat skin and carcass surfaces: Three experiments will be conducted at Fort Valley State University to study the effects of different types of feed type and withdrawal times, combined with spray-washing goats prior to slaughter on skin and carcass microbial loads. They will define an ideal pre-slaughter management method that results in the least bacterial counts on goat carcasses. Identification of sources of contamination will result in the ability to produce a cleaner product from goats due to a lower level of carcass contamination and thus higher quality. (Evans-Allen; CRIS Accession number 0206420).

Effects of pre-slaughter management on safety and quality of muscle foods derived from poultry and rainbow trout (Oncorhynchus mykiss): Lactic acid accumulation in poultry meat at slaughter is a primary determinant of muscle-food properties. Without proper and timely temperature control, poor breast meat quality can occur in turkeys, most notable as a pale, soft, and exudative condition. Researchers at West Virginia University found that stunning method minimally affected processing and fillet attributes of trout but feed withdrawal did affect fillet attributes and is a significant component of animal conditioning prior to harvest. Trout fillet color and composition were not affected by one-week feed withdrawal. These findings will increase consumer acceptance and demand for trout products. (Hatch; CRIS Accession number 0203762).

Effects of genotype and plane of nutrition performance, carcass composition, and meat quality traits of guinea fowl (Numida meleagris): Guinea fowl production has the potential for developing into an important sector of the local poultry industry. However, there is a lack of information regarding the production needs and nutrition of Guinea fowl. Researchers at the University of Puerto Rico will evaluate carcass composition, meat quality characteristics, and the nutritional quality of guinea fowl meat. They will investigate the effects of genotype and plane of nutrition on these characteristics in order to promote production of this increasingly important source of nutrition in Puerto Rico. This research will positively impact acceptance of this food source and stimulate production by small farmers. In turn, their standard of living will be improved as well as the health benefit to consumers. (Special Research Grant; CRIS Accession number 0204272).

KA 308 Improved Animal products (Before Harvest) Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Our animal production industries provide us with meat and meat products, poultry products (meat and eggs), fish, dairy products (milk, cheese, yogurt and ice cream) and non-food products such as fiber (wool, mohair, cashmere and leather). The viability of these industries and their effectiveness in supplying our needs depends upon improving the composition and quality of products and addressing consumer preferences, including flavor, texture, convenience and health benefits of food; and attractiveness, wearability and warmth of fiber products.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	- Provide leadership and coordination - Fiscal management - Partner with stakeholders - Ensure quality relevance and performance - Collect and analyze stakeholder input	Research, education and extension output vetted by scientists and educators submitted to CSREES - Research findings disseminated - Publications - Citations - Disclosures -Patents - Best management practices - Curricula Designed - Undergraduate and graduate students graduate - Training provided to producers	**-** Better understanding of management techniques and technologies to improve products - Scientific publications - Patents and licenses - Research methods and technology - Updated course content - Trained professionals - Educational techniques - Teaching/training materials **Example:** Researchers are developing repeatable and reliable animal models to study dark cutting (cost $ 130-750M/yr) condition in cattle. Exercise did not, but restraint and isolation stress did, elicit condition. Addressing poor pork color (cost $100M/yr). (Hatch: 0190564)	- Producers adopt management models to improve pre-harvest products of animal origin - Research methods and technology adopted - Course content improved - Research support increased - Highly capable Extension field staff **Example:** Scientists compared effect of housing type on egg and meat quality and consumer acceptance of poultry and egg products from pasture production facilities. Productivity measurements evaluated. Rabbit work in progress. Effort to increase communication among producers to simulate adoption. (Evans-Allen 0201726)	- Animal enterprises producing products of maximum health, nutrition and comfort benefit to consumers - Increased research and teaching capability and capacity - Improved quality of research and education - Improved efficiency profitability and quality of products of animal origin **Example:** Cooperative (TX, WY, MT) wool research to develop, evaluate and implement tools and technology to improve quality, marketing efficiency and international competitiveness. Infield use of the techniques for identifying and sorting wool is the goal for these small producers. (Hatch: 0193699)

Assumptions - Additional public, state, and local funding and private funding is often available. Cooperation across states and institutions.	**External Factors** - Regulations, weather, decreased funding, markets, public concerns, consumer preferences

Knowledge Area 308: Improved Animal Products' (Before Harvest) Outputs and outcomes

Multi-state research committees have been formed to create cooperative experimental protocols for projects that address critical issues summarized under KA 308. As noted elsewhere, KAs overlap and, to a degree, so do multi-state research committee projects. Even though most CRIS reports do not provide the dollars saved or created, there is abundant circumstantial evidence that tax dollars are being wisely spent on research within the KA 308 area. Research reported under this KA is wide-ranging, from Guinea fowl management for local markets in Puerto Rico to highly technical predictive models for carcass composition of swine, and modification of milk fatty acid composition in dairy cattle.

Knowledge Areas 311-314: Animal Diseases (311); External Parasites and Pests of Animals (312); Internal Parasites in Animals (313); and Toxic Chemicals, Poisonous Plants and Naturally Occurring Toxins and Other Hazards Affecting Animals (314)

Knowledge Areas 311-314: Animal Diseases (311); External Parasites and Pests of Animals (312); Internal Parasites in Animals (313); and Toxic Chemicals, Poisonous Plants and Naturally Occurring Toxins and Other Hazards Affecting Animals (314) Narrative Introduction

Short-term Goals:

- Increased basic and applied knowledge about pathogens and how they interact with hosts and environments; studies include immunology, physiology, pathology, bacteriology, virology, genetics, epidemiology, and ecology;
- Identification of novel candidate antigens for improved vaccines and diagnostics;
- Identification of innovative candidate therapeutics to decrease dependency on antibiotics;
- Development of publicly available tools/reagents for agricultural species, including immunological reagents;
- Recruit and train: researchers in animal disease research methodologies and techniques; educators to develop curriculum and educate students; and, extension personnel to develop outreach programs for animal health;
- Patents, licenses; publications
- Outreach programs, training materials
- Piloting improved management strategies to reduce the impact of animal disease;
- Better informed policy and decision makers;

Long-term Goals:

- New and/or improved vaccines, treatments, diagnostics
- Improved biosecurity and disease management strategies implemented by producers and veterinarians
- Next generation of research scientists, educators, and extension specialists retained in academic and other institutional settings
- Decreased impact of select high impact animal diseases

Priorities: Focus is on the nature of causative agents involved in high priority animal diseases; mechanisms of disease resistance and immunity; interrelationships among environment, genetics, and infectious agents in the etiology of diseases; strategies for diagnosis, prevention, treatment, control, and eradication of diseases, including development of equipment; evaluation of alternative control methods; understanding mechanisms involved in transmission of diseases to animals, including the role of vectors such as wildlife, insects, ticks, and mites

Public Benefit: The U.S. livestock industry is a multibillion-dollar industry with yearly farm gate receipts of $96.8 billion; animal products account for over half of farm-gate receipts from all agricultural products. Animal disease is the single greatest hindrance to efficient animal production on a global basis. The cost of disease in the animal industries

has been estimated to be as much as 17% of production costs in the developed world, and more than twice this figure in the developing world. **L**osses from livestock disease cost our economy billions of dollars each year. For example, the estimated cost of dairy cattle mastitis alone is estimated at one billion dollars annually due to milk production losses, treatment costs, and early culling of animals. The estimated cost of Porcine Reproductive Respiratory Syndrome (PRRS) virus is estimated annually at more than $600 million. This KA addresses major gaps of knowledge that prevent the US from more effectively controlling, preventing, or treating a myriad of diseases. It supports research, education, and extension activities to manage animal diseases that represent a major hazard to the production of an adequate and wholesome supply of animal products.

Contribution to the Portfolio: This KA is moving in the right direction as evidenced by notable outputs and outcomes, however, CSREES does not have resources to address all the high priority needs for this KA. CSREES continues to coordinate and partner resources with as broad a group of stakeholders and partners to reduce disease threats. For example, the ARS-CSREES animal health team continues to communicate frequently, including monthly coordination meetings hosted alternately at CSREES or ARS. This connection helps the intramural and extramural research components to become more than the sum of its parts. The APHIS-ARS-CSREES Animal Health Executive Committee facilitates close integration among the 3 agencies and also brings in the dimension of education and extension in supporting APHIS' response to stakeholder problems.

KEY ACTIVITIES

(1) Three multi-disciplinary, multi-institutional Animal Biosecurity Coordinated Agricultural Projects (CAPs) were awarded competitive renewals. The Avian Influenza CAP (www.aicap.umd.edu) was awarded an additional $5 million total over 3 years (5/2009 – 4/2012); $4.8 million total for 4 years for the Porcine Reproductive and Respiratory CAP (www.prrs.org) (7/2009- 7/2013); and, $4.8 million total for 4 years for the Johne's Disease CAP (www.jdip.org) (12/2008 – 12/2012).

In addition to cutting edge research, education and outreach activities, each CAP integrates with a wide array of partners/stakeholders and brings together their respective communities for common goals:

(a) For example, the Johne's CAP is leveraging its resources with an additional $500,000 from USDA-APHIS-VS for a vaccine project to identify viable vaccine candidates and evaluate those with the greatest potential for commercial development. The project is in the initial stages of a three step process. **Phase I** – Potential candidates are currently being solicited (Fall 2008). This includes both modified live organisms and subunits. In vitro screening in two laboratories will identify the "Best Candidates." **Phase II** - These "Best Candidates" will next be evaluated using a mouse model. It is anticipated that two laboratories will conduct the infection/protection studies in the mouse. **Phase III** – The "Best Candidates" identified through the mouse studies will then be evaluated using the "Goat model" that the Johne's CAP previously developed as an internationally accepted standard. This will provide data similar to that from cattle,

but the data are available in a much shorter time frame and at a lower cost. The coordinated three-stage evaluation will take approximately three years to complete.

(b) The AICAP initiated joint annual conferences with the six NIH Centers of Excellence for Influenza Research and Surveillance to integrate CSREES and NIH funding for influenza at the investigator level. The 2008 conference was held at St. Jude's Children Research Hospital and the 2009 meeting will be hosted by the University of Minnesota.

(c) The PRRS CAP has initiated efforts to incorporate PRRS into eXtension and they are also developing new educational programs with minority institutions to do a better job reaching small and minority producers. (*NRI Competitive; CRIS Accession Numbers: AICAP 0213465; PRRS CAP 0213946 ; Johne's CAP 0212120)*

(2) Mycobacteriosis is a severe bacterial disease of cultured research, food, ornamental and tropical fishes. A team at Virginia Polytechnic Institute is evaluating the effectiveness of a previously developed DNA vaccine for mycobacteriosis in juvenile striped bass and zebrafish. The vaccine has previously been shown to decrease the progression and severity of this disease in a cultured fish species. It is hoped that additional data in multiple species of fish will help provide data for USDA/APHIS approval of this vaccine. Approval would benefit not only fish, but would also reduce the possibility of humans working with fish and fish products from being exposed to this potential zoonotic infection. *(Animal Health; CRIS Accession Number: 0204169)*

(3) International engagement will be vital to continue to solve many animal health problems:

(a) The University of Pennsylvania's School of Veterinary Medicine is developing an international research and teaching program at the University of Pennsylvania, and setting up a model for training veterinary students in global competence in China (Zhejiang University). The new curricular material will augment the current curricula in US veterinary schools and train future veterinarians in dimensions affecting international trade in animal products and technologies. The collaborative research and training program will be beneficial to faculty and students in US and China (*SERD GRANT; CRIS Accession Number: 0214221).*

(b) The Veterinary College at North Carolina State University is using a multi-disciplinary approach with several institutions in India to evaluate issues faced by the dairy and poultry industries and to then develop cost-effective technologies that optimize production practices while also enhancing health and address the emerging biofuels sector. By engaging stakeholders in North Carolina and India, new avenues of research in these sectors will be identified. US and Indian students and faculty will be better educated through comparison, collaboration and assimilation of best practices. (*SERD GRANT; CRIS Accession Number: 0214188).*

(c) Antibiotic resistance transmission through the food chain is a global food safety and public health challenge. In response, the Ohio State University's College of Veterinary Medicine is building a food safety research and education program with the South China University of Technology. Additionally, an international food safety conference that focuses on antibiotic resistance associated with the food chain will be held in China. A bi-lingual educational TV program on enhancing safe agricultural

practices to combat antibiotic resistance transmission is being developed and will be broadcast in the US and China. (*SERD GRANT; CRIS Accession Number: 0214242).*

OUTPUTS AND OUTCOMES

1. There is a growing shortage of veterinarians to serve rural America. A team at the University of Nebraska and other collaborators has improved the visibility of opportunities for graduating veterinarians in food animal practice across the US. Since 2005, 2,000 veterinary students have been mentored by rural practicing veterinarians. The opportunities for veterinary practice in rural communities have been presented at 26 veterinary student groups and veterinary colleges. CSREES funding also aided the development of the Academy of Rural Veterinarians (ARV), whose sole purpose is to develop mentorship relationships with students to stimulate interest in living and serving rural communities. The ARV currently has 210 members who last year, on average, contributed over $5000 each through direct contributions, dues, lodging and travel for veterinary students interested in investigating opportunities in rural communities (*Critical Issues; CRIS Accession Number: 0205221).*

2. Patent # 6,929,799: D-alanine Biosynthetic Enzymes as Targets for Development of Anti-Mycobacterial Drugs and Vaccines (Inventors: Raul Barletta et al; University of Nebraska, Lincoln). Mycobacteria cause a number of diseases including tuberculosis in humans and animals, as well as Johne's disease in ruminants. The present invention is directed to D-alanine racemase mutants of mycobacterial species. The D-alanine racemase gene (alrA) is involved in the synthesis of D-alanine, a basic component of peptidoglycan that forms the backbone of the bacterial cell wall. The present invention is also directed to methods of making live-attenuated vaccines against pathogenic mycobacteria using such alrA mutants. It also holds promise to use the alrA mutants in methods for screening antimycobacterial agents that are synergistic with peptidoglycan inhibitors. Finally, the product is directed to methods to identify new pathways of D-alanine biosynthesis for use in developing new drugs targeting peptidoglycan biosynthesis in mycobacteria and to identify vaccines useful against pathogenic mycobacteria. (*NRI Competitive; CRIS accession number 0199138 ; and, Animal Health Formula; CRIS accession number 0184662)*

3. During its initial 3 years of funding, the Avian Influenza Coordinated Agricultural Project made significant contributions that support the prevention and control of AI in the U.S. and worldwide.
   → **An equipment disinfection study demonstrated that a combination of <u>both</u> directly applied and indirectly applied thermal fog is the preferred method to inactivate avian influenza virus** on equipment that is used during emergency depopulation and disposal responses. This finding was of direct benefit to the EPA, as well as the Office of Science and Technology Policy (OSTP) Foreign Animal Disease Threats Subcommittee.
   → **Two training programs provided to industry:**
   a. *National Training Program in Depopulation & Disposal Procedures for Catastrophic Poultry*

Disease Events (32 training sessions, 26 poultry producing states, over 1,800 participants;

Canada and Brazil adopted the training – 4 Canadian provinces; 2 Brazilian locations);

b. *AI Biosecurity training for Game Bird Producers*
(12 states, more than 1,250 participants).

→ →**Two new internationally available diagnostics:**

a. FLU DETECT® (Synbiotics) – detects all 16 subtypes of influenza type A virus in 15 minutes from poultry;

b. ProFlok® (Synbiotics) – detects antibody to AI in less than 2 hours from poultry serum.

→ **USDA News Release** when AICAP researcher detected a Low Pathogenic AI H5N1 from wild mallards in Maryland; follow-up surveillance on private land conducted for APHIS.

→ **AICAP contributed expertise to *Train the Trainer Modules: How to prepare for & control HPAI outbreaks*** for domestic & international use (USAID & DHS funding).

→ The H5 gene of AI was inserted into a replication-defective adenovirus serotype 5 vector and **protective immunity was demonstrated** against AI viruses in chickens by single-dose in ovo vaccination.

→ Adaptation studies of a mallard H2N2 virus in quail indicate that **quail could provide an environment in which AI from wild birds can adapt & increase their host range** including to chickens;

→ **In FY 2006, the AICAP received a $1.5 million DOD Congressional supplement to enhance the nation's AI H5N1 wild bird surveillance in the Pacific flyway**.

Surveillance sampling was coordinated with State and Federal partners following the US Interagency Strategic Plan for Asian H5N1 AI in wild migratory birds. Also, the University of California-Davis hosted a Coordination workshop for the Pacific flyway surveillance activities in June 2006 with participation from State, Federal, Local and Academic organizations to help coordinate the multiple partners. (NRI Competitive; *CRIS Accession Number: 0213465)*

4. CSREES released a teaching resource for high school biology students in 2007, "Understanding Avian Influenza". The lesson plan and instructor's guide are available at Ag in the Classroom (www.agclassroom.org).

5. The potential for epidemic livestock diseases and mass mortalities have increased the need for livestock producers and regulators to develop state-wide and national carcass management plans. Traditional methods of carcass management may not be capable of handling large numbers. Best practices need to be developed, evaluated, and shared to prepare for implementation. Bio-security is an integral part of the overall management plan. Extension program staff from Iowa, Maine, and Pennsylvania worked with the USDA and the Cornell Waste Management Institute to co-sponsor the International Carcass Disposal Symposium: Connecting Research, Policy and Response in Beltsville Maryland in December 2006. Twenty-five presenters shared their collective expertise with more than 200 agriculture service providers from 46 states and eight countries. Many regulatory entities are now developing or modifying carcass management regulations in

response to information transferred at the symposium. As an example, Michigan now has state policy that includes using best practices as an option for composting livestock mortalities, where none previously existed. California law, which currently does not allow composting of mammalian tissue, is being challenged based on scientific information disseminated at the Symposium. A best management program has been shared with regulators in Washington, Virginia, Iowa, California, Connecticut, Maine, Massachusetts, New York, and New Hampshire; and the USDA-APHIS has used the information to develop a decision protocol for emergency carcass management. These new regulations have positioned the U.S. livestock industry to better handle routine and catastrophic mortality events through increased awareness of bio-security and the need to protect the food supply. (University of Maine, Smith Lever, POW, 2007)

6. A cost effective on-farm test for determining udder health in ewes would benefit producers. Current on-farm test kits for cattle mastitis (e.g., the California Mastitis Test) costs $12.00/ewe. A University of Nevada study showed that an alternate Somatic Cell Count (SCC) kit, PortaSCC(r), was easy to use, provided excellent results for sheep, and was relatively inexpensive ($1.80/ewe). The 2002 Census of Agriculture, conducted by the USDA, reported that the average herd size for the US was 85 animals per farm. If PortaSCC(r) was used by the average producer, they would save an estimated $867 per round of testing when compared with $12.00/ewe treatments. (University of Nevada, Hatch, POW, 2007)

7. A team at Michigan State University is developing a rapid, low-cost animal side biosensor for detecting cattle persistently infected with bovine viral diarrhea virus (BVDV) and to detect new or emerging infectious diseases in livestock and poultry. Further refinement of the biosensor used to detect BVDV took place in 2007, and a new patent on processes related to manufacturing of the biosensor has been applied for. This research is also the basis of active collaboration between researchers that are expanding the knowledge gleaned from this project in the detection of other important animal and human pathogens, including Mycobacterium paratuberculosis in cattle, and important food pathogens including E.coli and Salmonella. (NRI Competitive; *CRIS Accession Number: 0203607*; Hatch, POW, 2007)

8. A vaccine against brucellosis is needed to ensure that Montana remains a brucellosis free state. A team at Montana State University is developing a subunit vaccine for brucellosis combined with live attenuated vaccines. Once appropriately formulated, it holds promise to provide a cheap and effective brucellosis vaccine for wildlife and cattle. Results of the bison and mouse vaccination studies are encouraging; protective efficacy was obtained in both bison and mouse systems. Protective efficacy was obtained in both animal systems through the identification of a smaller number of effective protein sub-units in the test vaccine. (Special Grant; *CRIS Accession Number: 0215012*)

9. Mild inflammation of the uterus is common in dairy cows, afflicting as many as 50 percent. It has a profoundly detrimental effect on reproduction, and results in increased involuntary culling of cows. Traditional treatment options include antibiotic administration. A group at Cornell University examined the effect of prostaglandin treatment on persistence of inflammation and reproductive outcome. The presence of macrophages in endometrial cytology after completion of involution was very detrimental to subsequent reproduction, and should be considered part of the definition of endometritis. Cows able to mobilize large numbers of neutrophils to the uterus immediately after calving were less likely to have uterine infection or inflammation later in lactation. Early postpartum infections involved E.coli, Streptococcus species and Clostridium species. Although these species were not involved in causing endometritis directly, E. coli infection did predispose to later infection with Arcanobacterium pyogenes and Prevotella melaninogenica, which did mediate uterine inflammation in the late postpartum period. Routine prostaglandin treatment in the postpartum period was confirmed beneficial to multiparous cows, significantly enhancing their first service conception rate, although apparently not reducing the incidence of endometritis. Establishment of the sequence and significance of postpartum uterine infection with specific bacteria now opens the door to strategic intervention to prevent development of later endometritis by preventing infection with early invaders. Determination of defined and substantiated cutoff points for diagnosis of endometritis in endometrial cytology samples provides a common procedure for researchers and practitioners. *(*Animal Health, *CRIS accession number* 0197922)

10. Type 2 porcine circovirus (PCV2) is an emerging swine pathogen. Inactivated vaccines are now available which anecdotally appear to control disease well, however, there is uncertainty whether a new generation of vaccine may become necessary if the virus shifts or mutates in the future. Researchers at the Virginia Polytechnic Institute used chimeric infectious DNA clones to study type 2 porcine circovirus replication and pathogenesis. A chimeric virus between PCV1 and PCV2 was shown to be attenuated and elicited protective immunity against PCV2 infection, thus demonstrating good potential as a candidate for a live vaccine against PCV2. The identification of 2 amino acids in the capsid gene of PCV2 that are responsible for the enhanced viral replication in vitro and attenuation in vivo will help delineate the molecular mechanisms of PCV2 pathogenesis and replication and will also aid in the development of a live-attenuated vaccine in the future. The infectious DNA clones and the chimeric infectious DNA clones approach developed from this project are now being used for follow-up structural and functional studies of PCV2 genes. (NRI Competitive; *CRIS Accession Number: 0199003)*

KA 311: Animal Diseases

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Situation:	*What CSREES invests:* • Financial Resources • Human Capitol • Time • Knowledge and experience • Administrative Infrastructure	*What CSREES does:* • Provide Leadership and Coordination • Fiscal Management • Partner with stakeholders • Ensure quality relevance and performance • Collect and analyze Stakeholder Input	*Who CSREES reaches:* • Scientists • Educators • Industries • Producers • Consumers • Policy makers • Public and Private Institutions and Organizations • Students and trainees	*What the short term results are:* • Increased basic/applied knowledge • Identification of novel candidate antigens for improved vaccines and diagnostics • Development of publicly available tools/reagents • Recruit / train scientists, educators, extension personnel **Example:** 2000 veterinary students mentored by rural practitioners(Critical Issues; 0205221); Live vaccine candidate against PCV2 and infectious DNA clones developed for follow-up structural and functional studies of PCV2 genes. (NRI; 0199003); Candidate subunit vaccine for brucellosis in wildlife and cattle combined with live attenuated vaccines (Special Grant; 0215012)	*What the medium term results are:* • Patents, licenses • Piloting improved management strategies to reduce the impact of animal disease • Graduates trained in animal disease research methodologies and techniques • Better informed policy and decision makers Example: Understanding Avian Influenza teaching resource (CSREES Ag in the Classroom); D-alanine biosynthetic enzymes as targets for development of anti-mycobacterial drugs & vaccines patent (NRI; 0199138; Animal Health Formula); National Training Program in Depopulation & Disposal Procedures for Catastrophic Poultry Disease Events &. AI Biosecurity training for Game Bird Producers (NRI; 0213465)	*That the ultimate results are:* • New / improved vaccines, treatments, diagnostics • Improved biosecurity and disease management strategies implemented by producers and veterinarians • Next generation of research scientists, educators, and extension specialists retained in academic and other institutional settings **Example:** FLU DETECT® (Synbiotics) & ProFlok® (Synbiotics) Diagnostic Kits (NRI; 0213465)

Assumptions -	**External Factors** -

Knowledge Area 312: External Parasites and Pests of Animals

NARRATIVE INTRODUCTION

Short-term Goals

- Increased basic and applied knowledge about pests and external parasites and how they interact with hosts and environments; studies include immunology, physiology, pathology, genetics, epidemiology, and ecology;
- Identification of novel approaches to control and prevention;
- Recruit and train: researchers in external parasitology research methodologies and techniques; educators to develop curriculum and educate students; and, extension personnel to develop outreach programs for external animal parasites;
- Patents, licenses; publications;
- Outreach programs, training materials;
- Piloting improved management strategies to reduce the impact of external parasites;

Long-term Goals

- New and/or improved treatments, preventatives;
- Improved management strategies implemented by producers and veterinarians that reduces impacts from external parasites
- Next generation of research scientists, educators, and extension specialists retained in academic and other institutional settings
- Decreased impact (economic & well-being) of external parasites.

Priorities: Focus is on studies of pests and external parasites, including insects, ticks, mites, and other parasitic arthropods that reduce animal productivity. Studies include research on more cost effective methods of control. Areas include: biology and life history of pests; biosystematics/taxonomy; use and development of irradiation, chemosterilants, attractants, repellents, and other non-insecticidal approaches to insect control; absorption, metabolism, and excretion of insecticides by insects feeding on or in animals; biological control of insects; the nature of insect resistance to chemical controls; evaluation of alternative control methods; development of methods and equipment for applying or using control materials; and integrated control systems.

Public Benefit: External parasites continue to cause negative impacts on the health, production and well-being of agriculturally relevant animal species. For example, the horn fly is one of the most serious and injurious pests of cattle. The irritation and blood loss can reduce weight gain 0.3 to 0.5 lbs. per day and lower milk production in dairy. Horn flies are also suspected of mechanically transmitting anthrax and other diseases within a herd. In Florida alone, losses to the horn fly are estimated to total 40 million dollars per year. Lice infestation causes dermal irritation with resultant scratching, rubbing, and biting of infested areas. A generally unthrifty appearance, rough coat, and lowered production in farm animals are common. In severe infestations, there may be loss of hair and local scarification. Extreme infestation with sucking lice can cause anemia. Ticks transmit a variety of significant infectious agents (e.g., *Theileria* , *Babesia* , *Anaplasma* , and *Cowdria* spp). In addition, ticks can harm their hosts directly by inducing toxicosis (e.g., sweating sickness, tick paralysis caused by salivary fluids containing

toxins), skin wounds susceptible to secondary bacterial infections and screwworm infestations, and anemia and death.

Contribution to the Portfolio: CSREES competitive funding for animal disease is stagnant and if adjusted for inflation, it's funding over the past 4 years has continued to drop. Formula funds are under similar budgetary constraints. Considering the panorama of animal health challenges and available agency funding, the portfolio has the right balance of resources for external parasites.

KEY ACTIVITIES

- The Lone Star tick (LST) (Amblyomma americanum) is a major tick pest of animals (e.g., cattle, deer) and humans. It impacts cattle production and vectors several emerging human pathogens. A team at Oklahoma State University is working to develop the first vaccine for control of the LST. Four key tick protective antigens in the LST previously identified are being characterized by sequence analysis and RT-PCR to confirm their role in tick development stages and selected tissues. Protective gene homologues will also be identified in other Amblyomma species. The four key genes will be tested individually as a vaccine antigen in preliminary vaccine trials in cattle. Based on the results of these trials, a prototype tick vaccine will be tested in cattle which may contain multiple antigens. Development of a vaccine for control of the LST is expected to significantly reduce tick infestations on cattle, thus preventing economic loss. Tick vaccines offer a cost-effective control measure, with the important advantages of reducing environmental contamination and preventing the selection of drug resistant ticks that result from repeated acaricide application. In addition, development of vaccines against the LST may allow inclusion of multiple antigens that could target a broad range of Amblyomma species and key pathogen antigens that collectively would reduce the vector capacity of the LST ticks for A. phagocytophilum, the causative agent of granulocytic ehrlichiosis and also other pathogens that impact human health. *(NRI Competitive; CRIS Accession Number 0212982)*

- Boophilus microplus is responsible for economic losses measured in billions of dollars per year worldwide. Boophilus is a tick vector for two important protozoal pathogens: Babesia spp. and Anaplasma spp.; worldwide, 600 million cattle are exposed to babesiosis and anaplasmosis . Boophilus microplus also occurs often on horses kept with infested cattle and experimentally it can transmit the equine piroplasma Babesia equi. The compounded economic impact of B. microplus infestation and cattle fever prior to the eradication effort in the southern U.S.A. in 1960 was estimated at over one billion dollars annually. Sporadic outbreaks of this tick in southern Texas are occurring and the danger is compounded by the fact that acaricide resistance to all acaricides currently available to control this tick is present in Mexican tick populations, specifically in the neighboring States. As the majority of cattle imports from Mexico consist of live cattle through Texas, the reintroduction of this tick is a ongoing threat to the U.S. economy and food security. In response, a team at Texas A & M is studying novel cell surface receptors in the tick to identify new acaricide lead molecules. It is expected that these studies will also generate important new knowledge on tick physiology, specifically on the role of the neuropeptides kinin and periviscerokinin in ticks. *(NRI Competitive; CRIS*

Accession Number 0212827)

- Ixodes scapularis Salivary protein (Salp) 15 is the first identified inducible antigen from a tick responsible for the immunomodulatory action of tick saliva on acquired immune responses and has been shown to promote the survival of Borrelia burgdorferi in the mammalian host. As a newly characterized protein with a defined action on a specific subset of cells from the immune system, Salp15 holds enormous promise to understand the evolutionary mechanisms developed by tick vectors to sustain in nature, and the intricate array of interactions that occur with both the mammalian host and infectious agents that are transmitted by the arthropods. For that reason, a team at the University of Massachusetts-Amherst is examining the potential use of Salp15 as a vaccine candidate against tick feeding using mice as a model species prior to initiating livestock studies. *(Hatch; CRIS Accession Number 0212514)*

OUTPUTS AND OUTCOMES

- Previously, with NRI Competitive funding, Mississippi State University scientists showed that Trematodes, especially Bulbophorus spp., are associated with heavy mortalities in commercial catfish grown in ponds. The host for the stage infecting catfish is the snail. With Special Grant follow-up support, the group showed that copper sulfate, when administered at .75-1.25 ppm (2.5-5 ppm CuSO4 *5 H20) around pond margins, was an efficacious method in controlling snail populations in commercial catfish ponds. The most efficacious method to monitor the snail populations was collecting snails from vegetation sites in conjunction with PVC pipes, which could detect the presence of snails 95.6% of the time. This project provided the necessary information catfish farmers needed to implement an effective management scheme to control trematode infections in catfish by effectively controlling the snail populations (Planorbella trivolvis) in commercial ponds. *(NRI Competitive; CRIS Accession Number 0191028; Special Grant; CRIS Accession Number 0191809).*

- A team at the University of Arkansas developed a new IPM option to reduce the incidence and severity of problems from buffalo gnats in their region. Buffalo gnats increase cattle production cost through the burning of hay bales to produce smoke, the cost of transporting livestock to safe locations, and the extra labor involved. Prior to implementing this program, livestock producers in one county in southwestern Arkansas lost 42 calves, 2 cows, 12 horses and over $750,000 in productivity. Following implementation, livestock producers along the southwest part of the county did not receive any damage during the year as a result of the successful surveys and treatments of the buffalo gnat control program. The IPM program included one timely pesticide treatment on 42 miles of river to reduce buffalo gnat numbers ($15,000 cost). A second application with a low rate of a larvacide was conducted to control local "Hot Spots" identified though special sampling techniques. (Two 5-mile sections of river were treated, preventing the need of an additional full treatment.) Sampling of the river before and after each treatment, showed a reduction of gnat larvae by 96%. Through timing and river management, in addition to significant savings in animal productivity, less pesticides were used saving $10,000 in reduced pesticide costs from amounts used in

previous years. *(University of Arkansas, Hatch and Smith Lever, POW 2007)*

- Northern fowl mites (Ornithonyssus sylviarum) are the most important external parasite of chickens. Chemical control options for northern fowl mite are rapidly diminishing because of the development of insecticide resistance, the reduction in federally approved materials, and a lack of new product formulation. Researchers at UC-Davis characterized the elements of the immune response to northern fowl mite; the genetic basis for the response, and the impact on the parasite. This new knowledge now lays the groundwork for immunologically-based parasite control, such as vaccines and breeding designs to enhance relevant immune effectors. By exploring the role of host immunity in the regulation of a parasite at the population level, this information will be valuable for understanding the epidemiology and evolution of metazoan parasites. Importantly, these studies show that mite resistance occurs, is linked to the MHC genes, and is multifactorial. Cellular and humoral immune effectors are involved and likely act in concert to reduce mite populations over a period of several weeks. The linkage to MHC haplotype should help encourage the development of mite-resistant hen lines as a novel control strategy. *(NRI Competitive; CRIS Accession Number 0204409)*

University of Arkansas researcher found that the lesser mealworm, house flies and a black garbage fly, Hydrotaea aenescens can serve as mechanical vectors for the spread of pathogens (Campylobacter, Salmonella, E. coli O157:H7 and the protozoan parasite Cocholosoma anatis) on turkey and broiler chicken production farms. This work also highlighted the importance of lesser mealworm and filth fly monitoring on weekly intervals during the poultry production cycles and shows the importance of establishing integrated beetle and filth fly management programs. *(Animal Health Formula; CRIS Accession Number 0182852)*

KA 312: External Parasites and Pests of Animals

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Situation: External parasites continue to cause negative impacts on the health, production and well-being of agriculturally relevant animal species. The goal of KA 312 is to improve the knowledge base to decrease the impact of external parasites on animals relevant to U.S. agriculture.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	*What CSREES does:* • Provide Leadership and Coordination • Fiscal Management • Partner with stakeholders • Ensure quality relevance and performance • Collect and analyze Stakeholder Input	*Who CSREES reaches:* • Scientists • Educators • Industries • Producers • Consumers • Policy makers • Public and Private Institutions and Organizations • Students and trainees	*What the short term results are:* • Increased basic and applied knowledge • Rapid dissemination of results • Recruit scientists, educators, extension personnel **Example:** Northern fowl mite infestation linked to MHC haplotype & host immune response to parasite characterized (NRI; 0204409) Lesser mealworm, house flies and black garbage fly can serve as mechanical vectors for zoonotic poultry pathogens; monitoring programs recommended (Animal Health; 0182852	*What the medium term results are:* • Patents, licenses • Follow-up development • Piloting improved management strategies • Graduates trained Example: Management strategy to control trematode infections in catfish with copper sulfate and snail surveillance (Special Grant;0191809)	*That the ultimate results are:* • New / improved control methods for external parasites • Improved disease management strategies implemented by producers & veterinarians • Trained scientists, educators, extension personnel **Example:** New Integrated Pest Management for buffalo gnat control (Hatch & Smith-Lever; Univ. Arkansas 2007 POW)

Assumptions - External parasites will not be resistant to new control methods.	**External Factors** - New and emerging disease outbreaks (both intentional and unintentional), natural disasters, changes in funding levels, changes in priorities, public perception

Knowledge Area 313: Internal Parasites in Animals (313)

NARRATIVE INTRODUCTION

Short-term Goals

- Increased basic and applied knowledge about internal parasites and how they interact with hosts and environments; studies include immunology, physiology, pathology, genetics, epidemiology, and ecology;
- Identification of novel approaches to control and prevention;
- Recruit and train: researchers in parasitology research methodologies and techniques; educators to develop curriculum and educate students; and, extension personnel to develop outreach programs for internal animal parasites;
- Patents, licenses; publications;
- Outreach programs, training materials;
- Piloting improved management strategies to reduce the impact of internal parasites;

Long-term Goals

- New and/or improved treatments, preventatives that reduce chemical use;
- Improved management strategies implemented by producers and veterinarians that reduces impacts from internal parasites
- Next generation of research scientists, educators, and extension specialists retained in academic and other institutional settings
- Decreased impact (economic & well-being) of internal parasites.

Priorities: Focus is on studies of internal parasites such as various kinds of worms, flukes, and protozoa. Emphasis is on reducing losses, including those due to mortality, reduced yield, condemnation of meat, feed wastage, and cost of drugs. Areas include: biotic relationships in parasitism; biosystematics/taxonomy; biocontrol and management practices that minimize reliance on chemicals; safe chemical means including systems for combating parasites; effective means of diagnosing parasitic infestation; evaluation and development of control methods and equipment; study of heritable traits, breeding, and selection to improve resistance to parasites, and integrated control systems.

Public Benefit: Internal parasites are a problem for all animals of agricultural importance because of the inapparent, unrecognized loss from subclinical parasitism. For example, deworming studies conducted in the U.S. and Canada have demonstrated lactating cows may lose anywhere from 100 to 1,200 pounds of milk per lactation due to internal parasites. Internal parasites are also detrimental to young animals in that they reduce performance and resistance to other diseases. They may also cause disease and death in animals (e.g., H. contortus in sheep and goats; S. vulgaris in horses).

Contribution to the Portfolio: CSREES competitive funding for animal disease is stagnant and when adjusted for inflation, it's funding over the past 4 years has continued to drop. Formula funds are under similar budgetary constraints. Considering the panorama of animal health challenges and available agency funding, the portfolio has the right balance of resources for internal parasites.

KEY ACTIVITIES

- Babesia bovis is a hemoparasite consisting of a complex multistage life cycle which involves mammalian and tick hosts. Interactions between B. bovis and its hosts have not been well studied and thus, no virulent markers are established. As a result, the underlying mechanisms of acquired or attenuated virulence are unknown. A team at Washington State University, through an ARS cooperative agreement, recently sequenced the genome of a virulent B. bovis strain and developed several associated tools including microarrays for expression profiling. The group completed the pyrosequencing of two additional virulent and avirulent strains and have identified extensive differences (deletions, insertions & SNPs) that could contribute to changes in virulence. Researchers at Washington State University and ARS collaborators are now studying possible virulence factors to help understand the molecular basis of host-parasite interactions and to inform developing new vaccines. Genomic differences among virulent and avirulent B. bovis strains will be identified. Indels, SNPs, rearrangements, etc. will be detected by in silico comparisons of each genome. Differences within and between virulent and avirulent genomes will be validated *(Animal Health Formula; CRIS Accession 0214924).*

- Helminthic infections are an enormous burden to public health and global agriculture. There is an urgent need to find unique vulnerabilities in helminths because drug resistance by nematodes is already prevalent in livestock and other animals. Metabolic pathways essential for nutrient acquisition in worms could be exploited as potential drug targets to control helminthic infections. C. elegans, a free-living multicellular nematode, and other medically relevant helminths are natural heme auxotrophs but acquire environmental heme (an iron containing porphyrin) to sustain normal growth and development. Thus, C. elegans may serve as an ideal model system for understanding the mechanisms of heme transport in eukaryotes and permit nutritional modeling for how heme is acquired by parasitic worms. Scientists at the University of Maryland-College Park are using a combination of forward genetic screens, reverse genetic functional RNAi screens, and genomic microarray approaches to identify genes involved in heme homeostasis. Results from these studies promise to provide novel insights into new drug targets for developing anthelmintics to combat worm infestations in livestock. *(Hatch; CRIS Accession 0214658)*

- As the cause of "white-spot" disease in freshwater fish, Ichthyophthirius multifiliis, or Ich, affects a wide range of freshwater fish species and is a major pest within the aquaculture industry in this country and abroad. To develop more effective preventive and treatment options to combat Ich infection, its genome is being sequenced and the genes that encode all its proteins identified by a team at the J.Craig Venter Institute. Because Ich is related to other organisms used as models in basic research, comparing their genomes will also offer much insight into biological processes of wide interest beyond simply Ich. (*NRI Competitive; CRIS Accession 0211573)*

- Cryptosporidium species are protozoans that infect a wide range of hosts, including livestock, wildlife, and humans. In the environment, Cryptosporidium persists as a

resistant oocyst stage. Scientists at Cornell University are working to minimize the impact of swine rearing facilities on the watersheds where these facilities are located by removing or reducing the number of oocysts of Cryptosporidium species in their waste streams. Different types of Cryptosporidium in swine waste lagoons are being identified and characterized. Length of oocyst viability is being determined in waste treatment lagoons to determine the impact of existing treatments on the viability of oocysts that are applied to land. It is believed that because the oocysts of Cryptosporidium are hardier than many other pathogens, they can also be used to monitor how well the processes remove or destroy pathogens in general to protect the environment from infectious agents. (*NRI Competitive; CRIS Accession 0207419)*

OUTPUTS AND OUTCOMES

- The Western Maryland Pasture-Based Meat Goat Performance Test is only one of three pastured-based performance tests for small ruminants in the U.S. and is sanctioned by the American Kiko Goat Association. It is supported by the University of Maryland-Eastern Cooperative Extension. Each year, up to 50 male goats are consigned to the Western Maryland Pasture-Based Meat Goat Performance. While on the test, the goats are evaluated for growth performance, carcass merit, and parasite resistance. The FAMACHA system is used to monitor and control internal parasites in the goats. The top performing goats are sold via private treaty. As a result of the Maryland test, a pasture-based meat goat test was started by Oklahoma State University in 2007. Each year, 35-50 goats complete the test. Consigners have represented 7 states. The FAMACHA system has proven to be an effective method for monitoring and controlling internal parasites in goats. The results of the test are shared at scientific meetings. *(Smith Lever Extension; University of Maryland- Eastern Shore: 2007 POW)*

- Langston University extension specialists conducted parasite workshops at 7 locations in Oklahoma in response to producer requests through their local county extension service. The one day workshops included training on biology and management of parasites, dewormers and dewormer resistance, hands-on evaluation of internal parasite symptoms in live animals, and training producers to do their own fecal egg count. The summer of 2007 was the wettest year on record in Oklahoma, however, many parasite workshop participants reported that they had not lost any goats in contrast to other local goat producers not attending the workshop. Two producers identified dewormer resistance in animals that they bought and were able to take corrective action with no losses. Participation in this program has helped goat producers reduce herd loss from internal parasite infestations. *(1890 Extension Funds; Langston University)*

- Studies at Oregon State University showed that skeletal abnormalities in fish in the Willamette River were due to parasites, and not pollutants, which saved the state millions of dollars in clean up funds. *(Hatch, CRIS Accession 0211328)*

- Toxoplasma gondii is a protozoan parasite that infects humans and most other warm-blooded animals. Humans become infected by ingesting meat containing tissue cysts. There are about 1,500,000 cases of toxoplasmosis in the US each year. Toxoplasmosis is the third leading cause of death due to food borne pathogens in the US. High pressure

processing (HPP) is an emerging technology that has been shown to be an effective non-thermal means of preserving and increasing the safety of a variety of food products. The shelf-life of the products is extended and the sensory features of the food are not or only minimally effected by HPP. A team at Virginia Polytechnic Insitute demonstrated that T. gondii can be eliminated from pork and other products (produce, juice) using HPP. Pressures and exposure times are with in acceptable limits for industrial use. Exposure times are 1 minute or less. Adverse effects on ground pork were not apparent at effective pressures. Additional studies indicate that HPP can inactivate other protozoans in juice (Encephalitozoon cuniculi) or in oysters (Cryptosporidium). *(Animal Health Formula, CRIS Accession 0201949)*

KA 313: Internal Parasites in Animals Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Disease caused by internal parasites of agriculturally important species continues to negatively impact both animal production efficiency and animal welfare in the United States. Of increasing concern, is the alarming rate of development of parasite resistance to currently approved anti-parasitic therapeutics. The goal of KA 313 activities is to control internal parasitic diseases of agriculturally important species	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	*What CSREES does:* • Provide Leadership and Coordination • Fiscal Management • Partner with stakeholders • Ensure quality relevance and performance • Collect and analyze Stakeholder Input	*Who CSREES reaches:* • Scientists • Educators • Industries • Producers • Consumers • Policy makers • Public and Private Institutions and Organizations • Students and trainees	*What the short term results are:* • Greater understanding of parasite physiology, ecology and pathogenesis • Improved models of complex host-parasite interaction • Improved understanding of molecular basis of endoparasitic animal disease **Examples:** 1- Internal parasite control workshops in Oklahoma reduce losses in goats (1890 Extension Funds; Langston University); 2-The state of Oregon saved millions of dollars of clean up funds when fish skeletal deformities shown to be caused by parasites and not pollutants (Hatch; 0211328)	*What the medium term results are:* • Identification of novel candidate epidemiologic, therapeutic and/or animal management strategies to control animal endoparasitism • Trained graduate students in parasitology **Example:** High pressure processing of pork products renders them safe from Toxoplasma gondii (Animal Health; 0201949)	*That the ultimate results are:* • Translational research leading to novel parasite control methods, which in turn enhance animal productivity and well-being • Enhanced national capacity (knowledge base and scientist expertise) to address emerging and evolving parasitic disease challenges. **Example:** Western Maryland Pasture-Based Meat Goat Performance Test improves parasite resistance & production (Smith Lever Extension; UMD-Eastern Shore)

Assumptions - Parasites will not be resistant to new anti-parasitic therapeutics.	**External Factors** - New and emerging disease outbreaks (both intentional and unintentional), natural disasters, changes in funding levels, changes in priorities, public perception

Knowledge Area 314: Toxic Chemicals, Poisonous Plants, and Naturally Occurring Toxins and Other Hazards Affecting Animals

NARRATIVE INTRODUCTION

Short-term Goals: The following priorities reflect short-term goals:

- Determine the specific sites and mechanisms of poisoning, bloat, and other disorders to learn the bases of these phenomena
- Study toxicology and safe levels of residues of pesticides and other chemicals, natural or synthetic, used directly on or ingested by livestock and poultry
- Determine methods of reducing ingestion of pesticides or other chemicals in or on animal feeds
- Investigate reasons for inter-species differences in detoxification mechanisms and sensitivity to poisoning by pesticides and other chemicals
- Develop animal management practices that minimize use of pesticides and otherchemicals that leave toxic residues or that reduce the level of residues
- Develop ways to prevent or alleviate "hardware disease," and effects of plants that cause bloat, poisoning, or deformities of livestock
- Develop methods for combating nuclear radiation hazards to livestock
- Develop methods for reducing animal losses from predators, foreign bodies, and other hazards.

Long-term Goals: Reduction of losses in productivity in livestock, poultry, and fish operations due to toxic chemicals, pesticides, poisonous plants, predators, ingestion of metal and other foreign bodies, and other hazards.

Public benefits: Benefits from this KA are realized through development of new basic and applied knowledge and methods aimed at reducing animal suffering and economic losses caused by harmful intoxications and predation of agricultural animals. The well-being of animals and the reduction of economic losses due to animal disease, whatever the cause, are central to the goals of the animal production and protection portfolio, as well as the overarching research, education and extension missions of CSREES. Given heightened concern about emerging biosecurity threats, particularly agroterrorism, this KA has taken on added relevance to the portfolio in recent years.

KEY ACTIVITIES

- Degradation of agricultural and natural toxins present in livestock feed and forage (Animal Health 1433 grant; Acc #0085372)*:* Investigators are studying enzymes in animal feeds that degrade a large number of foreign compounds. The development of rapid methods for the identification of toxic compounds in feed and forage is essential to ensure the safety of livestock species and protect human health. Objectives include development of rapid biosensors for the detection of pesticides, mycotoxins, bioterrorism agents and other foreign compounds in feeds.
- Vegetation change and risk in management of rangeland plants (Hatch Grant: Acc# 0178541): Locoweed poisoning is a serious problem for animals grazing on rangeland.

Following discovery that endophytic fungi infection of range plants is correlated to levels of the locoweed toxin swainsonine, scientists are performing experiments designed to better understand the relationship between fungal endophytes and swainsonine.

- Genetic variation and molecular toxicology of xenobiotic biotransformation (Animal Health Grant, Acc# 0198161): A large number of environmental and agricultural chemicals are directly bioactivated or detoxified by the `xenobiotic' biotransformation process in animals and humans. Scientists are conducting investigations to improve understanding of the molecular mechanisms that regulate toxin biotransformation capacity, and to develop new profiling methods for better characterizing the respective toxicities associated with chemical exposures in animals and man.

OUTPUTS AND OUTCOMES

- Food Animal Residue Avoidance Databank (Special Grant: Acc #: 0206725): The goal of FARAD is the production of safe foods of animal origin through the prevention and mitigation of violative chemical residues in food animal products. FARAD has continued to operate its telephone hot-line and e-mail access systems throughout the past year. The regional access centers answered over 760 specific inquiries (entailing 1,011 drugs/contaminants) last year along with website hits exceeding 20,000. Based on the efforts of all three centers, two FARAD DIGESTS were published in the Journal of the American Veterinary Medical Association last year. FARAD also provided data tables from its US Approved Animal Drug Database to CABI for inclusion in the 2006 and 2007 editions of the Animal Health and Production Compendium and its new aquaculture compendium.
- Honey bee diseases and pests: improving honey bee health using integrated pest management (Hatch Grant Acc #: 0198404) Honey bees are responsible for the pollination of over 90 fruits and vegetables. Among several integrated pest management approaches studied to control disease in honey bees, scientists have developed a modified electrified bear fence. The fence not only keeps bears out of an apiary but keeps bears who had previously destroyed colonies in that same location from destroying additional colonies. The fence design also eliminates several small mammalian pests - raccoons and skunks - who raid colonies at night and increase colony stress. Some beekeepers have installed the modified electrified bear fence and more are expected to do so as beekeepers discuss with each other the value of reducing mammalian predation on honey bees.
- Zebrafish fin regeneration: a model for dioxin toxicity (Hatch Grant, Acc #: 0198338.) Dioxin and related compounds are persistent environmental contaminates which are known to cause a plethora of effects in diverse vertebrate classes. New tool have been developed to look beyond the simple dioxin receptor activation, and instead focus on the events that are actually involved in producing adverse responses to exposure to persistent environmental contaminants. Scientists envision a completely new way to evaluate the role that the environment exposure to halogenated aromatic hydrocarbons (such as dioxin) plays in numerous diseases of animals and humans.

- **KA 314: Toxic Chemicals, Poisonous Plants and Naturally Occurring Toxins, and Other Hazards Affecting Animals**

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Natural and synthetic toxins, and other environmental hazards, comprise a highly diverse category of environmental exposures that can adversely impact animal health and well-being. Livestock production losses associated with the KA can be locally significant, but overall risk of such exposures to animal agriculture is considered less than that due to exposure to infectious disease agents. Presently, no animal toxicoses are listed among the commodity-specific diseases eligible for NRI funding. Intentional poisoning of feeds and livestock has gained new relevance since 9-11.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	*What CSREES does:* Provide Leadership Coordination Provide Fiscal Management Present with Stakeholders Collect and Analyze Stakeholders Ensure quality, relevance, and performance of funded projects	Research, education and extension output vetted by scientists and educators submitted to CSREES . Research findings . Publications . Citations . Disclosures . Patents . Best management practices . Updated/improved curricula for higher education . Workforce with expertise in veterinary sciences . Updated/improved extension content and training	*What the short term results are:* Greater understanding of basic physio-pharmacology ecology, and pathology of toxins Improved Pharmacokinetic/Parmaco-dynamic models of toxins *in vivo* Improved understanding of the molecular mechanisms of toxicoses. **Example:** Identification of genetic factors dictating capacity of detoxify chemical substances (Animal Health Formula: 0198161)	*What the medium term results are:* Identification of novel candidate epidemiologic, therapeutic and/or animal management strategies to control animal disease due to exposure to toxins and hazards. More trained graduate students in veterinary toxicology **Example:** Beekeepers have come to understand that resistance of mites to miticides is to be expected and sublethal impacts on honey bees. The demand for non-chemical mite control methods has thus increased. (Hatch: 0198404)	*What the ultimate results are:* Translational research leading to novel methods for control of exposure to an Safer food and animal origin, and improved animal welfare results from rigorous translation of scientific data into valid computation of pre-slaughter animal drug withdrawal times that ensure absence of toxic drug residues in animal-derived foods. (Special Grant: 0206725)

Assumptions - Increased understanding of mechanism and agents of animal toxicoses will facilitate efforts to prevent, diagnose and treat diseases caused by toxins in animals.	**External Factors** – New and emerging toxin/hazard exposures (both intentional and unintentional), institutional commitment; amount of volunteer and nonprofit, participation; national initiatives; directions of research; decrease funding; changing priorities; farmers' attitudes; natural disasters; economic conditions; coordination and cooperation with other government entities, public perception

Knowledge Area 315: Animal Welfare, Well-Being, and Protection

NARRATIVE INTRODUCTION

KA 315 represents a formal program area within CSREES which has responded to societal, industry, university, and animal well-being group concerns. Universities led the way in responding to welfare issues through the development of the NCR131 (Animal Behavior and Welfare) multi-state research committee in 1981. In 2006, NCR131 was converted to a full research committee, as NC-1029, Applied Animal Behavior and Welfare. As evidenced by several USDA/CSREES-led or influenced symposia, projects, classes and contests at land grant and other universities, professional organizations, or industry committees, significant progress has been made over the last twenty years in the area of animal welfare.

The purpose of this portion of the portfolio analysis is to provide an overview of animal welfare programming at the state and Federal levels.

Short-term Goal: Improve the knowledge base of consumers, industries, animal activists and scientists regarding animal welfare issues and alternative.

Long-term Goal: Improve the cooperation of personnel having diverse views on animal welfare.

KEY ACTIVITIES

Beef

Texas A&M University is conducting experiments to evaluate the efficacy and humane aspects of proposed European Union (EU) regulations for the transport of livestock. The researchers contend that the EU regulations are not based on research and because they involve frequent unloading and reloading of animals, the duration of the trip is greatly increased and the potential for injury to the animals is also increased due to the loading and unloading process. They are in the process of evaluating several species of animals. (*CRIS Accession 0177289*)

Dairy

Mississippi State University (*CRIS Accessions 0188651; 0190908*) is contributing to the knowledge of heat stress in dairy cows through their evaluation of management strategies (e.g., tunnel ventilated housing) and nutritional options that mitigate the impact of heat stress. They are using hormonal implants to enhance reproductive capacity during heat stress as part of the evaluation of embryo survival during severe heat stress. University of Arkansas researchers *(CRIS Accession 0188042*) are also working in the area of heat stress. They are cooling cows with various methods including fans and mist, and cooler bedding such as sand.

Poultry

Cost effective cooling systems are needed for laying hen houses. An Iowa State University (*CRIS Accession 0167442*) project evaluates two cooling systems (low-pressure sprinkling and high-

pressure fogging) for laying hens and evaluates data on heat and moisture production for modern poultry production systems. They found surface wetting provided a cost-effective and easy-to-implement cooling alternative for heat stress in the Midwestern states.

Swine

As reported in the 2005 review document, the Pork Industry Handbook (PIH) and CD-ROM continues as an important national continuing education effort on all phases of pork production. The PIH continues to be a valuable resource and is used, at least in part, to produce 99% of all hogs in the USA, and as a textbook in over 100 college courses.

Horses
University of Kentucky research (*CRIS Accession 0190817*) on heat stress in other animals is also being conducted with horses. They are using the same telemetry systems to measure core body temperatures as in other animals being evaluated in their experiments.

OUTPUTS AND OUTCOMES

Short-term Impacts:

- Educational opportunities to all stakeholders through symposia, proceedings, networking on committees, and other mechanisms to improve their understanding of a wide range of complex and interacting issues.
- Alternative management, transport, slaughter and processing alternatives that optimize animal welfare.

Long-term Impacts:

- Cooperation between moderate animal advocacy groups, industry and others to improve animal welfare and any regulatory response to animal welfare concerns.

KA 315: Animal Welfare Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
There have been significant changes in the management of food animal production and processing over the last 50 years. Society has insufficient understanding of animal welfare in production practices, requirements of framers, and the impact of chap food demands and global conditions. All of these factors are influenced by how our animals are raised, which is directly tied to the welfare considerations.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	Provide leadership and coordination (e.g., Liaison to multi-state research committees) . Fiscal management . Partner with stakeholders . Ensure quality relevance and performance . Collect and analyze stakeholder input	Research, education and extension output vetted by scientist and educators submitted to CSREES . Research findings . Publications . Citations . Disclosures . Patents . Best management practices . Curricula Designed . Undergraduate and graduate students graduate . Training provided to producers	Increased level of knowledge and understanding of: . Management techniques to improve the animal's welfare . Scientific and trade publications . Research methods and technology . Updated course content . Mechanisms to increase the number of trained personnel in animal welfare . Teaching/training materials, techniques **Example:** Pigs rely on their sense of smell. Researches exposed pigs to biologically relevant odors, pheromones with weaning stress. Progress is being made in neurobiological date collection continues. (NRI Competitive Grant: 0200140)	Adoption management models (e.g., housing) to improve the welfare of animals for food, work or entertainment . Develop strategies & systems to optimize animal welfare and financial returns. Develop improved housing practices. Research support increased, resulting in methods and technology adopted. Enhance animal behavior, welfare, and other course offerings, outreach programs to increase awareness of animal welfare concepts and concerns. **Example:** Dairy cow lameness was evaluated in free stall and loose-house barns. Mgt. (regular hoof maintenance) and housing factors can reduce lameness (Hatch: 2040301)	. Animal enterprises maintained to reduce stress on animals with improved animal welfare . Certification programs accepted and used to benefit animals and farmers for their added costs . Improved quality of research and education Example: Horses can utilize on-board water system equally well when in low, medium or high density in transport trailers. Aggression was influenced more by personality vs. density. Tiger stereotypic behavior due to external stimuli not lack of exercise. Evaluate if unloading counter-productive animal welfare. (Hatch: 0177289)

Assumptions - About how the program will work, the effect of people, the environment and the way we think it will work

External Factors - Institutional l commitment; amount of volunteer and nonprofit participation; national initiatives; direction of research; decrease funding; changing priorities; framers' attitudes; natural disasters; economic conditions; coordination and cooperation with other government entities

Knowledge Areas 721-722: Insects and Other Pests (721); and Zoonotic Diseases and Parasites Affecting Humans (722)

NARRATIVE INTRODUCTION

Short-term Goals: KA -721 short-term goals are reflected in the following priorities:
- Biology of insects, ticks, and mites affecting humans, including those important in forensic studies
- Developing attractants and repellents
- Developing and improving methods of pest control.

Short-term Goals: KA -722 short-term goals are reflected in the following priorities:
- Understanding mechanisms involved in transmission of diseases to humans, including the role of insects, ticks, and mites
- Developing control programs to reduce animal reservoirs of zoonotic agents
- Developing means of preventing transmission of zoonotic diseases and parasites from animals to humans.

Long-term Goals: KA 721 long-term goals include advancing understanding of insects, ticks, mites, and other pests that are an annoyance to humans. The emphasis is on developing safe, effective, and economical ways of controlling these pests.

Long-term Goals: KA 722 long-term goals include work on animal diseases and parasites such as anthrax, encephalitis, leptospirosis, and rabies that pose potential threats to human health. Included are studies on epidemiology, risk assessment, biosecurity, and evaluation of efficacy of control programs for disease vectors.

Public benefits derived from these related KAs are realized through development of new basic and applied knowledge and methods aimed at reducing human annoyance, human disease and suffering, and economic losses caused by arthropod pests, arthropod disease vectors, and other vectors and zoonotic disease agents that threaten human public health. These KA's exclude animal health concerns which are addressed under other KAs and instead focus exclusively on research, education and extension activities that have the ultimate aim of mitigating negative human mental and physical health effects associated with pests, zoonotic disease vectors, and other zoonotic agents.

KEY ACTIVITIES

- Coding of odors in the insect brain: anatomy, physiology and behavior (Hatch Grant: Acc#: 0198922). Insects use odors for a variety of tasks, e.g. to find humans in the dark, in the case of mosquitoes. Using neurophysiological tools to visualize brain activity while insects smell odors, scientists are studying how insects process olfactory information, differentiate between attractive and repulsive odors, and recognize odors. A better understanding of the insect olfactory world will improve insect control strategies.
- House fly behavior and improving ipm in confined animal systems (Other Grants Acc #: 0201062). New techniques exist for assessing such things as fly age, but they have not previously been applied in the field to facilitate fly control. Considering age structure impacts of pesticide

application was shown in this study to be a valuable addition to the prevalent practice of looking only at variation in fly numbers, which is subject to great variation with things such as temperature. Further investigation of these promising findings are underway.

- The genetic and biochemical basis of altered social behavior in the invasive Argentine ant (Linepithema humile) (NRI Grant: Acc # 0200579). Introduction of the Argentine ant (Linepithema humile) to North America has caused a variety of economic, agricultural, and ecological problems. In their introduced range, Argentine ants form massive "supercolonies" that can extend for thousands of kilometers. Scientists have identified chemicals that Argentine ant workers use to distinguish between nestmates and non-nesmates and through testing are finding these chemicals are able to induce aggression among nestmates. The chemicals hold promise for controlling this damaging invasive species by triggering aggression within spatially widespread, normally cooperative supercolonies.

OUTPUTS AND OUTCOMES

- Arthropods affecting human and animal health in Alabama – (Hatch Grant: Acc#: 0199810): A variety of organic materials, including oak leaves, pine straw, hardwood mulch, and composted manure, were found to be attractive to egg-laying female mosquitoes associated with spread of West Nile and Eastern Equine Encephalitis virus. All were found to be similarly attractive for trapping and sampling the Southern House Mosquito (Culex quinquefasciatus) and Asian tiger mosquito (Aedes albopictus), two of the most important species of public-health interest in the southeastern U.S. The data indicate that infusions made from inexpensive and readily available organic materials can be successfully used in gravid traps as an effective sampling device for monitoring local populations of Culex and Aedes species that breed in water-filled containers.
- Defining mosquito vector-vertebrate host relationships of non-indigenous and recently introduced arboviruses in Florida (Special Grant: Acc #**:** 0204491). Florida first experienced West Nile virus related bird deaths and human mortality in 2001. Identification of which species of mosquitoes are capable of transmitting West Nile virus and other arboviruses is essential to guide development of disease control strategies by public health officials. Scientists have discovered West Nile virus in Culex nigripalpus mosquitoes suggesting that this species of mosquitoes may vector West Nile virus to humans and other animals. This information provides mosquito control districts with data that will help them better predict when to spray for mosquitoes such as Culex nigripalpus to prevent the spread of the virus.
- Genetic structure in populations of Solenopsis daguerrei, a natural enemy and potential biological control agent of the red imported fire ant (NRI Grant: Acc# 0207615). The Red Imported Fire Ant, *Solenopsis invicta*, is the dominant insect in the many areas that it infests, having serious impacts on humans, agriculture, and the natural environment in the US. Because *S. invicta* is an introduced pest, it is a good candidate for biological control. Through genetic analyses of host-parasite relationships, significant genetic compatibility correlations have been found providing strong evidence that efforts to utilize the natural enemy, *S. daguerrei,* for the biological control of *S. invicta* in the U.S.A should focus on *S. daguerrei* variants collected from *S. invicta* hosts in either northern Argentina or southern Brazil.
- Biology, ecology, behavior and methods of control of the formosan subterranean termite (Hatch Grant: Acc# 0198450). The Formosan subterrenean termite is an invasive species that is the most destructive pest in Louisiana and other southern states costing homeowners $500,000,000 a year in Louisiana alone. Critical to the development of new, safe and efficacious control strategies is a

better understanding of the colony dynamics, foraging behavior and population regulation. Several important findings from research on Formosan subterranean termite biology, behavior and methods of control in 2007 have been disseminated through newspaper articles (Wall Street Journal, Times Picayune, Advocate, Associated Press articles); News stations (WAFB Channel 9); LSU AgCenter website articles, bulletins and video displays made for marketing to local TV stations; oral presentations to Planter's Club, several local Kiwanis Clubs, Louisiana Pest Management Association meetings, USDA/ARS technical committee meeting reports, Entomological Society of America National Meeting presentations; and written presentations in 9 refereed journal articles and 3 non-refereed articles. One patent disclosure resulted in a provisional application (60/922,886)

- Tick-borne disease prevention (Special Grant: Acc# 0203967). The high incidence of tick-borne disease, including Lyme disease, in the northeastern US results from intense peridomestic human exposure to blacklegged ticks. This project developed a model framework and a communication tool for a comprehensive tick-borne disease prevention action plan. Tick-bite protection outreach programming was delivered at 16 venues statewide to more than 1,000 citizens. The University of Rhode Island's Tick Encounter Resource Center's (TERC) interactive tick-bite protection and disease prevention website was launched. This information delivery and decision support tool had more than 40,000 visitors in the first year of operation. The site also was used to collect survey data, to begin to understand people's behaviors and activities related to tick-bite protection. Nearly 300 surveys were submitted and stored in a database, and data currently are being analyzed and interpreted. Surveillance indicated striking deer tick increases (200-850% over 2006) at several locations on the eastern side of Narragansett Bay. Press releases and additional awareness programs were delivered to alert residents of Newport County about their increasing tick-borne disease risk

KA 721: Insects and Other Pests and
KA 722: Zoonotic Diseases and Parasites Affecting Humans Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
The goal of KAs 721 and 722 is to control insects, pests, and parasites, and their ability to transmit zoonotic diseases, and to decrease incidence of zoonotic diseases. Insects, pests, parasites, and zoonotic diseases greatly impact the social, environmental, and economic health, well-being, and quality of life of rural residents and communities. In view of high-profile threats form terrorism and other high-consequence emerging and resurging diseases. It is important tot be prepared to respond effectively to invasive pests, zoonotic diseases, and parasites both with in and outside the U.S.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	What CSREES does: Provide Leadership and Coordination Provide Fiscal Management Partner with Stakeholders Collect and Analyze Stakeholder Input Ensure quality, relevance, and performance of funded projects	Research, education and extension output vetted by scientists and educators submitted to CSREES . Research findings . Publications . Citations . Disclosures . Patents . Best management practices . Updated/improved curricula for higher education . Workforce with expertise in these KAs . Updated/improved extension content and training	*What the short term results are:* Train students in essential skills needed in public health, parasitology, pathology, pest management, or forensic science. Basic and applied research to underpin development of new vaccines, diagnostic tests, and pest management tools & techniques. **Example:** Ingestion of blood is a requirement of mosquitoes to initiate egg development. Scientists have now discovered the molecular mechanism underlying nutritional regulation of egg development (Hatch: 0199135)	*What the medium term results are:* Development of diagnostics, vaccines Patients and licenses for new products. Extension & education curricula to effectively disseminate findings of significant discoveries and new technologies that will mitigate the effects of these pests, zoonotic diseases, and parasites. **Example:** Genetic analyses of host-parasite relationships reveal which genetic variant of the Red Imported Fire Ant will be more efficacious bio-control agent (NRI Grant: 0207615)	*What the ultimate results are:* New policies in the rural areas adopted as a result of changes in learning or heightened awareness about severity of these pests, diseases and parasites to quality of life. **Example:** The Louisiana arbovirus surveillance program provides an ongoing early warning system for detection of West Nile virus. St. Louis encephalitis in mosquitoes, in sentinel wild birds and chickens. The program also provides ongoing data and educational outreach to public health officials (Animal Health: 0194417)

Assumptions – Research, education, and extension on the management, transmission, biology, physiology and genetics of insects, pests, parasites, and zoonotic disease affecting humans provide science-based technology, products, and information for informed decisions.	**External Factors** – New and emerging disease outbreaks (both intentional and unintentional), natural disasters, changes in funding levels, changes in priorities, public perception, public acceptance of advancements in pest management.

National Animal Health Laboratory Network (NAHLN)

NARRATIVE INTRODUCTION

Protecting animal agriculture is vital to food security in the United States. Animal diseases cause significant economic losses to the animal agriculture sector. The intentional or unintentional introduction of a foreign pathogen, pest or toxin into the livestock population could dramatically increase these losses by causing high levels of animal morbidity and mortality, or through the impact on quality, marketability, and confidence in American food animal commodities. In addition, the intentional introduction of a transmissible zoonotic disease (*e.g.*, anthrax) could have significant public health consequences.

In 2002, the U.S. Department of Agriculture partnered with State and University members of the American Association of Veterinary Laboratory Diagnosticians (AAVLD) to create the National Animal Health Laboratory Network (NAHLN) (Figure 1). The specific purpose of this Network is to provide nationwide early detection, response, and recovery activities for significant foreign and domestic animal diseases. The broader purpose is to develop a cohesive State and Federal animal disease laboratory network that provides improved service to animal agriculture and the American public. The NAHLN was established with an initial group of 12 laboratories, through the cooperative effort of two USDA agencies, the Cooperative State Research, Education and Extension Service (CSREES) and the Animal and Plant Health Inspection Service (APHIS), in partnership with the AAVLD laboratories. This network establishes a link between the considerable animal disease diagnostic expertise of the two national APHIS-Veterinary Services laboratories and the expertise, capabilities, and extensive infrastructure of State and University animal disease diagnostic laboratories across the U.S., including AAVLD accredited laboratories. Many of these laboratories are located within Colleges of Veterinary Medicine, which provide additional diagnostic expertise. In addition, the presence of these laboratories within veterinary colleges in land-grant universities provides for collaboration with existing extension resources that will provide educational support to inform veterinarians, producers and the general public about the potential for animal disease agents being introduced and their role in alerting appropriate agencies.

The NAHLN has an overall objective to rapidly and accurately detect and report animal and zoonotic pathogens of national interest. By providing funding and leadership to Land Grant University and State diagnostic laboratories involved with the NAHLN, the Animal Health and Protection program helps strengthen and provide coordination for the improvement of animal disease diagnostic systems of the United States. This serves agricultural producers by speeding detection of disease incidents, potentially preventing the types of widespread euthanasia that were recently forced upon European nations as a result of BSE and Foot and Mouth Disease outbreaks. Additionally, endemic animal disease detection services that are more commonly requested by producers are also improved as a positive by-product of this program.

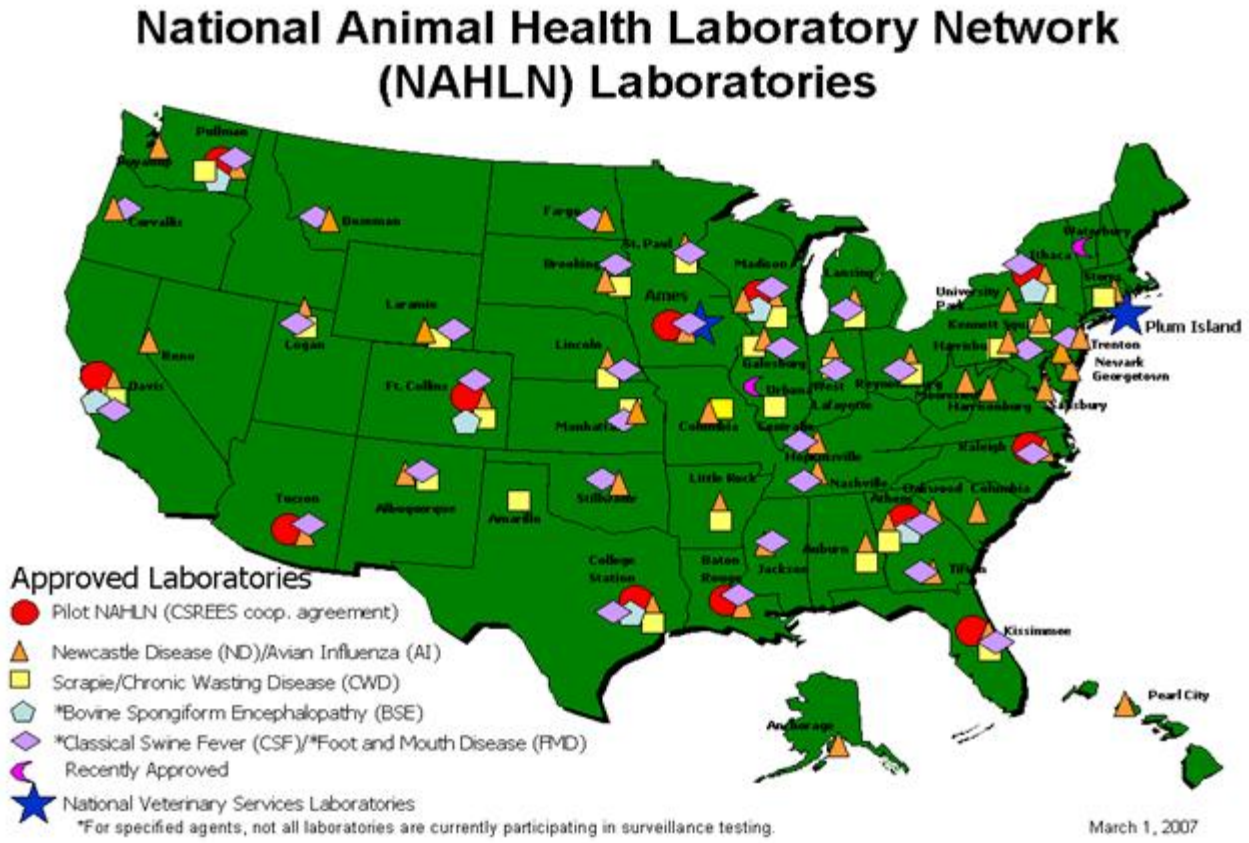


Figure 1: NAHLN map

The NAHLN is part of a national strategy to coordinate and network Federal laboratory capacity with the expertise, extensive infrastructure, and support of State and University laboratories to better respond to animal health emergencies, including bioterrorist events, newly emerging diseases and foreign animal disease (FAD) agents that threaten the Nation's food supply and public health. CSREES support and leadership of the network contributes to increased geographically-distributed diagnostic capabilities by:

- Providing programmatic leadership to help determine the strategic plan, policies, recommendations, and overall operational plans of the Network, and the research and extension activities of the individual NAHLN laboratories through Cooperative Agreements;
- Providing support for the training of laboratory personnel to improve diagnostic and other service capabilities, and support for the expansion of standardized rapid and sensitive diagnostic capabilities;
- Providing support to the increase of the nation's biosafety level (BSL)-3 capacity, the assurance of quality standards and proficiency testing, and improving communications to share data between laboratories; and
- Providing support for personnel in order to help make possible the APHIS-funded surveillance testing for Foot and Mouth Disease, Classical Swine Fever, Exotic Newcastle Disease, Highly Pathogenic Avian Influenza, BSE, and Chronic Wasting Disease nationwide.

Inter-agency Coordination

- CSREES works closely with APHIS-Veterinary Services (APHIS-VS) to develop the Network laboratories, most with biosecurity level 3 (BSL-3) capabilities;
- CSREES cooperatively manages the Network with APHIS-VS-National Veterinary Services Laboratory (APHIS-VS-NVSL).
- APHIS-VS provides operational testing and deployment of diagnostic tests originally developed by ARS and the land grant system.
- State and University NAHLN laboratories provide a geographically distributed set of secure and competent testing facilities that dramatically increase surge capacity in the event of an animal agro-terrorism incident, as well as serve as a resource for non-network laboratories.

The NAHLN program assumes that certain foreign animal disease outbreaks have the potential to both undermine the confidence in the domestic food supply held by American and foreign consumers and cause economic losses to American producers. It further assumes that rapid detection of such outbreaks can help contain them and limit the damage to animal and public health, and consumer confidence. One measure that fosters early detection is surveillance testing programs that include a large sample of geographically distributed livestock. For this to occur in an economical manner, a geographically distributed set of laboratories must be capable, available, and have the capacity to perform these tests in an efficient manner with prescribed diagnostic tools. The NAHLN laboratories perform the testing for this type of active surveillance using tools prescribed by USDA-VS-APHIS. In addition to active surveillance, the NAHLN laboratories also perform passive surveillance as producers and veterinarians bring suspect livestock into the laboratories at their own volition. It is assumed that this passive surveillance compliments active surveillance efforts, potentially bringing about faster identification of animal health threats. The increased civic capacity added by the NAHLN, in an effort to prevent widespread animal disease outbreaks that threaten food supply confidence and economic loss, is the ultimate outcome of the program.

Investment

CSREES' Food and Agriculture Defense Initiative (FADI) provides funding and support for leadership for homeland security-related stakeholder outreach activities through the National Animal Health Laboratory Network (NAHLN), National Plant Diagnostic Network (NPDN), and the Extension Disaster Education Network (EDEN). Ultimately, the networks increase the land grant university system's ability to help protect the nation's agricultural resources by: 1) identifying, containing, and minimizing disease and pest threats through early detection and 2) helping the cooperative extension system effectively respond to national emergencies. CSREES personnel have provided leadership for the NAHLN since its inception, including service on the NAHLN Steering Committee. The agency has provided funding in the following amounts to each of these NAHLN laboratories in FY 2002 through FY 2008 (figures in **TABLES NAHLN-A** and **NAHLN-B** represent thousands of dollars):

TABLE NAHLN-A: CSREES NAHLN Funding (in thousands) for original core laboratories

FISCAL YEAR	NY	WI	NC	GA	FL	LA	IA	TX	CO	AZ	WA	CA
2002-2003	750	1950	750	1950	750	1950	750	750	1950	750	750	1950
2004	309	309	309	309	309	309	309	309	309	309	309	309
2005	301	301	301	301	301	301	301	301	301	301	301	301
2006	300	300	300	300	300	300	300	300	300	300	300	300
2007	300	300	300	300	300	300	300	300	300	300	300	300
2008	298	298	298	298	298	298	298	298	298	298	298	298
TOTAL	**2258**	**3458**	**2258**	**3458**	**2258**	**3458**	**2258**	**2258**	**3458**	**2258**	**2258**	**3458**

TABLE NAHLN-B: CSREES NAHLN Funding (in thousands) for additional laboratories

FISCAL YEAR	UT	TN	OR	KY	KS	MS	OH	MI	SD	MN	WY	PA	NM	NE	NJ	IN
2005	30	30	30	30	30	30	30	30	30	30	30	30	30	0	0	0
2006	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
2007	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
2008	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
TOTAL	**180**	**180**	**180**	**180**	**180**	**180**	**180**	**180**	**180**	**180**	**180**	**180**	**180**	**150**	**150**	**150**

These laboratories have successfully leveraged these funds through budget and personnel increases funded by their own or cooperating institutions.

KEY ACTIVITIES

The following are activities that the NAHLN is pursuing to enhance its capabilities:

- Standardized data/sample management system: bar-coding, sample tracking, data capture, information security and validation systems;
- Data interpretation and integration systems, and automated event triggers;
- Accelerated development of control technologies for high consequence pathogens;
- Deployment of existing and development of next generation animal disease diagnostic tools;
- Information on preventing incursions of disease from wildlife into the national herd;

Epidemiology/ecology models of disease agents

OUTPUTS AND OUTCOMES

CSREES-supported NAHLN laboratories, through assay development and training activities, have increased the national surveillance capacity for foot and mouth disease, classical swine fever, exotic newcastle disease, low and high pathogenic avian influenza, bovine spongiform encephalopathy, chronic wasting disease, and scrapie.

Between FY 2002 and FY 2008 the NAHLN grew from 12 CSREES-supported laboratories to 28 CSREES-supported and an increasing number of unsupported laboratories that provide fee-for-service testing for APHIS-VS. The NAHLN is poised to continue its expansion during the next few years by expanding the number of pathogens and toxins assayed, adding testing technologies, and increasing test volume capacity per laboratory. It will also increase the effort to utilize diagnostic data for epidemiological purposes. The result will be continued expansion and improvement of the United States' capacity to detect and respond to foreign, emerging, and bioterrorist animal disease emergencies.

Full implementation of the NAHLN as originally envisaged will require additional CSREES funding for diagnostic assay development and validation, laboratory personnel training for standardized diagnosis of specific animal pathogens, facilities improvement, and additional equipment, as well as annual allocations for the maintenance and long-term sustainability of the network.

National Animal Health Laboratory Network (NAHLN) Logic Model

Note: The following activities and outcomes are examples of accomplishments made in KAs 311-314

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
The intentional or unintentional introduction of a foreign pathogen, pest of toxin into the livestock population could increase agricultural economic losses by causing animal deaths, or through the impact on quality, marketability, and confidence in American meat. The National Animal Health Laboratory Network's (NAHLN) primary objective is to establish a functional national network of existing diagnostic laboratories to increase diagnostic capabilities for animal diseases of national interest, particularly those pathogens that have the potential to be intentionally introduced through agro-terrorism	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	Related to Research, Extension, Education: **Animal Disease Surveillance:** USDA led by APHIS expanded its testing for bovine spongiform encephalopathy with the help of NAHLN.	Research, education and extension output vetted by scientists and educators submitted to CSREES • Research findings disseminated • Publications • Citations • Disclosures • Patents • Best management practices • Curricula Designed • Undergraduate and graduate students graduate • Training provided to producers	Increased knowledge and understanding of animals by participating a surveillance testing program and testing between 12, 000 and 15,000 animals annually	Increased the surveillance capacity of the veterinary diagnostic system for Foot & Mouth Disease, Classical Swine Fever, Exotic Newcastle Disease & Highly Pathogenic Avian Influenza.	• Robust sector economics • Food security • Reduced loss

Assumptions - About how the program will work, the effect of people, the environment and the way we think it will work	**External Factors** - Institutional commitment; amount of volunteer and nonprofit participation; national initiatives; direction of research; decrease funding; changing priorities; farmers' attitudes; natural disasters; economic conditions; coordination and cooperation with other government entities

Extension Disaster Education Network (EDEN)

NARRATIVE INTRODUCTION

CSREES supports the Extension Disaster Education Network's (EDEN's) agricultural bio-security programming; which increases civic capacity to prepare for, prevent, respond to, mitigate, and recover from agricultural bio-security events in the United States. Such bio-security events include those that could be brought about by bio-terrorism, unintentional human action, or natural causes. EDEN is a leader among departmentally supported programs that pursue the information and human capital development objectives outlined in Homeland Security Presidential Directive #9. It does so through the pursuit of three main goals:

1) EDEN promotes inclusive, community based, agricultural bio-security planning and program implementation that utilizes the best cross-disciplinary and contemporary science base available.
2) EDEN promotes individual farm, agribusiness, and rural community resiliency planning, with a particular focus on agricultural bio-security, utilizing the best cross-disciplinary and contemporary science base available.
3) EDEN develops, assembles, and promotes the highest quality educational and reference resources; which enables the science base and outreach power of the land grant university system to be brought to bear on agricultural bio-security preparation, prevention, response, mitigation, and recovery.

Investments

Food and Agricultural Defense Initiative (FADI) funds have provided a small amount of funding for EDEN to complement the mission of the National Plant Diagnostic Network (NPDN) and the National Animal Health Laboratory Network (NAHLN). This FADI support has allowed producers and other stakeholders to utilize agricultural bio-security educational and reference resources that were developed, made available, and/or promoted through the EDEN.

In 2002, as part of a supplemental appropriation, the Extension Disaster Education Network received $600,000 to strengthen its ability to assist with agrosecurity issues. In 2004, the Extension Disaster Education Network received an allocation of $230,000. In 2005, the Extension Disaster Education Network received an allocation of $250,000. In 2006, the Extension Disaster Education Network received an allocation of $280,000. Additionally, FY 2006 supplemental funds were provided for the initial EDEN Regional Animal Agro-security conferences ($90,000) and the development of the EDEN Animal Biosecurity & Emergency Management Course ($56,000). In 2007, The Extension Disaster Education Network received an allocation of $300,000 and the agency continued to support the EDEN Regional Animal Agro-security conferences.

Additionally, state Extension Disaster Education Network delegates are supported by Smith Lever 3(d) funds at various levels.

Seven CSREES national program leaders provide leadership for EDEN activities. Joe Wysocki (main contact) Dennis Kopp, Kitty Cardwell provide leadership for non-animal related programs. Bill Hoffman, Mark Robinson, and Gary Sherman provide leadership for animal agro-security related programs. Jan Singleton provides leadership for food defense issues.

Program Shifts

Funding to date has enabled regional pilot projects that bring together federal government, state government, local government, non-governmental organizations, and academia to plan and articulate the roles of various agricultural bio-security players. Future activities in this arena are needed that go beyond mission support for the plant and animal laboratory diagnostic networks.

Future activities will work to build upon previous small scale pilot projects and multiply the effectiveness of the cooperative extension system. Additional funding dedicated to these activities has the potential to:

- More aggressively promote individual farm, agribusiness, and community resiliency planning; with a particular focus on agricultural bio-security. Without such aggressive promotion, only a minority of stakeholders undertake a thorough and introspective planning process.
- Provide agricultural extension personnel the guidance and science-based tools they need to be an active and valued asset in county and state emergency management planning; which will bring much needed agricultural bio-security expertise to this process. Heretofore much of this county and state planning has almost exclusively focused on non-agricultural first responders (fire, police, ambulance, hospitals, etc.).
- Sponsor regionally based agricultural bio-security planning activities that assemble disparate stakeholders from all levels of government, industry, and academia. Pilot EDEN regional activities have successfully broken down some parochial organizational barriers and fostered inter-organizational cooperation. However, these efforts need to occur on a nationwide basis and such cooperation requires some maintenance.
- Sponsor agricultural bio-security preparedness and response exercises that include government, industry, and academia.
- Develop, make available and update, an expanding portfolio of science based agricultural bio-security resources. New resources on post-harvest bio-security, state and county bio-security emergency planning, producer psychological affects following a bio-security event, post-quarantine farm financial survival plan templates, and other timely resources must be developed to meet the agricultural bio-security challenges faced by the farm-to-fork continuum.

These program shifts are well aligned with the future needs expressed in the 2008 Food and Agricultural Sector Annual Report on Critical Infrastructure Protection, which is developed under the supervision of the Agriculture Homeland Security Sector Coordinating Council, USDA, DHS, and FDA. An excerpt of the statement of future needs mentions EDEN by name: " The Extension Disaster Education Network (EDEN) needs to be enhanced by developing and then making available and updating an expanding portfolio of science-based agricultural bio-security resources. New resources on post-harvest bio-security, State and county bio-security emergency planning, psychological effects among producers following a bio-security event, post-quarantine farm financial survival plan templates, and other topics must be developed to meet the agricultural bio-security challenges across the farm-to-fork continuum."

KEY ACTIVITIES

The EDEN helps provides disaster preparation, prevention, response, and recovery over 1 million times per year. This is measured not as mere “hits” to a website but sustained web visits, requests for information, and delivery of courses. The majority of this use is satisfied by a web-based library of disaster education

resources at: www.eden.lsu.edu. A few of the EDEN developed animal protection resources available at the EDEN website include:

- EDEN Foot & Mouth Disease Issue Page: http://www.eden.lsu.edu/Issues_View.aspx?IssueID=5F3B1EFB-D295-4D8E-9CAB-8E3BBA3C3824
- EDEN Avian Influenza Issue Page: http://www.eden.lsu.edu/Issues_View.aspx?IssueID=A59E222E-12A4-4964-AC7C-42E9E01F846A
- EDEN BSE Issue page: http://www.eden.lsu.edu/Issues_View.aspx?IssueID=3d9f5165-6e27-4eaa-aa8c-87717aff5f6e
- EDEN Classical Swine Fever Issue Page: http://www.eden.lsu.edu/Issues_View.aspx?IssueID=1deafc64-404c-4d2d-a2b6-2f6863b713c0
- EDEN Agrosecurity Issue Page: http://www.eden.lsu.edu/Issues_View.aspx?IssueID=12400a02-24d9-46bc-93ef-5a6d7685e431
- EDEN Animal Biosecurity & Emergency Management Course: http://www.eden.lsu.edu/LearningOps/AnimalAgrosecurity/default.aspx

In addition to EDEN developed content, EDEN serves as an information clearinghouse for animal agrosecurity and other disaster information. A sampling of the resources developed by others that are available from the EDEN resource catalog (http://www.eden.lsu.edu/Resource_Search.aspx) includes:

- University of Minnesota: Pricing and use of drought-stressed and immature corn as silage for beef cattle
- Clemson University: Animal Emergencies
- North Dakota State University: Protecting Livestock From Heat
- Purdue University: Producing Emergency or Supplemental Forage for Livestock
- Colorado State University: Caring for Livestock After Disasters

This type of central clearinghouse makes it possible for states to utilize and/or adapt disaster resources from other states. A common example is Oregon, a non tornado prone state, could utilize Oklahoma's cattle related tornado recovery resources if necessary. This prevents Oregon from reinventing a resource that is already available. In FY 2006, over 15 requests for resources went out over the EDEN list serve from states that had a disaster but no relevant educational resources. Most of these requests were satisfied during the same business day.

With support from the USDA-CSREES, EDEN offered six regional animal agrosecurity conferences during 2007 and 2008. The goal of these regional conferences was to understand the role of Extension, and other stakeholders in an animal agrosecurity event. These conferences enabled attendees to: 1) Discuss and define the roles of Extension as well as other agencies/organizations and 2) Improve interagency communication within the region. On the first day of each conference, each represented agency had the opportunity to speak on their understood role during an animal agrosecurity event.

With multiple players from the local, state, and national/federal levels present at the conferences, the individual roles and the opportunities to collaborate at all levels and all phases were present in most presentations. As Extension's ability and capacity was more clearly defined, other collaborators agreed that

Extension would, indeed, play a critical role. For example, the typical report that Extension has with local producers, identifies the local educator/agent as the logical first contact in a response effort. All conferences agreed there is a need for additional, more consistent, and higher quality training for Extension professionals. Many regions took the opportunity to identify who, within each state's Extension system, would play an active role in an animal agrosecurity incident, but lack the necessary training. In addition, key administrative personnel attended, which (1) allowed them to see the importance of Extension's role; and (2) begin the necessary discussion regarding expectations of their Extnesion staff, as well as the educators' diverse abilities at the county level.

Statistics from each of the six conferences are listed below:

Six Regional Conferences at a Glance...

Region	Dates	Location	Host	# in Attendance	# of St
Northeast	3/27-28/07	Grantville, PA	Dave Filson (Penn State Univ.)	65	10
Southwest	4/3-4/07	Las Cruces, NM	Bill Dictson (NMSU)	225	10
Southeast	1/8-10/08	Clemson, SC	Howard van Dijk (Clemson)	130	12
Western	5/21-22/08	Denver, CO	Tom McBride (Colorado State Univ.)	143	10
North Central	6/4-6/08	Fargo, ND	Charlie Stoltenow (NDSU)	200	16 (+4
Midwest	10/7-8/08	St. Louis, MO	Conne Burnham (Univ. of Missouri)	88	12

Selected post conference progress includes:

- Northeast – EDEN contacts in several of the participating states continue to collaborate in agrosecurity education. At least four multi-institutional grants have been awarded to EDEN participants (each with an emphasis on agrosecurity for producers).
- Southwest – Interagency projects were initiated in many of the states that attended. Extension has taken a much more active role in emergency management issues largely due to discussions that took place at this conference. At least four states are actively involved in agrosecurity planning.
- Southeast – Extension places a greater importance on biosecurity and terrorism concerns, and local educators/agents are using conference information to educate producers. In addition, livestock and poultry Veterinarians continue to reference the materials from the EDEN conference as they continue preparing the livestock and poultry industry for an FAD incident.
- North Central – In a 90-day post-conference survey of all participants, 86% of participants had used information received at the conference at the conference and 52% had changed or enhanced their animal agrosecurity-related activities. Feedback from the participants of this conference titled "Beyond Borders" include the following quotes:
    - "(It) was a comprehensive conference that highlights various aspects of animal agrosecurity, why we should care and what we can do about it." Animal Agrosecurity Consultant;
    - "The information from the conference has served as a building block for the development of educational programs in Manitoba." The Manitoba Agriculture, Food and Rural Initiatives (MAFRI);
    - "We've used the information from Beyond Borders In development and updating of the Ani mal Health Annex of the

State Emergency Operations Plan." The North Dakota Department of Emergency Services; and

- "We have strengthened our commitment to communicate information regarding foreign anim al diseases." South Dakota State University Extension Service.

The EDEN is also an eXtension pioneer community of practice. A focus area of a 2008 content launch was animal agro-security, particularly avian influenza.

EDEN established a Agrosecurity Committee to work on agriculture response issues in July 2007. One of our projects is called Strengthening Communities though Agriculture Planning (SCAP), which will develop a model approach for Extension to use with counties to assist them develop an agriculture annex to their response plan. Too many counties in the US are silent relative to agriculture response even though their economy depends on agriculture.

New Mexico State University and the University of Kentucky are co leading a development team from Texas, Montana, Tennessee, Nebraska, Colorado, South Carolina, and Utah. The team has been working on this project for several months and the model will be piloted early in 2008. The participating states and schedule for these pilot sessions is as follows: New Mexico (Jan 13-15 in Las Cruces); Michigan (Feb 24-26 in Kalamazoo); Tri State (Mar 1-3 in Chattanooga); Vermont (Mar 10-12 in Burlington); Nebraska (Mar 29-30 in Alliance); Utah (TBA); South Dakota (TBA); and Pennsylvania (TBA).

OUTPUTS AND OUTCOMES

While it is difficult to measure the impact of increased civic capacity, an animal agriculture disaster provides an opportunity for the demonstration of that capacity. One such disaster occurred early in 2007, which drew upon planning and preparation investments from FY 2006.

The Extension Disaster Education Network (EDEN) has made it possible for local educators to immediately re-tool and be re-tasked to provide an educational response and recovery assistance in the wake of Hurricane Ike, Gustav, and spring floods in the Midwest. Responders and the affected public have relied on State and county Cooperative Extension Services as a trusted source of locally appropriate information.

In cooperation with federal and state government officials, statewide and county extension professionals are serving in the following capacities in 2008 utilizing FY 2007 and 2008 funds:

- Assessing crop and livestock damage to support USDA County Emergency Boards;
- Providing the public with information and education regarding State evacuation, sheltering, and animal care plans;
- Addressing agricultural producer and local jurisdiction needs regarding animal care and feeding on farms and ranches following the storm, as well as proper carcass disposal methods;
- Printing and distribution of recovery educational materials for homeowners and agricultural producers; and
- Providing local leadership for long term community recovery efforts.

The help provided in this regard by Texas A&M, Louisiana State University, the University of Missouri, University of Illinois, and Purdue University cannot be overstated.

Extension Disaster Education Network Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
HSPD #9 calls for human capital and national capability for the prevention, preparation, response and recovery associated with agrosecurity incidents.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	*What CSREES does:* • Provide leadership and coordination • Fiscal • Management • Partner with • Stakeholders • Collect and Analyze Stakeholder Input • Ensure quality, relevance, and performance of funded projects	•Extension information provided to over 1 million recipients includes: • Web based resources developed on animal agrosecurity • Sharable state based resources made available through a clearinghouse • Local, state & regional live courses	Increased appreciation for the importance of disaster preparedness. Improved knowledge of where to find information when disaster strikes. Improved knowledge for all disaster phases	Farms and communities plan for animal agrosecurity disasters. Science based information is utilized in animal agrosecurity preparedness, prevention, response, and recovery. Existing resources are used or adapted to avoid effort duplication.	Increased civic capacity for animal agrosecurity preparedness, prevention, response and recovery. Decreased impact of disasters through education and improved practice. (see Colorado example)

Assumptions - **1)** Animal agrosecurity is and will remain an administration priority.	**External Factors** - 1) Federal, state and local funding for EDEN and related efforts will remain flat, increase, or decrease across federal, state, and industry sources; 2) Other players will increase or decrease their interaction with State Cooperative Extension Services, making them more or less effective.

Section IV External Panel Recommendations

A Brief Summary of the PREP Report with the Panel's Specific Portfolio Recommendations:

Until 2007, the Animal Production and Animal Protection portfolios were reviewed as separate portfolios of work by separate review panels and processes. In 2004 and 2005 panels comprised of independent experts from the field were convened to assess and score the current state of the Animal Production and Animal Protection Portfolios, respectively. The external reviews conducted in 2004 found that the Animal Production portfolio was outstanding with regard to its work and accomplishments. The panel noted that the Animal Production portfolio has dedicated NPLs who are involved with stakeholders and who collaborate with other agencies. The two major deficiencies found in the Animal Production portfolio were (1) a lack of integration among mission areas and (2) a lack of measurable outcomes and impacts, especially with regard to extension and technology transfer.
In the 2005 PREP review, the Animal Protection portfolio was found to be an extremely important part of the U.S. agriculture system with creative and well-respected NPLs leading the programs. The Coordinated Agriculture Programs were identified as strength in that the programs bring together states, agencies and industry in coordinated, integrated, and focused research, education, and extension efforts. The quality of outputs of relevant portfolio projects was found to be excellent. The panel found significant productivity in the Animal Protection portfolio despite relatively limited funding. A discussion of specific panel comments and recommendations related to each of the dimensions of the three Office of Management and Budget (OMB) research and development criteria used (relevance, quality, and performance) is provided below. Responses are provided sequentially by year for overall panel comments and recommendations.

RELEVANCE

Overall Comment: A lack of integration across mission areas of the agency and within animal production program areas was identified by PREPs as a major deficiency that reduces the strength of our work. The review teams for both the animal production and animal protection portfolio reviews recommended that a strategic plan with performance indicators be developed for the combined portfolios and that plan be linked to performance tracking and evaluation of these portfolios.

2008 Response
Based on the 2008 Farm Bill, CSREES will be reorganized into the National Institute for Food and Agriculture (NIFA) by October 1, 2009. The Animal Systems strategic plan is being reevaluated in light of new guidance provided in the Farm Bill, including the creation of six new REEO Divisions in the Office of the Undersecretary. Among the six REEO Divisions is Animal Health, Production and Products. CSREES Animal Systems staff has also begun coordination activities with the Division Chief of Animal Health, Production and Products to participate in the draft of a USDA blueprint for animal health, production and products.

2007 Response
To address this deficiency and the readily apparent lack of integration across animal protection and animal production activities, the two portfolios were united under the umbrella of a comprehensive new single Animal Systems portfolio. As one of the first endeavors of the fully integrated Animal Systems

team, an initial draft strategic plan for Animal Systems was developed. The restructuring and the development of a draft strategic plan are responsive to panel comments related to across-agency issues and to those specific to animal programs regarding integration, balance, and accountability.

2006 Response
The portfolio review process reinforced the need and value for strategic alignment of programs with broader goals and objectives of the department and the agency to address critical national needs. The Animal Systems team agreed that strategic planning is a key element of effective operations and management. The program leadership of the Animal Systems team took formal responsibility for strategic planning, which was identified as a priority activity, and initiated steps to develop an Animal Systems Roadmap that would serve as both a strategic plan as well as a performance plan. The agency's strategic plan, as well as portfolio reviews, served as overarching guidance for the Animal Systems strategic plan. During 2006, the Animal Systems team contributed to the revision of the agency's strategic plan, preparing for development of the Animal Systems plan.

Scope
The scopes of both animal production and protection portfolios were judged to be very good and generally good in 2004 and 2005, respectively. The panel suggested enumeration of the value of the industry, the potential value of working on a problem and the value of a successful implementation of the knowledge generated by a CSREES-funded effort. They recommended that CSREES make investments that provide an insurance policy for American agriculture and the American public.

2008 Response
Portfolio scope remained very good in 2007. Logic models are now required for all integrated proposals submitted to the former NRI and the new AFRI (Agriculture and Food Research Initiative). The use of logic models enables an easier identification of outcomes and their economic impacts.

2007 Response
The Animal Systems team and our land-grant partners are now utilizing logic-model concepts to a greater degree to better plan and align investments with desired outcomes and impacts. In addition, the Animal Systems team is proactively working across the REE mission area to address and coordinate mission-area activities in the rapidly emerging areas of animal-related agriculture (e.g., bioenergy, genomics) by taking on lead roles in interagency and departmental working groups and task forces. The Animal Systems team retained the previous score for Scope at 3.

2006 Response
The portfolio's coverage of work with the available funds remained exceptional. The scope and relevance were maintained at the highest level during 2005.

Focus
The focus of the animal production and protection portfolios was evaluated by the PREPs to be in line with their scope, relevant, and timely.

2008 Response
Considering the available pool of resources, focus remained in line with reasonable scope, relevance, and timeliness.

2007 Response
While the need to focus on priority issues in the National Research Initiative is recognized, the portfolios continue to work to maintain scientific knowledge across a number of areas to maintain capacity. The Animal Systems team retained the previous score for Focus at 3.

2006 Response
The Animal Systems team worked to focus National Research Initiative priorities to maintain appropriate scope. The portfolio demonstrated a continued focus on issues, topics and critical needs of the nation.

Contemporary and/or Emerging Issues

The PREPs stated that the Animal Production and Animal Protection teams demonstrated good ability to address emerging issues, notably with genetics and genomics. They cited Animal ID and animal welfare issues as areas that deserve attention in the future.

2008 Response
The portfolio further enhanced its ability to respond to contemporary and/or emerging issues through competitive programs. For example, the FY 08 NRI Animal Protection and Biosecurity Program continued announcing a priority for "Emerging/ Re-emerging Diseases" to allow submission for areas that were not listed on the more limited species-specific high priorities. Animal Well-Being also continued to be listed prominently as one of three elements of that program. The NRI Animal Genome Program priorities are fully aligned with the USDA's Animal Genome Blueprint; this Program also announced a new priority for "Whole Genome Enabled Animal Selection". This new priority solicited proposals to bring together a multi-institutional and multi-disciplinary team(s) to integrate genomic discoveries and technologies with breeding practice and accelerate identification of traits of interest directly useful to animal breeders.

2007 Response
The Animal Systems team continues to address emerging issues by working with and involving other agencies. An example of a major multi-agency effort is the publication of the USDA's Blueprint for Animal Genomics, which lays the foundation for the Department's research, education, and extension work in this area and provides plans to address issues likely to emerge over the next decade. Similarly, the Animal Systems team has led CSREES work in partnership with APHIS to develop a new webbased resource for the National Animal Identification System. Finally, the Animal Systems team has been a leader during the past year to address the emerging field of bioenergy production and its impacts on animal agriculture by coordinating closely with ARS counterparts and other agencies in reviewing the state of science, conveying our work to industry leaders, and participating in the development of future plans. The Animal Systems team retained the previous score for Emerging Issues at 3.

2006 Response
The portfolio continued to identify contemporary and/or emerging issues that are consistent and relevant to the portfolio and its mission.

Integration

Integration is solid in overall coverage, but it is apparent that researchers and extension personnel are not communicating as well as they should be. The panel reviewing Animal Protection felt that integration is an area that required significant attention. Integration among the three parts of USDA is weak and completed efforts lack proper documentation. The panel recommended serious efforts to bring the appropriate parties together to develop a new working paradigm that structures how CSREES operates internally. This new paradigm would then be rolled out to Land-Grant partners.

2008 Response
CSREES Animal Systems staff is coordinating agency activities with the REEO Division Chief of Animal Health, Production and Products and will provide input into the draft of a USDA Blueprint for Animal Health, Production and Products. All three Animal Biosecurity Coordinated Agricultural Projects (CAPs) include strong linkages between researcher and extension personnel. For example, during the 2008 Johne's CAP annual meeting in Michigan, a special one day session was held for extension veterinarians to provide access and training on the most up to date knowledge needed for effective control programs. The NAHLN is being restructured to enhance integration even further. To further help integrated research, education, and extension across the entire portfolio, the Animal Systems unit created a new position for a National Program Leader for Animal Production Systems and successfully recruited Dr. Adele Turzillo.

2007 Response
In addition to the agency-wide responses to integration issues, the Animal Production and Animal Protection teams followed up with the agency's Office of Planning and Accountability on the notion that the portfolios, as defined, created an inherent lack of integration, especially as regards performance reporting. A mutual decision was made to combine the portfolios (as described above under "Overall Comment"), which has resulted in improved integration of knowledge-area planning and performance as well as integration of education, extension, and research activities. In addition, this move is anticipated to improve transparency of integration across program and mission areas during the review and reporting process.

Progress has been made in 2007 integrating research, education, and extension efforts in several distinct areas led by the Animal Systems team: (1) the National Animal Identification System, (2) the National Animal Health Laboratory Network, (3) the Extension Disaster Education Network, and (4) eXtension's dairy and beef modules. The Animal Systems team led CSREES work with the joint CSREES/APHIS development of a new web-based resource for extension educators (Extension-NAIS Resource Center), which was rolled out in 2007 to provide access to latest tools to help inform local 12 livestock and poultry producers about the National Animal Identification System. The National Animal Health Laboratory Network provides nationwide early detection, response, and recovery activities for significant foreign and domestic animal diseases with the broad objective to develop a cohesive state and federal animal disease laboratory network that provides improved service to animal agriculture and the American public. The Extension Disaster Education Network has initiated pilot projects that bring together federal and state government, non-governmental organizations, and academe to plan and articulate the roles of various agricultural bio-security players. Similarly, CSREES NPLs contributed to the development of eXtension's focused web sites that bring together results of research, expertise of the land-grant system, and educational materials, delivering it to those in the field who need it. The DAIReXNET was launched in 2007 and the beef web site is scheduled to launch in 2008.

The Animal Systems team retained the previous score for Integration at 2.

2006 Response
The Animal Systems team moved forward in terms of program integration by aligning goals and objectives for each knowledge area within the Animal Systems portfolios with goals and objectives in the broader agency strategic plan. The team continued to move toward a systems-based approach to program planning, delivery, and performance tracking. Significant progress continued in integrating the competitive grants portfolio with other programs by building a strong team across units (Competitive Programs and Plant and Animal Systems). The team continued to focus on integration of programs in terms of biological systems as well as commodity/species based production systems.

The Animal Systems team recognized that Planning and Accountability had defined portfolios based on the aggregation of knowledge areas used for tracking projects and expenditures. Use of these knowledge areas in reporting performance across program areas does result in biases from a review and assessment perspective. Programs and projects are actually more integrated across knowledge areas.

Multidisciplinary Balance

This topic refers to disciplinary balance, not multidisciplinary balance. On the positive side, NPLs and KAs make a real effort to work with other organizations. Some areas had reports and papers documenting their leadership in communications with states, professional societies, etc., intended to effectively bring the federal programs forward. We wish to see NPLs take more risks, think outside the box, and encourage non-traditional approaches. Examples of where this is occurring include genomics, animal identification, and air quality.

2008 Response
NPLs continue to find creative ways to enhance CSREES programs by thinking outside the box even with diminishing resources. For example, CSREES entered into a partnership with the NSF and the DHS to launch the new $16 million NIMBioS (National Initiative for Mathematical and Biological Synthesis) at the University of Tennessee- Knoxville. IBM and ESRI are two industry partners. CSREES is not contributing funding to NIMBioS, but is an equal partner with NSF and DHS as a member of the steering committee overseeing this Initiative, including the selection of focus areas. The issue of feral swine and their potential role in dissemination of Foreign Animal Diseases is the first working group to be established and many others will follow. The Critical Issues Program responded rapidly when Porcine High Fever Disease (PHFD) appeared in parts of Asia and the threat level to the US swine industry was unknown. A request for proposals was announced in May 2008 and following competitive peer review an award was made in the Fall to study the etiology and molecular pathogenesis of PHFD. NPLs also co-organized a workshop with NOAA to address the urgent need for alternative feeds for the aquaculture industry in light of the increased feed costs to the industry.

2007 Response
The Animal Systems team continues to work innovatively in genomics, animal identification, and air quality, animal welfare, and bioethics. The Animal Systems team gave Multidisciplinary Balance a score of 3, which is the same as the previous Animal Protection score and an increase from the previous Animal Production score of 2. Several activities relating to animal welfare and bioethics, including

major national symposia at professional society meetings, reflect significant advances in the ability of NPLs to work with other organizations to bring multi-disciplinary expertise together to address hard-hitting and contentious issues.

2006 Response
The portfolio continues to demonstrate a multidisciplinary balance in solving scientific problems. NPLs will continue to challenge the stakeholders for innovative and futuristic approaches in research, education and extension mission areas. A continued interaction with stakeholders through multi-state meetings, professional societies, and other federal partners will be maintained and improved.

QUALITY

Overall Comment: The quality of the animal production portfolio was varied and quality of the animal protection portfolio was good. In both portfolios, PREPs noted that outcome data were insufficient and there is a need to be able to measure outcomes.

Significance of Findings

Outcomes need to be measured, the results packaged in a consumable way and then they need to be promulgated so that they inform and promote CSREES efforts.

2008 Response
The new POW continues to be developed with pilot presentations for NPLs slated for early 2009. NPLs now have an enhanced Leadership Dashboard on their computers that compiles in one location large amounts of award data related to their responsibilities. Information is provided in a user friendly and visually appealing manner. The Leadership Dashboard enables NPLs to more easily track project outcomes.

2007 Response
With regard to measurements of outcomes/impacts, the new POW reporting system is anticipated to improve our abilities in this area. With regard to packaging results in a consumable way, NPLs have been innovative in utilizing materials drafted as highlights for the agency's web pages and for the Animal Systems Annual Performance Review report, compiling and distributing these key results and impacts of funded research, education, and extension activities in brochures and other informational materials. The Animal Systems team gave Significance of Findings a score of 2.5 which reflects, on average, no change in the previous Animal Protection score of 3 and the previous Animal Production score of 2.

2006 Response
The portfolio continues to demonstrate the generation of significant findings and outputs from its stakeholders. Efforts to improve reporting, especially in extension and education-related outputs, will be enhanced.

Stakeholder/Constituent Inputs
The PREPs commended the animal production and protection teams for working with stakeholders, noting FAIR (1995 and 2002). Recommendations were made to have a clear definition of the term

"stakeholder" in the self-review document and to take a more systematic approach to the methods and timing of connecting with stakeholders.

2008 Response
The second joint ARS/CSREES National Aquaculture Program Planning Stakeholder workshop was held in 2008 for planning the direction of the USDA intramural (ARS) and extramural (CSREES) national research, education and extension programs in the aquaculture areas. The development and conduct of this stakeholder meeting involved close collaborations of the two agencies to plan a useful program for interaction with a diverse set of stakeholders. This was the first joint workshop that also addressed education and extension needs, in addition to those for research. The ARS/APHIS/CSREES Animal Health Executive Committee continued to meet quarterly to coordinate activities. A two day APHIS Research Priorities Animal Health Conference sponsored by ARS, APHIS and CSREES was held in March 2008 for program staff from all 3 agencies to update, prioritize, and plan future research that directly supports Animal and Plant Health Inspection Service (APHIS) regulatory programs and develop research plans that are responsive to the needs of animal agriculture and our stakeholders. The outcome of the meeting led to the formation of teams for various diseases and topics composed of ARS, APHIS and CSREES land-grant investigators whose first task was to update the knowledge gaps impeding solutions for their areas. This was the first integration of land-grant partners into this type of research planning.

2007 Response
In April 2006, the Animal Systems team embarked on the first-ever joint ARS/SCREES National Animal Production Program Planning Stakeholder workshop for planning the direction of the USDA intramural (ARS) and extramural (CSREES) national research programs in the animal production and well-being areas. The development and conduct of this stakeholder meeting involved close collaborations of the two agencies to plan a useful program for interaction with a diverse set of stakeholders. In addition, a new web-based stakeholder comment form was launched for animal health, removing the inherent biases, financial constraints and challenges associated with obtaining stakeholder input through large, structured, one-time meetings. The Animal Systems team gave Stakeholder/Constituent Inputs a score of 3, which is an increase from the previous Animal Protection score of 2.5 and retains the previous Animal Production score of 3.

2006 Response
The portfolio continued to demonstrate high-quality stakeholder/constituent input for all three mission areas. An example of continued stakeholder input through ARS and CSREES partnership include a USDA Domestic Animal Genomics Workshop. The Animal Systems team clearly recognized the importance of enhanced integration of the CSREES and ARS programs in Animal Production and Protection. CSREES and ARS jointly sponsored two major national stakeholder workshops for animal production and protection since the portfolio reviews were conducted. These workshops are part of the ARS 5-year performance planning and management cycle, and are now part of the CSREES performance planning cycle. These joint workshops will greatly enhance the integration of ARS and CSREES programs consistent with the needs of diverse stakeholders. These workshops help to ensure the relevancy of major research programs of both agencies. Linked to other performance planning and tracking efforts of the Animal Systems team, these efforts should enhance the quality and performance of programs within both portfolios. Stakeholders have been supportive of these workshops and the fact that CSREES and ARS are engaged in joint program planning and stakeholder interaction.

Alignment with Current State of Science

The CSREES really has direct control only over non-formula funds. The NRI has shifted its areas of emphasis over the years and is in alignment with current and emerging issues within animal agriculture. Given the time period and resources available the PREP felt there was good alignment between work in animal protection that preceded the review period and work accomplished during the review period.

2008 Response
Alignment with the current state of science remains strong based on a review of supported projects.

2007 Response
The portfolio continues to demonstrate alignment with current state of science. With the newly integrated single Animal Systems portfolio, there will be greater opportunities to ensure alignment and to make appropriate adjustments as necessary. The Animal Systems team retained the previous score for Alignment with Current State of Science at 3.

2006 Response
The portfolio continues to demonstrate alignment with current state of science-based knowledge and previous work to the strategic plan of the agency.

Appropriate and/or Cutting Edge Methodology

The methodology shown for research in animal production and animal protection was found to be generally appropriate; however, concerns were expressed about voids in extension and education methods. In addition, the panel felt that the animal protection peer review process must be visible, transparent, and applied wherever possible. Highly advanced, cutting-edge methods may not always 15 be required to answer some important issues. The key to this evaluation question is appropriate methods. Overall, the current system was judged to be good, but there is a concern about the limiting nature of funds spent only on certain diseases. There is no way of knowing when the next important disease will emerge and therefore there is a need to educate a pool of experts on many diseases not just certain diseases.

2008 Response
Methodologies remain appropriate, in some cases being highly advanced and cutting-edge and in other situations that require less sophistication there are simpler methodologies employed.

2007 Response
The Animal Systems team recognized that methodologies must be appropriate for the scenario. Peer review processes that are visible and transparent have been adopted by NPLs responsible for administering formal and ad hoc competitive grants programs (e.g., critical issues, rangeland research). Awards are made on the basis of scientific merit, quality, and priority. With the competitive processes in place for these two programs, the quality of research funded has improved and the education and extension components desired in projects are better clarified. The Animal Systems programs seek not only cutting edge methodologies, but also practical application of the knowledge, which is now conveyed through RFAs. The Animal Systems team gave Appropriate and/or Cutting Edge

Methodology a score of 3, which is the same as the previous Animal Protection score and an increase from the previous Animal Production score of 2.

2006 Response
The portfolio continued to provide leadership to stakeholders in utilizing and adopting cutting edge methodologies. For example, a number of food science/food safety distance education courses (including one about food science and the law) were developed at North Carolina State University. Purdue and Michigan State Universities have several distance education classes and a real time distance education class on animal welfare.

PERFORMANCE
Overall Comment: Both portfolio review reports indicated a need to improve performance tracking and accountability documentation for the two portfolios.

Portfolio Productivity
The PREP viewed performance of the animal production team as mixed, with some KAs providing better evidence than others. Productivity in terms of research measures, such as scientific papers, is strong. However, productivity in terms of technology transfer is poor and must be improved. If technology transfer and other extension activities are taking place there needs to be a system to report this productivity. The PREP was complimentary of the performance of the animal protection team and noted that there needs to be an effective and appropriate method for evaluating and reporting productivity. There is a need to determine how the tangible and intangible outcomes can be measured and recognized, with due credit given and reported. The tangible aspects of research involvement are one thing; the intangibles of education and extension involvement are another. This provides a challenge of incorporating education and extension into the logic model to get the recognition of and feedback from those aspects.

2008 Response
Productivity remains high for research (including dissemination of impacts) and there is an increasing effort made to highlight extension's important role in providing outcomes. For example, new EDEN modules have been produced and additional Communities of Practice are forming.

2007 Response
The Animal Systems team has acted on the panel's recommendation to incorporate education and extension into logic models, which will facilitate recognition and reporting on productivity and performance. The implementation of electronic grant submissions should improve review and award processes and performance. Recent advances in education and extension efforts, including technology transfer, have been described above and will serve as examples for documenting and reporting on performance (e.g., EDEN, eXtension). The Animal Systems team gave Portfolio Productivity a score of 2.5 which reflects, on average, no change in the previous Animal Protection score of 3 and the previous Animal Production score of 2.

2006 Response
The portfolio continued to demonstrate moderate productivity to create and provide services through funding, directing, managing, and partnering with its various stakeholders. Enhanced efforts were

promised to properly document technology transfer and extension activities through the available databases and progress/termination reports under each knowledge area.

Portfolio Comprehensiveness

The PREP found the same weaknesses here as were found in "Portfolio Productivity" as regards documenting technology transfer. While there was good coverage of national and international needs, the panel expressed concern about focusing, emphasizing that it is important to maintain an infrastructure of facilities and to continue to train individuals to carry on the activities of this agency so that the very dynamic and varied needs of the future are met.

2008 Response
No significant changes from the 2007 response.

2007 Response
The Animal Systems team continues to utilize its comprehensive annual performance report as the basis for annual and 5-year reviews and performance tracking. This report indicates program shifts, resource trends, highlighted accomplishments, and impacts by each knowledge area. The process serves as a valuable tool from a program leadership perspective in enhancing the quality, relevancy and performance of the diverse portfolios managed and led by the Animal Systems team. The Animal Systems team gave Portfolio Comprehensiveness a score of 2.5 which reflects, on average, no change in the previous Animal Protection score of 3 and the previous Animal Production score of 2.

2006 Response
The portfolio continues to demonstrate moderate comprehensiveness in terms of areas of work, outputs, and outcomes. Efforts will be made to enhance documentation of extension and education activities.

Portfolio Timeliness

Timeliness was an area that was difficult for the panel to assess, given there is little to no data available on timeliness of projects. The bioethical issues in animal production were very timely.

2008 Response
The new NPL Leadership Dashboard provides each NPL with a visual display of their award responsibilities, including annual progress, final, and termination reports filed. This tool makes it easier for NPLs to communicate even more timely with Project Directors to encourage them to remain up to date with all award reporting requirements.

2007 Response
The portfolio is comprised of projects that are required to have annual progress, final, and termination reports filed. The portfolio continues to improve timeliness of projects by monitoring and encouraging project directors to complete these reports and their work on time. The portfolio continues to be timely in its coverage of topics, such as bioethics and bioenergy, where workshops and sessions at professional scientific meetings (e.g., American Society of Animal Science Bioethics of Food Animal Production) have drawn praise from stakeholders. The Animal Systems team gave Portfolio Timeliness a score of 3,

which is the same as the previous Animal Protection score and an increase from the previous Animal Production score of 2.

2006 Response
The portfolio continues to monitor timely completion and closure of projects under various knowledge areas. Efforts will be enhanced to ensure timely and adequate progress/termination report monitoring, and timely feedback to bridge voids and gaps.

Agency Guidance

The review panels found evidence of good guidance in some areas, but also found some voids such as in the areas of technology transfer and other extension. Leadership was judged to be good in research and although not explicit, the review team indicated that there is a need to enhance the agency's roles in terms of leadership for the extension function within the Animal Systems portfolio. The panel recommended that NPLs be dynamic, forward looking, creative, and innovative. It was unclear what guidance is given by the agency and what information reaches individual investigators. Improved communication is needed with physical geographic contact from top to bottom, bottom to top, and laterally. For example, NPLs need to communicate available programs to investigators as well as institutional administrators. Also, administrators should communicate better with investigators/recipients and feedback (formal reports and informal comments) should be expected and incorporated into work plans. The panel felt this was an important need.

2008 Response
CSREES' extension leadership continues to grow in the area of Animal Systems. In addition to response information provided in previous years below, in FY08, the NRI included language encouraging all integrated proposals to develop content suitable for delivery through eXtension. Funds may also be used to contribute to an existing Community of Practice or to form a new Community of Practice as appropriate. The Animal Protection and Biosecurity also encouraged applicants to consider submissions to the Small Business Innovation Research Program for vaccine development applications that may approach or enter the commercialization stage. New national extension activities are ongoing now for dairy and equine.

2007 Response
NPLs have increased efforts in the areas of guidance and leadership. NPL State Liaison activities have increased the interaction of NPLs with professionals at all levels. Exchanges of information (informal and formal) are occurring through the liaison and POW processes. Solicitation processes have been implemented and complete information on availability of competitive funding has been provided in an open and timely manner. NPLs are seeking new and innovative input from stakeholders to guide the portfolio. The Animal Systems team gave Agency Guidance a score of 2.5 which reflects, on average, no change in the previous Animal Protection score of 3 and the previous Animal Production score of 2.

2006 Response
The portfolio continued to provide dynamic leadership and management to foster a broad spectrum of activities to develop human resources and collaborative interaction among all three mission areas. The team addressed opportunities to strengthen leadership for the extension function. NPLs are now asked to report accomplishments and describe their leadership roles for research and extension functions.

The team promised to assess opportunities to strengthen leadership relative to extension programming. NPLs within the team network extensively with extension counterparts in the states. Meetings with extension specialists and special sessions on extension programs are held in conjunction with professional meetings and national workshops. The team planned to integrate extension goals into performance planning and leadership functions; however, as mentioned above, there are still major deficiencies in terms of reporting extension accomplishments and impacts. These deficiencies must be resolved at the agency level.

Portfolio Accountability

Accountability on balance of the animal production portfolio was not good. Much progress regarding methods and relevance needs to be done to be useful, meaningful, and comprehensive. The CSREES has an evaluation system for projects up front, but there is no follow up at the end of projects to determine if something really was accomplished. There is a strong need to improve accountability showing measurable impacts, not just in CSREES, but throughout the system and down to individual investigators. Overall, the panel was pleased with the accountability evidenced by the animal protection portfolio's self-review document. Communication of research results seemed to be adequate, if not exemplary. Even though the funds contributed to a project by CSREES may be a minor percentage of the total project funding, investigators need to be reminded that demonstration of wise use of all funds, as well as research outcomes, is paramount for assuring sustained or increased federal research funding in the future.

2008 Response
All NRI competitive programs (and now the FY09 AFRI programs) hold annual project director workshops. For example, the Animal Protection program holds its workshops as a satellite meeting during the Conference of Research Workers in Animal Disease (CRWAD). The Animal Genome program convenes funded investigators each year at the Plant and Animal Genome (PAG) meeting. Attendance at these workshops is required and provides awardees the opportunity to highlight their ongoing progress via oral and poster presentations. Roundtable discussions help the program further identify important scientific issues. The new REEO Division for Animal Health, Production, and Products is developing a USDA blueprint for the same area; this blueprint, as well as the pre and post follow-up coordination among agencies is expected to further improve portfolio accountability and integration across the USDA.

2007 Response
The Animal Systems team concurs with the observation that accountability needs to be improved. Concurrent with agency-wide efforts to improve portfolio accountability, the Animal Systems team is increasing efforts to improve post-award management and requirements for funded projects. The team's strategic plan, with actionable goals, will also improve its ability to be accountable and to report on what has actually been accomplished. The Animal Systems team retained the previous score for Scope at 2.

2006 Response
This is a broad systemic problem across the agency. Improved reporting systems for extension and higher education integrated with the research reporting that provides measurable outcomes and impacts are needed. The agency is moving forward to address this issue regarding reporting needs and systems.

The Animal Systems team recognizes that there need to be new approaches and visionary thinking regarding the tracking of outcomes and impacts. There is a need to focus on performance reports instead of activity reports. Current systems being discussed within the agency are project-based reporting systems. Most reportable impacts occur well after projects are terminated and are not based on inputs from a single project. The agency needs to consider new models for performance tracking and impact documentation.

Section V: Self Assessment

Portfolio Scoring

Animal Systems Portfolio Scores

	Panel Score		**2006 Score**		**2007 Score**	**2008 Score**
	Animal Production	**Animal Protection**	**Animal Production**	**Animal Protection**	**Animal Systems**	**Animal Systems**
Relevance						
1. Scope	3	3	3	3	3	3
2. Focus	3	3	3	3	3	3
3. Contemporary and/or Emerging Issues	3	3	3	3	3	3
4. Integration	1	2	2	2	2	2.5
5. Multi-disciplinary Balance	2	3	2	3	3	3
Quality						
1. Significance of Findings	2	3	2	3	2.5	2.5
2. Stakeholder/ Constituent Inputs	3	2	3	2.5	3	3
3. Alignment with Current State of Science	3	3	3	3	3	3
4. Appropriate and/or Cutting Edge Methodology	2	3	2	3	3	3
Performance						
1. Portfolio Productivity	2	3	2	3	2.5	2.5
2. Portfolio Comprehensiveness	2	3	2	3	2.5	2.5
3. Portfolio Timeliness	2	3	2	3	3	3
4. Agency guidance		3	2	3	2.5	3
5. Portfolio Accountability	2	2	2	2	2	2
Overall Score	**81**	**95**	**82**	**96**	**93**	**94**

Portfolio Score Change Discussion:

2008 Portfolio Score Change Discussion

Relevance

- Integration: Increased from 2 to 2.5

Justification: The 2008 Farm Bill, Agricultural and Food Research Initiative (AFRI), increased the funding percentage allocated for integrated activities to a minimum of 30% compared to its predecessor initiative, the NRI, that could only allocate up to 26% for integrated awards.
The research and extension aspect of this portfolio contributed to the integration score increase due to better leadership and improved working relations with the clientele. The 2008 joint ARS-CSREES Aquaculture Stakeholder Workshop provided insights and recommendations related to technology transfer mechanisms and integrated research-extension approaches to problem-solving and demonstration projects.

Quality

- Significance: Remained unchanged at 2.5

Justification: This score remain unchanged with the caveat that we will continue to improve our ability to identify significant outcomes and improve our summaries to customers. The Office and Planning and Accountability has an improved system in place for reporting Plan of Work outcomes and the Animal Systems staff is doing a better job at packaging these findings brochures, flyers, etc.

Performance

- Agency Guidance: Increased form 2.5 to 3.

Justification: Enhanced communications within the Animal Systems dairy and equine programs contributes to this score increase. Also, through State Liaison responsibilities with 1862 land grant partners, as well as 1890 and 1994 institutions, individual NPL's have made it a priority to share information and answer questions about the broad range of CSREES funding opportunities that are available to applicants. Our partner institutions now have a point of contact at CSREES to communicate with if clarification is needed about CSREES programs.

Appendix A – External Panel Recommendations to the Agency:

In response to directives from the Office of Management and Budget (OMB) of the President, CSREES implemented the Portfolio Review Expert Panel (PREP) process to systematically review its progress in achieving its mission. Since this process began in 2003, fourteen expert review panels have been convened and each has published a report offering recommendations and guidance. These external reviews occur on a rolling five-year basis. In the four off years an internal panel is assembled to examine how well CSREES is addressing the expert panel's recommendations. These internal reports are crafted to specifically address the issues raised for a particular portfolio. Electronic versions of both external and internal reviews for all portfolios are located on the Agency's website (http://www.csrees.usda.gov/about/strat_plan_portfolio.html).

Even though the expert reports were all written independent of one another on portfolios comprised of very different subject matter, several themes common to the set of review reports have emerged. This set of issues has repeatedly been identified by expert panels and requires an agency-wide response. The agency has taken a series of steps to effectively respond to those overarching issues.

- **Issue 1: Getting Credit When Credit is Due**

For the most part panelists were complimentary when examples showing partnerships and leveraging of funds were used. However, panelists saw a strong need for CSREES to better assert itself and its name into the reporting process. Panelists believed that principal investigators who conduct the research, education and extension activities funded by CSREES often do not highlight the contributions made by CSREES. Multiple panel reports suggested CSREES better monitor reports of its funding and ensure that the agency is properly credited. Many panelists were unaware of the breadth of CSREES activities and believe their lack of knowledge is partly a result of CSREES not receiving credit in publications and other material made possible by CSREES funding.

Issue 1: Agency Response:

To address the issue of lack of credit being given to CSREES for funded projects, the Agency implemented several efforts likely to improve this situation.

First CSREES developed a standard paragraph about CSREES's work and funding that project managers can easily insert into documents, papers and other material funded in part or entirely by CSREES.

Second, the Agency is in the process of implementing the "One Solution" concept. One Solution will allow for the better integration, reporting and publication of CSREES material on the web. In addition, the new Plan of Work (POW), centered by a logic model framework, became operational in June 2006. Because of the new POW requirements and the POW training conducted by the Office of Planning and Accountability (OPA), it will be simpler for state and local partners to line up the work they are doing with agency expenditures. This in turn will make it easier for project managers to cite CSREES contributions when appropriate.

The Agency has started the process of upgrading the Current Research Information System (CRIS), once upgraded it will be named the CSREES Information System (CIS). The CIS will allow users to access information from the Plan of Work (POW) and new Standard Report in a more effective and

efficient manner. In addition to the CIS, the new Annual Reporting system that is based on activities discussed in the POW was launched in 2008.

- **Issue 2: Partnership with Universities**
  Panelists felt that the concept of partnership was not being adequately presented. Panelists saw a need for more detail to be made available. Panelists asked a number of questions revolving around long-term planning between the entities they also asked how the CSREES mission and goals were being supported through its partnership with universities and vice versa.

  Issue 2: Agency Response:
  CSREES has taken several steps to strengthen its relationship with university partners. During the November 2005 National Association of State University and Land Grant Colleges (NASULGC) meeting in Washington, D.C., Dr. Colien Hefferan announced a new cooperative program entitled the new NPL Institutional Liaison program. The primary goal of this program is to strengthen the relationship between CSREES and its state partners, thus enhancing the effectiveness of the work done by CSREES. Through teleconferences, campus visits, e-mails and other meeting opportunities; CSREES's knowledge and understanding of institutional interests and needs will increase. CSREES is committed to learning more about state research, extension and education activities, strategic plans, and goals.

  NPL Liaisons have the following duties:
  - Become knowledgeable about the administrative structure budget sources and major program commitments of your institution
  - Meet regularly with the CSREES deputy administrator liaison with your region
  - Make quarterly phone calls or teleconferences to appropriate university officials in order to create ongoing dialogue of shared interests and needs
  - Schedule campus visit/s in order to enhance the partnership
  - Serve as the joint reviewers of your integrated annual plans of work from cooperative extension and research
  - Identify partnership opportunities within CSREES and other federal agencies to strengthen your programs and assist in meeting your goals

  Finally, several trainings that focused on the POW were conducted by CSREES in geographic regions throughout the country. A major goal of this training was to better communicate CSREES goals to state leaders which will facilitate better planning between the universities and CSREES.

- **Issue 3: National Program Leaders**
  Without exception the portfolio review panels were complimentary of the work being done by NPLs. They believe NPLs have significant responsibility, are experts in the field and do a difficult job admirably. Panelists did however mention that often times there are gaps in the assignments given to NPLs. Those gaps leave holes in programmatic coverage.

  Issue 3: Agency Response:
  CSREES values the substantive expertise that NPLs bring to the Agency and therefore requires all NPLs to be experts in their respective fields. Given the budget constraints often times faced by the agency, the agency has not always been able to fund needed positions and had to prioritize its hiring for

open positions. In addition, because of the level of expertise CSREES requires of its NPLs, quick hires are not always possible. Often, CSREES is unable to meet the salary demands of those it wishes to hire. It is essential that position not only be filled but filled with the most qualified candidate.

Operating under these constraints and given inevitable staff turnover, gaps will always remain. However, establishing and drawing together multidisciplinary teams required to complete the portfolio reviews has allowed the Agency to identify gaps in program knowledge and ensure that these needs are addressed in a timely fashion. To the extent that specific gaps are mentioned by the expert panels, the urgency to fill them is heightened.

- **Issue 4: Integration**

Lack of integration has been highlighted throughout the panel reviews. While review panelists certainly noted in their reports where they observed instances of integration, almost without fail panel reports sought more documentation in this regard.

Issue 4: Agency Response:

Complex problems require creative and integrated approaches that cut across disciplines and knowledge areas. CSREES has recognized the need for these approaches and has undertaken steps to remedy this situation. CSREES has recently mandated that up to twenty-six percent of all NRI funds be put aside specifically for integrated projects. These projects cut across functions as well as disciplines and ensure that future Agency work will be better integrated. Integration is advanced through the portfolio process which requires cooperation across units and programmatic areas.

- **Issue 5: Extension**

While most panels seemed satisfied at the level of discussion that focused on research, the same does not hold true for extension. There was a call for more detail and more outcome examples based upon extension activities. There was a consistent request for more detail regarding not just the activities undertaken by extension but documentation of specific results these activities achieved.

Issue 5: Agency Response:

Conferences have been conducted to increase the awareness of improved methodologies and reporting systems for documenting outcomes and impacts for the Agency. A CSREES Planning and Evaluation Mini-Conference was held April 23-24, 2007 in conjunction with the Administrative Officers' Conference in Seattle, WA. This mini-conference was designed for those planning programs or engaged in performance measurement and program evaluation. Participants learned about Plan of Work reporting, what CSREES has learned from the 2007-2011 Plans submitted, and how CSREES has used and expects to use information from annual reports and plans.

In addition to the CSREES Planning and Evaluation Mini-Conference, CSREES, in partnership with Texas A&M University, started a bi-monthly CSREES Reporting Web Conference Series (RWC) in February 2008. This series originated from requests for more information on various topics identified at the 2007 CSREES Planning and Accountability Mini-Conference. Topics for the series include:

- Agricultural Research, Extension, and Education Reform Act (AREERA);

- Plans of Work (POW);
- Annual Reports;
- One Solution;
- CRIS (soon to become CSREES Information System (CIS)); and
- Outcome reporting.

The AREERA Plan of Work and Annual Reporting system (POW) made extension-based results and reporting a priority. The new POW includes program descriptions and progress reports limited to four legislatively prescribed lines of funding. POW includes descriptions and annual accomplishments for each subject program. POW is a database application containing a combination of structured data and unstructured text box fields. These reports provide state level documentation of extension outcomes and impacts not previously captured in Agency wide reporting systems. Approved state plans of work and annual reports will be available in the Research, Education, and Economics Information System (REEIS) in the fall of 2008.

- **Issue 6: Program Evaluation**

Panelists were complimentary in that they saw the creation of OPA and portfolio reviews as being the first steps towards more encompassing program evaluation work; however, they emphasized the need to see outcomes and often stated that the scores they gave were partially the result of their own personal experiences rather than specific program outcomes documented in the portfolios. In other words, they know first hand that CSREES is having an impact but would like to see more systematic and comprehensive documentation of this impact in the reports.

Issue 6: Agency Response:

The effective management of programs is at the heart of the work conducted at CSREES and program evaluation is an essential component of effective management. In 2003 the PREP process and subsequent internal reviews were implemented. Over the past four years 14 portfolios have been reviewed by expert panel members and continue to be self-assessed annually. Each year this process improves, including reconfiguration of several portfolios to become better structured for planning and assessment. NPLs are now familiar with the process and the staff of the Office of Planning and Accountability (OPA) has implemented a systematic process for pulling together the material required for these reports.

Simply managing the process more effectively is not sufficient for raising the level of program evaluations being done on CSREES funded projects to the highest standard. Good program evaluation is a process that requires constant attention by all stakeholders and the agency has focused on building the skill sets of stakeholders in the area of program evaluation. The OPA has conducted training in the area of evaluation for both NPLs and for staff working at Land-Grant universities. This training is available electronically and the OPA will be working with NPLs to deliver training to those in the field.

The OPA is working more closely with individual programs to ensure successful evaluations are developed, implemented and the data analyzed. Senior leadership at CSREES has begun to embrace program evaluation and over the coming years CSREES expects to see state leaders and project directors more effectively report on the outcomes of their programs as they begin to implement more

rigorous program evaluation. The new POW system ensures data needed for good program evaluation will be available in the future.

The newly formatted annual review document has encouraged the discussion of program evaluations conducted regarding programs funded by the Agency for the particular portfolio being highlighted.

- **Issue 7: Logic Models**
  Panelists were consistently impressed with the logic models and the range of their potential applications. They expressed the desire to see the logic model process used by all projects funded by CSREES and hoped not only would NPLs continue to use them in their work but, also, that those conducting the research and implementing extension activities would begin to incorporate them into their work plans.

  Issue 7: Agency Response:
  Logic models have become a staple of the work being done at CSREES and the Agency has been proactive in promoting the use of logic models to its state partners.

  Two recent initiatives highlight this. First, in 2005, the POW reporting system into which states submit descriptions of their accomplishments was completely revamped. The new reporting system now closely matches the logic models being used in portfolio reports. Beginning in fiscal year 2007, states will be required to enter all of the following components of a standard logic model. These components include describing the following:
  - Program Situation
  - Program Assumption
  - Program Long Term Goals
  - Program Inputs which include both monetary and staffing
  - Program Output which include such things as patents
  - Short Term Outcome Goals
  - Medium Term Outcome Goals
  - Long Term Outcome Goals
  - External Factors
  - Target Audience

A series of training workshops were conducted by the OPA for staff from CSREES and from the land grant partnership. OPA senior staff traveled to regional conferences attended by Project Directors and Principal Investigators funded by CSREES. They conducted workshops on budget and performance integration and logic models. These sessions helped our partners understand the full picture and emphasized the need for our partners to report their accomplishments. Senior staff presented the logic model as a conceptual as well as an application tool useful for planning and reporting. Partners have now begun to use logic model in their work as well as report their accomplishments. In fact the Competitive Program unit of the Agency has made the inclusion of logic models a requirement for Integrated Programs.

Appendix B - Detailed Funding Tables for Primary KAs – CSREES Funding: These tables provide detailed information on CSREES funding of portfolio Primary KAs to support the summary table in the document (see Table 1).

KA 301: Reproductive Performance of Animals CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$6,503.00	$6,566.00	$6,175.00	$6,504.00	$6,839.00	$32,587.00
McIntire-Stennis	$68.00	$65.00	$60.00	$76.00	$82.00	$351.00
Evans Allen	$1,737.00	$1,551.00	$2,054.00	$816.00	$1,006.00	$7,164.00
Animal Health	$144.00	$137.00	$186.00	$255.00	$272.00	$994.00
Special Grants	$752.00	$1,330.00	$1,398.00	$1,986.00	$0.00	$5,466.00
NRI Grants	$4,688.00	$3,937.00	$4,819.00	$3,833.00	$5,837.00	$23,114.00
SBIR Grants	$524.00	$220.00	$545.00	$345.00	$359.00	$1,993.00
Other CSREES	$501.00	$556.00	$575.00	$368.00	$882.45	$2,882.45
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$8.50	$8.50
Total Reported in CRIS	$14,917.00	$14,362.00	$15,811.00	$14,184.00	$15,285.95	$74,559.95
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$2,412.91	$2,412.91
1890 Extension	n/a	n/a	n/a	n/a	$520.32	$520.32
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$2,933.23	$2,933.23
Total	$14,917.00	$14,362.00	$15,811.00	$14,184.00	$18,219.19	$77,493.19

KA 302: Nutrient Utilization in Animals CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$6,905.00	$6,865.00	$7,199.00	$7,594.00	$7,950.00	$36,513.00
McIntire-Stennis	$0.00	$7.00	$5.00	$8.00	$0.00	$20.00
Evans Allen	$1,659.00	$1,903.00	$1,909.00	$1,136.00	$1,280.00	$7,887.00
Animal Health	$86.00	$83.00	$58.00	$69.00	$58.00	$354.00
Special Grants	$1,693.00	$2,074.00	$1,931.00	$2,309.00	$0.00	$8,007.00
NRI Grants	$1,583.00	$2,231.00	$1,695.00	$2,735.00	$3,610.00	$11,854.00
SBIR Grants	$413.00	$145.00	$335.00	$231.00	$40.00	$1,164.00
Other CSREES	$980.00	$860.00	$1,426.00	$880.00	$10.00	$4,156.00
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$0.00	$0.00
Total Reported in CRIS	$13,319.00	$14,168.00	$14,558.00	$14,961.00	$12,948.00	$69,954.00
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$2,424.50	$2,424.50
1890 Extension	n/a	n/a	n/a	n/a	$419.19	$419.19
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$2,843.70	$2,843.70
Total	$13,319.00	$14,168.00	$14,558.00	$14,961.00	$15,791.70	$72,797.70

KA 303: Genetic Improvement of Animals CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$2,862.00	$3,245.00	$3,135.00	$3,150.00	$3,717.00	$16,109.00
McIntire-Stennis	$0.00	$0.00	$0.00	$12.00	$27.00	$39.00
Evans Allen	$559.00	$419.00	$447.00	$326.00	$391.00	$2,142.00
Animal Health	$59.00	$24.00	$36.00	$54.00	$38.00	$211.00
Special Grants	$1,854.00	$1,350.00	$1,528.00	$2,231.00	$0.00	$6,963.00
NRI Grants	$1,349.00	$1,239.00	$2,224.00	$1,372.00	$512.00	$6,696.00
SBIR Grants	$436.00	$40.00	$168.00	$219.00	$502.00	$1,365.00
Other CSREES	$1,702.00	$2,094.00	$2,697.00	$2,566.00	$532.60	$9,591.60
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$6.40	$6.40
Total Reported in CRIS	$8,821.00	$8,411.00	$10,235.00	$9,931.00	$5,726.00	$43,124.00
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$1,279.78	$1,279.78
1890 Extension	n/a	n/a	n/a	n/a	$339.76	$339.76
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$1,619.54	$1,619.54
Total	$8,821.00	$8,411.00	$10,235.00	$9,931.00	$7,345.54	$44,743.54

KA 304: Animal Genome CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$2,300.00	$2,934.00	$2,991.00	$2,353.00	$2,949.00	$13,527.00
McIntire-Stennis	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Evans Allen	$56.00	$175.00	$309.00	$312.00	$434.00	$1,286.00
Animal Health	$190.00	$41.00	$96.00	$78.00	$52.00	$457.00
Special Grants	$563.00	$797.00	$906.00	$1,261.00	$0.00	$3,527.00
NRI Grants	$2,631.00	$11,331.00	$7,908.00	$9,902.00	$10,372.00	$42,144.00
SBIR Grants	$0.00	$0.00	$0.00	$80.00	$0.00	$80.00
Other CSREES	$84.00	$7.00	$400.00	$155.00	$72.00	$718.00
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$0.00	$0.00
Total Reported in CRIS	$5,824.00	$15,285.00	$12,609.00	$14,141.00	$13,879.00	$61,738.00
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$234.92	$234.92
1890 Extension	n/a	n/a	n/a	n/a	$0.00	$0.00
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$234.92	$234.92
Total	$5,824.00	$15,285.00	$12,609.00	$14,141.00	$14,113.92	$61,972.92

KA 305: Animal Physiological Processes CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$4,220.00	$3,953.00	$3,410.00	$3,586.00	$4,066.00	$19,235.00
McIntire-Stennis	$134.00	$30.00	$0.00	$1.00	$0.00	$165.00
Evans Allen	$1,542.00	$1,859.00	$1,265.00	$739.00	$830.00	$6,235.00
Animal Health	$130.00	$83.00	$99.00	$173.00	$153.00	$638.00
Special Grants	$597.00	$673.00	$398.00	$309.00	$0.00	$1,977.00
NRI Grants	$4,382.00	$1,928.00	$4,163.00	$3,403.00	$2,651.00	$16,527.00
SBIR Grants	$371.00	$16.00	$0.00	$0.00	$260.00	$647.00
Other CSREES	$26.00	$90.00	$260.00	$170.00	$0.00	$546.00
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$35.22	$35.22
Total Reported in CRIS	$11,402.00	$8,632.00	$9,595.00	$8,381.00	$7,994.22	$46,004.22
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$579.66	$579.66
1890 Extension	n/a	n/a	n/a	n/a	$58.42	$58.42
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$638.08	$638.08
Total	$11,402.00	$8,632.00	$9,595.00	$8,381.00	$8,632.30	$46,642.30

KA 306: Environmental Stress in Animals CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$1,014.00	$1,086.00	$1,351.00	$968.00	$1,053.00	$5,472.00
McIntire-Stennis	$0.00	$0.00	$0.00	$26.00	$42.00	$68.00
Evans Allen	$0.00	$0.00	$0.00	$27.00	$62.00	$89.00
Animal Health	$15.00	$24.00	$13.00	$39.00	$19.00	$110.00
Special Grants	$190.00	$1,030.00	$315.00	$210.00	$0.00	$1,745.00
NRI Grants	$141.00	$0.00	$341.00	$183.00	$1,453.00	$2,118.00
SBIR Grants	$0.00	$24.00	$187.00	$0.00	$24.00	$235.00
Other CSREES	$0.00	$0.00	$41.00	$483.00	$0.00	$524.00
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$0.00	$0.00
Total Reported in CRIS	$1,360.00	$2,164.00	$2,248.00	$1,936.00	$2,653.00	$10,361.00
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$593.81	$593.81
1890 Extension	n/a	n/a	n/a	n/a	$38.75	$38.75
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$632.56	$632.56
Total	$1,360.00	$2,164.00	$2,248.00	$1,936.00	$3,285.56	$10,993.56

KA 307: Animal Production Management System CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$3,221.00	$3,488.00	$3,565.00	$3,473.00	$4,161.00	$17,908.00
McIntire-Stennis	$0.00	$0.00	$2.00	$2.00	$1.00	$5.00
Evans Allen	$2,014.00	$2,354.00	$2,389.00	$2,716.00	$2,502.00	$11,975.00
Animal Health	$49.00	$11.00	$41.00	$27.00	$59.00	$187.00
Special Grants	$4,810.00	$2,639.00	$2,887.00	$3,367.00	$0.00	$13,703.00
NRI Grants	$100.00	$1,228.00	$621.00	$1,050.00	$2,286.00	$5,285.00
SBIR Grants	$414.00	$296.00	$317.00	$261.00	$346.00	$1,634.00
Other CSREES	$2,529.00	$3,202.00	$3,902.00	$3,552.00	$2,500.22	$15,685.22
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$353.58	$353.58
Total Reported in CRIS	$13,137.00	$13,218.00	$13,724.00	$14,448.00	$12,208.80	$66,735.80
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$7,391.59	$7,391.59
1890 Extension	n/a	n/a	n/a	n/a	$1,552.00	$1,552.00
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$8,943.60	$8,943.60
Total	$13,137.00	$13,218.00	$13,724.00	$14,448.00	$21,152.40	$75,679.40

KA 308: Improved Animal Products (Before Harvest) CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$948.00	$1,071.00	$1,126.00	$958.00	$1,058.00	$5,161.00
McIntire-Stennis	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Evans Allen	$118.00	$144.00	$140.00	$178.00	$337.00	$917.00
Animal Health	$20.00	$22.00	$42.00	$60.00	$31.00	$175.00
Special Grants	$410.00	$1,189.00	$1,172.00	$744.00	$0.00	$3,515.00
NRI Grants	$29.00	$5.00	$255.00	$2,500.00	$1,033.00	$3,822.00
SBIR Grants	$150.00	$0.00	$60.00	$32.00	$87.00	$329.00
Other CSREES	$206.00	$194.00	$209.00	$690.00	$147.08	$1,446.08
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$63.40	$63.40
Total Reported in CRIS	$1,881.00	$2,625.00	$3,004.00	$5,162.00	$2,756.48	$15,428.48
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$1,011.56	$1,011.56
1890 Extension	n/a	n/a	n/a	n/a	$132.38	$132.38
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$1,143.94	$1,143.94
Total	$1,881.00	$2,625.00	$3,004.00	$5,162.00	$3,900.42	$16,572.42

KA 311: Animal Diseases CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$5,045.00	$5,082.00	$4,974.00	$5,100.00	$6,565.00	$26,766.00
McIntire-Stennis	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Evans Allen	$557.00	$197.00	$132.00	$134.00	$272.00	$1,292.00
Animal Health	$2,850.00	$2,736.00	$2,867.00	$2,891.00	$2,788.00	$14,132.00
Special Grants	$2,874.00	$1,808.00	$3,048.00	$3,838.00	$0.00	$11,568.00
NRI Grants	$6,548.00	$19,819.00	$11,152.00	$8,936.00	$9,356.00	$55,811.00
SBIR Grants	$746.00	$1,031.00	$874.00	$775.00	$1,476.00	$4,902.00
Other CSREES	$3,043.00	$3,954.00	$3,250.00	$4,031.00	$4,780.26	$19,058.26
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$84.74	$84.74
Total Reported in CRIS	$21,663.00	$34,627.00	$26,297.00	$25,705.00	$25,322.00	$133,614.00
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$2,278.17	$2,278.17
1890 Extension	n/a	n/a	n/a	n/a	$525.80	$525.80
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$2,803.98	$2,803.98
Total	$21,663.00	$34,627.00	$26,297.00	$25,705.00	$28,125.98	$136,417.98

KA 312: External Parasites and Pests of Animals CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$790.00	$1,071.00	$971.00	$1,045.00	$812.00	$4,689.00
McIntire-Stennis	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Evans Allen	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Animal Health	$185.00	$200.00	$314.00	$221.00	$94.00	$1,014.00
Special Grants	$280.00	$497.00	$432.00	$443.00	$350.00	$2,002.00
NRI Grants	$567.00	$3.00	$678.00	$364.00	$637.00	$2,249.00
SBIR Grants	$371.00	$661.00	$160.00	$376.00	$346.00	$1,914.00
Other CSREES	$456.00	$292.00	$0.00	$187.00	$172.00	$1,107.00
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$22.00	$22.00
Total Reported in CRIS	$2,649.00	$2,724.00	$2,555.00	$2,636.00	$2,433.00	$12,997.00
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$338.88	$338.88
1890 Extension	n/a	n/a	n/a	n/a	$139.72	$139.72
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$478.60	$478.60
Total	$2,649.00	$2,724.00	$2,555.00	$2,636.00	$2,911.60	$13,475.60

KA 313: Internal Parasites in Animals CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$415.00	$359.00	$225.00	$156.00	$333.00	$1,488.00
McIntire-Stennis	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Evans Allen	$0.00	$295.00	$559.00	$497.00	$409.00	$1,760.00
Animal Health	$269.00	$264.00	$191.00	$208.00	$153.00	$1,085.00
Special Grants	$171.00	$112.00	$97.00	$125.00	$50.00	$555.00
NRI Grants	$774.00	$699.00	$202.00	$893.00	$1,154.00	$3,722.00
SBIR Grants	$0.00	$80.00	$296.00	$0.00	$16.00	$392.00
Other CSREES	$0.00	$102.00	$574.00	$0.00	$648.00	$1,324.00
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$0.00	$0.00
Total Reported in CRIS	$1,629.00	$1,911.00	$2,144.00	$1,879.00	$2,763.00	$10,326.00
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$247.98	$247.98
1890 Extension	n/a	n/a	n/a	n/a	$106.63	$106.63
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$354.62	$354.62
Total	$1,629.00	$1,911.00	$2,144.00	$1,879.00	$3,117.62	$10,680.62

KA 314: Toxic Chemicals, Poisonous Plants and Naturally Occuring Toxins and Other Hazards Affecting Animals CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$807.00	$689.00	$606.00	$587.00	$758.00	$3,447.00
McIntire-Stennis	$94.00	$59.00	$85.00	$65.00	$136.00	$439.00
Evans Allen	$70.00	$14.00	$0.00	$0.00	$0.00	$84.00
Animal Health	$125.00	$72.00	$96.00	$74.00	$63.00	$430.00
Special Grants	$102.00	$0.00	$15.00	$0.00	$25.00	$142.00
NRI Grants	$30.00	$4.00	$0.00	$0.00	$919.00	$953.00
SBIR Grants	$0.00	$71.00	$0.00	$0.00	$0.00	$71.00
Other CSREES	$221.00	$0.00	$58.00	$228.00	$36.00	$543.00
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$0.00	$0.00
Total Reported in CRIS	$1,449.00	$909.00	$860.00	$954.00	$1,937.00	$6,109.00
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$100.32	$100.32
1890 Extension	n/a	n/a	n/a	n/a	$7.50	$7.50
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$107.82	$107.82
Total	$1,449.00	$909.00	$860.00	$954.00	$2,044.82	$6,216.82

KA 315: Animal Welfare, Well Being, and Protection CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$623.00	$633.00	$722.00	$736.00	$831.00	$3,545.00
McIntire-Stennis	$18.00	$24.00	$32.00	$33.00	$48.00	$155.00
Evans Allen	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Animal Health	$210.00	$190.00	$147.00	$124.00	$190.00	$861.00
Special Grants	$0.00	$317.00	$258.00	$79.00	$0.00	$654.00
NRI Grants	$592.00	$830.00	$1,867.00	$1,528.00	$1,442.00	$6,259.00
SBIR Grants	$0.00	$160.00	$744.00	$296.00	$80.00	$1,280.00
Other CSREES	$109.00	$419.00	$2.00	$53.00	$130.60	$713.60
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$8.40	$8.40
Total Reported in CRIS	$1,552.00	$2,573.00	$3,772.00	$2,849.00	$2,729.00	$13,475.00
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$1,503.58	$1,503.58
1890 Extension	n/a	n/a	n/a	n/a	$99.84	$99.84
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$1,603.42	$1,603.42
Total	$1,552.00	$2,573.00	$3,772.00	$2,849.00	$4,332.42	$15,078.42

KA 721: Insects and Other Pests Affecting Humans CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$627.00	$686.00	$743.00	$790.00	$1,097.00	$3,943.00
McIntire-Stennis	$17.00	$16.00	$19.00	$0.00	$0.00	$52.00
Evans Allen	$0.00	$0.00	$0.00	$0.00	$51.00	$51.00
Animal Health	$3.00	$4.00	$3.00	$2.00	$3.00	$15.00
Special Grants	$357.00	$205.00	$216.00	$163.00	$40.00	$981.00
NRI Grants	$156.00	$412.00	$1.00	$377.00	$626.00	$1,572.00
SBIR Grants	$75.00	$80.00	$96.00	$0.00	$0.00	$251.00
Other CSREES	$160.00	$260.00	$813.00	$147.00	$201.00	$1,581.00
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$2.00	$2.00
Total Reported in CRIS	$1,395.00	$1,663.00	$1,891.00	$1,479.00	$2,019.00	$8,447.00
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$289.09	$289.09
1890 Extension	n/a	n/a	n/a	n/a	$7.33	$7.33
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$296.42	$296.42
Total	$1,395.00	$1,663.00	$1,891.00	$1,479.00	$2,315.42	$8,743.42

KA 722: Zoonotic Diseases and Parasites Affecting Humans CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
Hatch	$274.00	$251.00	$385.00	$667.00	$1,143.00	$2,720.00
McIntire-Stennis	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Evans Allen	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Animal Health	$36.00	$58.00	$62.00	$200.00	$192.00	$548.00
Special Grants	$19.00	$96.00	$186.00	$660.00	$0.00	$961.00
NRI Grants	$2.00	$0.00	$1,400.00	$521.00	$406.00	$2,329.00
SBIR Grants	$30.00	$0.00	$47.00	$0.00	$20.00	$97.00
Other CSREES	$33.00	$291.00	$58.00	$63.00	$340.00	$785.00
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	$0.00	$0.00
Total Reported in CRIS	$394.00	$696.00	$2,138.00	$2,111.00	$2,101.00	$7,440.00
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$616.76	$616.76
1890 Extension	n/a	n/a	n/a	n/a	$14.65	$14.65
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$631.41	$631.41
Total	$394.00	$696.00	$2,138.00	$2,111.00	$2,732.41	$8,071.41

Appendix C - Detailed Funding Tables for Primary KAs – All Known Funding: These tables provide detailed information on all known funding of portfolio Primary KAs to support the summary table in the document (see Table 1).

KA 301: Reproductive Performance of Animals Overall Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$14,916.00	$14,362.00	$15,811.00	$14,184.00	$18,219.19	$77,492.19
Other USDA	$702.00	$880.00	$2,739.00	$1,377.00	$2,221.00	$7,919.00
Other Federal	$8,387.00	$7,035.00	$14,730.00	$5,019.00	$9,550.00	$44,721.00
State Appr.	$33,933.00	$28,059.00	$34,119.00	$28,818.00	$34,933.00	$159,862.00
Self-Gen	$6,599.00	$6,428.00	$13,338.00	$7,135.00	$14,862.00	$48,362.00
Ind/Gr Agrmt	$4,048.00	$3,158.00	$4,105.00	$2,690.00	$3,713.00	$17,714.00
Other Non-Fed	$2,369.00	$2,502.00	$4,211.00	$2,703.00	$5,567.00	$17,352.00
Total	$70,956.00	$62,423.00	$89,054.00	$61,924.00	$89,065.19	$373,422.19

KA 302: Nutrient Utilization in Animals Overall Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$13,320.00	$14,167.00	$14,558.00	$14,961.00	$15,791.70	$72,797.70
Other USDA	$1,188.00	$1,312.00	$1,532.00	$1,052.00	$2,114.00	$7,198.00
Other Federal	$2,486.00	$2,713.00	$3,704.00	$2,883.00	$3,779.00	$15,565.00
State Appr.	$35,322.00	$35,443.00	$39,847.00	$35,805.00	$42,738.00	$189,155.00
Self-Gen	$11,119.00	$10,124.00	$13,074.00	$14,601.00	$17,052.00	$65,970.00
Ind/Gr Agrmt	$6,671.00	$11,394.00	$7,659.00	$6,861.00	$8,433.00	$41,018.00
Other Non-Fed	$2,543.00	$2,308.00	$3,388.00	$3,053.00	$4,023.00	$15,315.00
Total	$72,647.00	$77,462.00	$83,762.00	$79,217.00	$93,930.70	$407,018.70

KA 303: Genetic Improvement of Animals Overall Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$8,821.00	$8,411.00	$10,235.00	$9,931.00	$7,345.54	$44,743.54
Other USDA	$646.00	$836.00	$981.00	$751.00	$1,391.00	$4,605.00
Other Federal	$3,959.00	$3,959.00	$8,693.00	$6,117.00	$9,473.00	$32,201.00
State Appr.	$16,354.00	$14,682.00	$18,029.00	$18,015.00	$18,561.00	$85,641.00
Self-Gen	$6,925.00	$5,499.00	$7,435.00	$7,035.00	$7,682.00	$34,576.00
Ind/Gr Agrmt	$2,390.00	$2,600.00	$3,249.00	$2,460.00	$2,922.00	$13,621.00
Other Non-Fed	$1,985.00	$1,919.00	$2,006.00	$1,638.00	$2,568.00	$10,116.00
Total	$41,079.00	$37,907.00	$50,628.00	$45,946.00	$49,942.54	$225,502.54

KA 304: Animal Genome Overall Funding						
(as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$5,825.00	$15,285.00	$12,609.00	$14,141.00	$14,113.92	$61,973.92
Other USDA	$985.00	$970.00	$1,040.00	$1,096.00	$794.00	$4,885.00
Other Federal	$4,182.00	$4,376.00	$9,182.00	$7,675.00	$11,268.00	$36,683.00
State Appr.	$9,779.00	$12,027.00	$13,599.00	$15,263.00	$17,700.00	$68,368.00
Self-Gen	$1,494.00	$3,719.00	$4,592.00	$4,403.00	$4,914.00	$19,122.00
Ind/Gr Agrmt	$1,357.00	$2,668.00	$4,026.00	$2,807.00	$4,490.00	$15,348.00
Other Non-Fed	$719.00	$1,590.00	$4,852.00	$1,298.00	$1,231.00	$9,690.00
Total	$24,339.00	$40,636.00	$49,901.00	$46,683.00	$54,510.92	$216,069.92

KA 305: Animal Physiological Processes Overall Funding						
(as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$11,402.00	$8,632.00	$9,595.00	$8,381.00	$8,632.30	$74,331.30
Other USDA	$554.00	$945.00	$776.00	$499.00	$1,324.00	$4,098.00
Other Federal	$16,760.00	$20,717.00	$46,504.00	$18,072.00	$153,243.00	$255,296.00
State Appr.	$22,972.00	$21,327.00	$31,273.00	$25,080.00	$30,396.00	$131,048.00
Self-Gen	$3,307.00	$2,410.00	$4,727.00	$2,764.00	$5,446.00	$18,654.00
Ind/Gr Agrmt	$4,012.00	$4,054.00	$5,692.00	$3,189.00	$4,365.00	$21,312.00
Other Non-Fed	$2,005.00	$1,924.00	$3,571.00	$1,341.00	$2,750.00	$11,591.00
Total	$61,012.00	$60,009.00	$102,138.00	$59,326.00	$206,156.08	$488,641.08

KA 306: Environmental Stress in Animals Overall Funding						
(as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$1,359.00	$2,163.00	$2,248.00	$1,935.00	$3,285.56	$10,990.56
Other USDA	$630.00	$850.00	$881.00	$922.00	$563.00	$3,846.00
Other Federal	$1,475.00	$2,338.00	$2,954.00	$1,475.00	$1,594.00	$9,836.00
State Appr.	$8,016.00	$7,758.00	$7,213.00	$7,358.00	$5,655.00	$36,000.00
Self-Gen	$1,302.00	$1,611.00	$2,035.00	$2,180.00	$1,996.00	$9,124.00
Ind/Gr Agrmt	$1,576.00	$1,455.00	$1,049.00	$1,489.00	$917.00	$6,486.00
Other Non-Fed	$750.00	$1,287.00	$1,198.00	$1,231.00	$1,082.00	$5,548.00
Total	$15,108.00	$17,461.00	$17,578.00	$16,590.00	$15,092.56	$81,829.56

KA 307: Animal Production Management System Overall Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$13,138.00	$13,218.00	$13,726.00	$14,447.00	$21,152.40	$75,681.40
Other USDA	$553.00	$433.00	$3,414.00	$506.00	$3,706.00	$8,612.00
Other Federal	$1,239.00	$1,282.00	$5,382.00	$1,251.00	$3,394.00	$12,548.00
State Appr.	$17,338.00	$19,422.00	$25,471.00	$17,961.00	$28,402.00	$108,594.00
Self-Gen	$5,679.00	$9,519.00	$7,226.00	$4,006.00	$7,257.00	$33,687.00
Ind/Gr Agrmt	$1,347.00	$1,432.00	$1,821.00	$1,876.00	$3,170.00	$9,646.00
Other Non-Fed	$1,613.00	$2,211.00	$2,887.00	$1,653.00	$2,890.00	$11,254.00
Total	$40,907.00	$47,518.00	$59,927.00	$41,701.00	$69,971.60	$260,024.60

KA 308: Improved Animal Products (Before Harvest) Overall Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$1,881.00	$2,624.00	$3,005.00	$5,162.00	$3,900.42	$16,572.42
Other USDA	$280.00	$310.00	$408.00	$103.00	$407.00	$1,508.00
Other Federal	$697.00	$834.00	$972.00	$689.00	$906.00	$4,098.00
State Appr.	$5,030.00	$5,386.00	$5,621.00	$3,987.00	$4,656.00	$24,680.00
Self-Gen	$1,293.00	$1,587.00	$1,216.00	$1,131.00	$1,046.00	$6,273.00
Ind/Gr Agrmt	$913.00	$953.00	$752.00	$827.00	$691.00	$4,136.00
Other Non-Fed	$515.00	$579.00	$720.00	$981.00	$320.00	$3,115.00
Total	$10,609.00	$12,272.00	$12,693.00	$12,880.00	$11,926.42	$60,380.42

KA 311: Animal Diseases Overall Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$21,662.00	$34,627.00	$26,296.00	$25,707.00	$28,125.98	$136,417.98
Other USDA	$6,510.00	$6,470.00	$11,329.00	$6,764.00	$11,924.00	$42,997.00
Other Federal	$46,292.00	$48,348.00	$113,649.00	$60,470.00	$307,768.00	$576,527.00
State Appr.	$46,945.00	$45,610.00	$97,391.00	$47,863.00	$109,882.00	$347,691.00
Self-Gen	$8,449.00	$7,799.00	$21,750.00	$5,737.00	$35,821.00	$79,556.00
Ind/Gr Agrmt	$10,548.00	$9,179.00	$19,895.00	$11,233.00	$20,812.00	$71,667.00
Other Non-Fed	$10,335.00	$13,590.00	$28,701.00	$14,985.00	$31,265.00	$98,876.00
Total	$150,741.00	$165,623.00	$319,011.00	$172,760.00	$545,597.98	$1,353,732.98

KA 312: External Parasites and Pests of Animals Overall Funding						
(as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2008**	**Total**
CSREES Admin	$2,649.00	$2,724.00	$2,555.00	$2,636.00	$2,911.60	$13,475.60
Other USDA	$274.00	$298.00	$264.00	$388.00	$392.00	$1,616.00
Other Federal	$981.00	$1,101.00	$2,751.00	$1,068.00	$1,904.00	$7,805.00
State Appr.	$3,489.00	$3,644.00	$4,208.00	$4,086.00	$4,429.00	$19,856.00
Self-Gen	$302.00	$292.00	$535.00	$620.00	$652.00	$2,401.00
Ind/Gr Agrmt	$415.00	$479.00	$491.00	$422.00	$507.00	$2,314.00
Other Non-Fed	$231.00	$241.00	$682.00	$430.00	$516.00	$2,100.00
Total	$8,342.00	$8,779.00	$11,487.00	$9,650.00	$11,311.60	$49,569.60

KA 313: Internal Parasites in Animals Overall Funding						
(as reported by the Current Research Information System)						
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$1,630.00	$1,912.00	$2,144.00	$1,879.00	$3,117.62	$10,682.62
Other USDA	$290.00	$220.00	$389.00	$239.00	$440.00	$1,578.00
Other Federal	$738.00	$1,356.00	$3,556.00	$1,692.00	$2,600.00	$9,942.00
State Appr.	$4,105.00	$4,187.00	$5,534.00	$3,909.00	$5,296.00	$23,031.00
Self-Gen	$114.00	$146.00	$386.00	$125.00	$437.00	$1,208.00
Ind/Gr Agrmt	$676.00	$801.00	$1,056.00	$709.00	$742.00	$3,984.00
Other Non-Fed	$199.00	$169.00	$457.00	$139.00	$182.00	$1,146.00
Total	$7,752.00	$8,791.00	$13,522.00	$8,693.00	$12,814.62	$51,572.62

KA 314: Toxic Chemicals, Poisonous Plants and Naturally Occuring Toxins and Other Hazards Affecting Animals Overall Funding						
(as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$1,449.00	$911.00	$860.00	$954.00	$2,044.82	$6,218.82
Other USDA	$905.00	$936.00	$1,221.00	$572.00	$718.00	$4,352.00
Other Federal	$7,234.00	$6,530.00	$12,603.00	$8,020.00	$9,907.00	$44,294.00
State Appr.	$8,779.00	$7,338.00	$11,258.00	$7,375.00	$11,162.00	$45,912.00
Self-Gen	$863.00	$536.00	$1,087.00	$601.00	$1,077.00	$4,164.00
Ind/Gr Agrmt	$1,547.00	$2,999.00	$1,860.00	$2,482.00	$1,755.00	$10,643.00
Other Non-Fed	$437.00	$597.00	$1,266.00	$596.00	$2,110.00	$5,006.00
Total	$21,215.00	$19,847.00	$30,156.00	$20,600.00	$28,773.82	$120,591.82

KA 315: Animal Welfare, Well Being, and Protection CSREES Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$1,553.00	$2,573.00	$3,771.00	$2,848.00	$4,332.42	$15,077.42
Other USDA	$713.00	$500.00	$510.00	$278.00	$467.00	$2,468.00
Other Federal	$1,049.00	$1,597.00	$4,629.00	$3,221.00	$5,905.00	$16,401.00
State Appr.	$5,704.00	$5,107.00	$6,716.00	$7,332.00	$7,746.00	$32,605.00
Self-Gen	$447.00	$441.00	$592.00	$631.00	$1,304.00	$3,415.00
Ind/Gr Agrmt	$533.00	$667.00	$1,054.00	$1,445.00	$2,256.00	$5,955.00
Other Non-Fed	$529.00	$565.00	$4,374.00	$454.00	$3,301.00	$9,223.00
Total	$10,529.00	$11,450.00	$21,648.00	$16,208.00	$25,311.42	$85,146.42

KA 721: Insects and Other Pests Affecting Humans Overall Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$1,395.00	$1,663.00	$1,889.00	$1,479.00	$2,315.42	$8,741.42
Other USDA	$223.00	$246.00	$354.00	$383.00	$557.00	$1,763.00
Other Federal	$2,909.00	$4,318.00	$6,227.00	$4,101.00	$7,059.00	$24,614.00
State Appr.	$5,390.00	$4,454.00	$7,050.00	$6,856.00	$9,384.00	$33,134.00
Self-Gen	$505.00	$347.00	$391.00	$535.00	$600.00	$2,378.00
Ind/Gr Agrmt	$1,122.00	$1,528.00	$1,084.00	$1,381.00	$1,831.00	$6,946.00
Other Non-Fed	$636.00	$1,008.00	$1,341.00	$827.00	$1,468.00	$5,280.00
Total	$12,180.00	$13,564.00	$18,336.00	$15,562.00	$23,214.42	$82,856.42

KA 722: Insects and Other Pests Affecting Humans Overall Funding (as reported by the Current Research Information System)						
	$ in the thousands					
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	$393.00	$697.00	$2,138.00	$2,111.00	$2,732.41	$8,071.41
Other USDA	$150.00	$304.00	$484.00	$451.00	$355.00	$1,744.00
Other Federal	$2,378.00	$2,490.00	$12,713.00	$5,362.00	$18,564.00	$41,507.00
State Appr.	$2,299.00	$2,837.00	$5,524.00	$5,143.00	$10,479.00	$26,282.00
Self-Gen	$136.00	$171.00	$412.00	$234.00	$523.00	$1,476.00
Ind/Gr Agrmt	$292.00	$339.00	$585.00	$553.00	$1,741.00	$3,510.00
Other Non-Fed	$210.00	$452.00	$1,154.00	$198.00	$540.00	$2,554.00
Total	$5,860.00	$7,290.00	$23,010.00	$14,051.00	$34,934.41	$85,145.41

Appendix D – List of Programs Supporting the Animal Systems portfolio

Programs Related to Portfolio:	
Name of Program	**Contribution to Portfolio**
Hatch	Formula research grant program to the 1862 land grant universities that provides broad funding, including support for this portfolio
Evans-Allen	Formula research grant program to the 1890 land grant universities that provides broad funding, including support for this portfolio
National Research Initiative	Broad competitive research grants program that provides broad funding, including support for this portfolio
Animal Health and Disease/Section 1433	Formula research grant program that provides broad funding to accredited State schools or colleges of veterinary medicine or agricultural experiment stations that conduct animal health and disease research.
Smith-Lever 3(b) and (c)	Formula extension grant program to the 1862 land grant universities that provides broad funding, including support for this portfolio
Federal Admin Grants	Congress directed funds to CSREES to administer certain funds to individual investigators at universities or consortia of universities or further distributed on a competitive basis by the recipient institution.
Special Grants	Congressional Earmarks
Minor Use Animal Drugs	Broad competitive research grants program that provides broad funding, including support for this portfolio
Veterinary Medical Services Act	Veterinary Medicine Loan Repayment Program authorizing the Secretary of Agriculture to carry out a program of entering into agreements with veterinarians under which they agree to provide veterinary services in veterinarian shortage situations

Appendix E - Partnering Agencies and Other Organizations:

Animal System Portfolio Partnering Agencies and Organizations	
Name of Program	**Agency Type**
Agricultural Research Service (ARS)	USDA Agency
Animal Plant Health Inspection Service (APHIS)	USDA Agency
Economic Research Service (ERS)	USDA Agency
Food Safety and Inspection Service (FSIS)	USDA Agency
Foreign Agricultural Service (FAS)	USDA Agency
Department Of Defense (DOD)	U.S. Department
Department of Homeland Security (DHS)	U.S. Department
Department of Health and Human Services (HHS)	U.S. Department
Food and Drug Administration Center for Veterinary Medicine (FDA)	Non-USDA Federal Agency
National Institutes of Health (NIH)	Non-USDA Federal Agency
Centers for Disease Control (CDC)	Non-USDA Federal Agency
Department of the Interior (DOI)	U.S. Department
Environmental Protection Agency (EPA)	U.S. Department
National Science Foundation (NSF)	U.S. Department
National Oceanic and Atmospheric Administration (NOAA)	U.S. Department
Office of Management and Budget (OMB)	U.S. Department
US Agency for International Development (USAID)	U.S. Department
US Geological Survey (USGS)	U.S. Department
Veterans Administration (VA)	U.S. Department
Academy of Veterinary Consultants	Professional Society and Organization
American Association of Avian Pathologists	Professional Society and Organization
American Association of Bovine Practitioners	Professional Society and Organization
American Association of Veterinary Medical Colleges	Professional Society and Organization
American Association of Extension Veterinarians	Professional Society and Organization
American Association of Equine Practitioners	Professional Society and Organization
American Association of Swine Veterinarians	Professional Society and Organization
American Dairy Science Association	Professional Society and Organization
American Society of Animal Science	Professional Society and Organization
American Humane Association	Professional Society and Organization

Animal System Portfolio Partnering Agencies and Organizations	
Name of Program	**Agency Type**
American Veterinary Medical Association	Professional Society and Organization
Council for Agricultural Science and Technology (www.cast-science.org) Morris Animal Foundation	Professional Society and Organization
National Institute for American Agriculture	Professional Society and Organization
Society for the Study of Reproduction	Professional Society and Organization
US Animal Health Association	Professional Society and Organization
American Horse Council	Industry
Animal Agriculture Coalition	Industry
American Sheep Industry Association	Industry
Biotechnology Industry Organization	Industry
Catfish Farmers of America	Industry
Grayson-Jockey Club Research Foundation	Industry
National Cattlemen's Beef Association	Industry
National Chicken Council	Industry
National Milk Producers Federation	Industry
National Pork Producer Council	Industry
National Pork Board	Industry
US Egg & Poultry Association	Industry
Food and Agriculture Organization	Others
Numerous US and foreign universities and colleges via CSREES grants (competitive, formula, special grants, cooperative agreements)	Others

Appendix F - Program Evaluations:

Animal Systems' Program Evaluation of the National Animal Health Laboratory Network				
Date	**Type of Evaluation/Analyses**	**Brief Description**	**Evaluation Recommendations**	**What Was the Effect**
3/Sep/2007	After five years of operation, the need for and value of an evaluation of the National Animal Health Laboratory Network (NAHLN) was identified by the cooperating partners through the NAHLN Steering Committee. In early 2007, the NAHLN Steering Committee (which is composed of representatives from AAVLD, the United States Animal Health Association, the Assembly of Chief Livestock Officials, USDA APHIS and CSREES) asked that a group be assembled to evaluate the NAHLN. The proposed plan was to conduct a three-phased evaluation, with Phase 1 being to identify the five or six key areas of the NAHLN to examine further in subsequent phases of the evaluation. It is anticipated that a phase 2 and, if needed, a phase 3 would engage a broader range of expertise, using various analytical methods and tools to gather data and make specific recommendations.	Evaluation of NAHLN review covered how well NAHLN met or is meeting its original objectives, how it needs to proceed for the future and what objectives need to change. The group that was assembled to conduct Phase 1 was comprised of NAHLN partners and stakeholders. Specifically, the group was asked to identify the initial and current objectives of the network, how well NAHLN met or is meeting those objectives and whether changes in objectives are needed	The following recommendations were made after the review: 1. NAHLN Program Leadership, Management and Organization- evaluation of the adequacy and the need for change in the current NAHLN management and organization. Assessment of federal and state roles in the network and stakeholder input. 2. Lab Network Structure- Reassessment of laboratory network structure concerning the number, types and responsibilities of the labs. 3. Information Technology: Examine project management and direction of the Information Technology component of NAHLN 4. Communication: To find the best mechanism(s) to inform and educate stakeholders on NAHLN network activities 5. Priority Agents: To reassess the list of priority agents and provide recommendations on changes to the list 6. Laboratory Quality: To provide thorough investigation, recommendations that will ensure the labs are meeting the expected quality standards.	In part, the effect was a change in structure of the leadership of NAHLN, a clearer definition of responsibilities and initiation of closer examination or progress and priorities.