

Application for Nomination to the 2011 Experiment Station Section Excellence in Multistate Research Award

Nominating Region: Southern Region

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Project or Committee Number and Title:

S-1032 Improving the Sustainability of Livestock and Poultry Production in the United States

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Situation statement:

From the very founding of this country, the U.S. has enjoyed a diversity of agricultural production systems, including livestock and poultry, affording the population attractive choices of healthy and high value food and fiber. As with all production sectors around the globe, pressures from population growth, increasing income and consumption, diminishing resource base, economic competition, and environmental concerns have necessitated structural and technological changes in agriculture. S-1032 scientists, engineers, economists, educators, and policy makers have joined to holistically address the environmental, natural resource use and energy issues facing the North American livestock and poultry industries. The intertwining of problem-solving enterprises led to a bold approach in conceptualizing the S-1032 project that involves these various disciplines in describing functions and interactions of livestock and poultry production with the environment at local, regional, and global scales. Such a new approach positions S-1032 at the heart of the livestock industry's research needs, while placing science and engineering within reach of policymakers as they address questions of sustainability.

Project objectives:

Objective (1) Develop models of each animal industry that describe its cumulative ecological risk, as a function of the stocks, flows, and transformations of matter and energy in concentrated animal feeding operations. S-1032 members conduct research and develop ways to: (2) improve land application of manure, (3) treat manure to meet environmental goals and improve farm profitability, (4) reduce undesirable airborne emissions from livestock and poultry farms, and (5) feed animals strategically to reduce excretion of environmentally sensitive nutrients.

Outcomes (typical, not an exhaustive list):

To achieve project objectives, a holistic approach is needed. Included is the consideration of all aspects of livestock production from birth to final marketing including feeding formulations, manure resource recovery, and management models. Details are listed below.

Science-enabled refinements of basic animal husbandry processes

- Dramatically reducing excretion of phosphorus by pigs and poultry, by the introduction of synthetic phytase enzyme in the diets – what are the best practices, costs, and benefits
- Demonstrating the effects of feeding supplemental amino acids, excess nutrients, and reduced sulphur on air emissions of undesirable compounds due to poultry.
- Demonstrating the effects of inclusion of DDGS and alternate sources of mineral supplement on air emissions of undesirable compounds by pigs and poultry.

Creative approaches to established management practice components

- Demonstration of refined wastewater treatment systems to produce re-usable water in dairy facilities using constructed wetlands, bark filter mounds, anaerobic digestion, and nitrification and denitrification.

- Improvement of vegetative and aquatic systems that “polish” wastewater to sequester nutrients in a harvestable crop.
- Use of black soldier flies to digest manure and produce a valuable animal feed which can also reduce swine manure odor.
- Development of new standards including ASAE D384.2 Manure Production and Characteristics, a universal methane productivity equation, and air emissions measurement standard equipment and procedures.

New technologies and methods

- Discovery of a newly isolated treatment bacterium for removing ammonia and greenhouse gases from livestock wastewater promises to reduce wastewater treatment costs and mitigate environmental impacts.
- Development of a continuous thermochemical conversion process for making crude oil product from manures and other agricultural by-products is nearing commercialization.
- Development of protocols to examine effects of blending manures with other agricultural wastes to maximize energy production by effectively using manure nutrients.
- Mapping of waste biomass and modeling of net energy potential to encourage blending of agricultural residuals to maximize the potential of biomass conversion technologies.

Addressing emerging areas of concern in environment and energy

- Investigation of antibiotic resistant organisms in manure and the fate of endocrine disruptors in runoff from land application sites. Studies of *E-coli* bacteria in rural streams provide valuable information on contributions by livestock and wildlife in watersheds with pasture settings.
- Pilot-scale tests of on-farm gasification of manure to produce energy provided technical data on syngas volume and composition from poultry litter and dairy manure solids.
- Efforts at systems modeling of carbon footprint and lifecycle analyses of potential changes to livestock and poultry production address environmental and energy concerns.
- Establishment of the Environmental Collaborative on Sustainable Environmental and Agricultural Management (ECOSEAM) that is developing upper level undergraduate, low level graduate classes, and continuing education modules on agricultural watershed management and environmental issues at rural/suburban interfaces.

Applying economics to analyze efficient use of increasingly scarce resources

- Inclusion in systems modeling efforts of the costs and benefits of inputs consumed and outputs generated by manure management systems, land application methods, and changes in livestock production systems to address environmental and energy concerns.

Impacts:

S-1032 is engaging a team of key collaborators in building process models to develop and improve management technologies. Modeling results will provide policymakers with the science-based information needed to refine local, state, and federal regulations and will enable researchers to identify and address changing environmental priorities. In 2010, *S-1032* members reported on 5 projects for Objective 1 and 28 projects relating to Objective 2 through 5. Members also reported the publication of 24 journal articles, 12 conference presentations and/or proceedings, and 5 extension and web related guidance documents relating to *S-1032* objectives.

Project members authored most of the chapters and reviewed and pilot tested the entire Livestock and Poultry Environmental Stewardship national curriculum (www.lpes.org), which is now a widely recognized text defining livestock manure management and odor control

technologies. Various states use the LPES curriculum in Extension training environments. An augmented LPES effort on the eXtension platform features S-1032 members as experts.

In many states, science-based information from S-1032 and predecessor projects has been shared with community members to clarify the actual environmental impacts of livestock systems. Such dialogue is critical in acceptance of existing and proposed production practices.

Results of animal diet changes, based on S-1032 member research, have shown huge reductions of 30-50% in the amounts of phosphorus excreted by swine and poultry, and the potential to limit undesirable air emissions with no harm to animal health or performance.

New manure treatment methods present more options for a livestock industry that is struggling to remain competitive and environmentally responsible. Protocols on modeling and testing of blended waste agricultural residuals are complete; over 200 different blends have been screened for synergistic and antagonistic trends. A member state instituted a waste biomass inventory that predicts the quantity of biomass and net energy from multiple sources, including manure, within a selected radius around a specific location.

The S-1032 member-led field manual, 'Managing contaminated animal and plant materials: Field guide on best practices' (<http://tammi.tamu.edu/MortalityTSWGguide-2008.pdf>) won the American Society of Agricultural and Biological Engineers 2009 Blue Ribbon Educational Award in the comprehensive publication category.

The S-1032 annual meeting has established an active venue for graduate student participation in trans-disciplinary topics related to the ecological sustainability of livestock and poultry production systems. Additionally, S-1032 member-led manure management educational programs such as the 2009 Texas Animal Manure Management Issues Conference in Round Rock, Texas, provide venues to share information with producers, scientists, regulators, agriculture business personnel, students, and media. Media coverage of related issues appeared in the Houston Chronicle (<http://www.chron.com/disp/story.mpl/business/energy/6649844.html>) and the New York Times (<http://www.nytimes.com/2009/12/29/science/29manure.html>).

Newly formed links to eXtension:

S-1032 comprises a membership of faculty with research, teaching, and extension appointments. In addition to exploiting the extension linkages made available by virtue of appointment, S-1032 is collaborating with eXtension projects to get information to public stakeholders (example: http://www.extension.org/animal_manure_management).

Collaborations:

Building on the past, S-1032 takes a systems approach to merge members' knowledge into a collection of models of each animal industry that describe its cumulative ecological risk or footprint as a dynamic, nonlinear function of the stocks, flows, and transformations of matter and energy comprising CAFO systems. New collaborations are incorporating process-oriented research of members into models that aid our understanding of interactions of the system. S-1025 has met jointly with S-1032, providing valuable interaction between the two committees. These two regional committees have met jointly with the NIFA NRI Air Quality Project Directors and the eXtension Livestock, Poultry and the Environment Learning Center.

Leveraged Funds:

Grants attributable to the project demonstrate relevance of the research and demonstration with a total of over \$10.27 million in grants with 65% federal, 31% other and 4% commodities from September 2007 to 2010. Details are available upon request.