**Nomination to the 2021 Experiment Station Section Award for Excellence in Multistate Research**

**Nominating Region:** Southern Region
**Nominator:** Wendy Powers **E-mail:** wendy.powers-schilling@ucop.edu
**Project or Committee Number and Title:** S-1074, Future Challenges in Animal Production Systems: Seeking Solutions through Focused Facilitation
**Technical Committee Chair:** Lide Chen **E-mail:** lchen@uidaho.edu
**Administrative Advisor:** Wendy Powers **E-mail:** wendy.powers-schilling@ucop.edu

**Issue, problem or situation addressed**:

S-1074 was designed to build from a systems-based framework to meet the food needs of the ever-increasing population by evaluating resources and efficiencies in animal protein production. S-1074 members joined to holistically address the environmental and natural resources use issues facing US livestock industries with an approach that involves inter- and transdisciplinary personnel in describing functions and interactions of livestock production with the environment at local, regional, and national scales. Such a new approach positions S-1074 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.

Each S-1074 participant brings individual research strengths, outreach initiatives, and partnerships that enhance our ability to address the challenges and opportunities facing animal production systems. This nomination focuses on three synergistic and added-value initiatives for S-1074 with tangible outputs, outcomes, and impacts. These initiatives are: **Engaging the Next Generation**; **Assessing and Addressing Nutrient Imbalance**; and **Collaborative Growth**.

**Project objectives:**

(1) Create issue-focused adaptive networks that transcend discipline and stakeholder boundaries, now and into the future.

(2) Synthesize data, analytical tools and communication mechanisms to analyze animal protein supply chain sustainability metrics on various spatial and temporal scales.

(3) Propose solutions, through research and Extension directions to significantly contribute to sustainable animal protein systems and food security.

**Outputs** *(typical, not an exhaustive list):*

- 67 graduate students trained in cohort challenges designed to build team skills while focusing on a societal issue involved in animal protein production through INFEWS-ER building capacity NSF funded grant addressing the Nexus of Food Energy and Water, in addition to graduate students mentored by the S-1074 members.
- A manuscript Identifying Nutrient Imbalance in Animal Agriculture Systems.
- An issue-focused adaptive network to Assess and Address Nutrient Imbalance. This initiative started with S-1074 group and grew through involvement with USDA-ARS researchers, USDA-Animal and Plant Health Inspection Service (APHIS) scientists, EPA scientists, and the Livestock and Poultry Environmental Learning Community (LPELC). The network is poised for additional growth through collaboration with a national conference (Waste to Worth) and publications.
- Quarterly technical webinars, periodically integrated with stakeholder organizations like the LPELC.
- A substantive network of journal papers (112), proceedings (83), Extension articles (80) and curated databases (i.e. Manure Value Library) from individual members since 2018.

- Over $10.4 million of grants attributable to the project since 2018.

**Short-term outcomes:**

- *Engaging the Next Generation* and welcoming graduate student participation in S-1074 meetings. This is often students' first exposure to multi-state research teams, in addition to issue-based technical content. More in-depth training and engagement is facilitated through the INFEW-ER cohort challenges. These experiences enhance graduate student training through exposure to capture diversity (cultural, geographical, and political) that affects animal production. Moreover, the students gain colleagues.
- Sharing approaches to *Assessing and Addressing Nutrient Imbalance* and experiencing *Collaborative Growth* by organizing/co-organizing webinars. S-1074's internal webinar series has expanded our network to new disciplines and organizations by invitation. Also, S-1074 co-organized a national webinar with the LPELC that reached over 50 participants who informed over 9000 producers across the US and Canada. The webinar, entitled "Watershed Nutrient Inventories-Opportunities and Needs", provided an opportunity to both learn and share with EPA scientists who were particularly interested in our efforts to estimate manure nutrients from livestock and poultry, to refine nutrient inventories for larger watersheds.
- *Addressing emerging areas of concern in livestock operations* such as (1) establish and disseminate tips for bulk milk disposal on dairy farms, and (2) develop and launch a virtual reality (VR) delivery platform for a nationwide quick shift to online delivery of educational programs in animal waste management field as a result of COVID-19.

**Medium-term outcomes:**

- *Engaging the Next Generation* through training in transdisciplinary research skills. The application of transdisciplinary research skills is evidenced by the products emanating from cohorts. Additional behavior changes are expected by the stakeholders for the various projects. One cohort's process was shared back to S-1074, resulting in our team adopting a practice.
- *Assessing and Addressing Nutrient Imbalance* experiences influence changes of policies and regulations. For example, results of the research done by S-1074 members from UC Davis reported to California Department of Food and Agricultural and California Air Resources Board have provided the scientific data for policies and regulations.
- *Development of technical standards* S-1074 members led or engaged in development of four ANSI/ASABE technical standards, including *ASAE S292.6 SEP 2019 Uniform Terminology for Agricultural Waste and By-Product Management*. These standards dictate the norm for data, practices and technology moving forward.

**Long-term outcomes:**

These three initiatives will enhance the sustainability of animal protein production through a well-trained next generation of transdisciplinary scientists to ensure science-based policies and regulations. This group has been and continues to work with regulatory agency personnel at the national and state levels to inform sound policy development.

**Impacts:**

- *Engaging the Next Generation*: Cohorts of graduate students are actively tackling 5 challenges (details are available upon request) that impact animal production systems with novel approaches and sharing their creations with stakeholders from across the US. Since its inception, five cohort groups (67 graduate students) participated in challenges. These graduate students represent the next generation of scientists to tackle national and global issues. Graduate student participants gain insight through experience to engage successfully

with individuals from other disciplines and understand more fully concepts around transdisciplinary work through exercises in systems thinking, stakeholder engagement, a topical subject matter and high performing team development. In addition to team science skills, the S-1074 and INFEWSer projects provide the students with expanded networks of peers, faculty and stakeholders, and vice versa.

- *Assessing and Addressing Nutrient Imbalance:* S-1074 has collectively authored a white paper, Identifying Nutrient Imbalance in Animal Agriculture Systems, defining core concepts of measuring nutrient balance, assessing strengths and weaknesses of alternative approaches, and recommending direction for future scientific and application endeavors. Quantifying nutrient fluxes and balances in animal/feed production systems is essential to identify farms and regions with challenging nutrient imbalances, assess animal agriculture's circularity and inform interventions.
- *Collaborative Growth:* Past and future collaborations are examples of win-win situations that enhance awareness of S-1074 through existing networks and communication mechanisms. Through the co-organized webinar of S-1074 and LPELC, S-1074 was able to reach an audience more than double an internal webinar, an audience that engages over 9000 producers each year. In turn, S-1074 members took on organizational roles and expanded LPELC's network as well. In many states, science-based information from S-1074 members has been shared with individuals from community members to regulatory agency staff to clarify the actual environmental impacts of livestock systems.

**Added-value and synergistic activities across mission areas:**

- *Engaging the Next Generation:* The funded mechanism for the majority of grad student work came from cooperation of S-1074 (formerly S1032) members. S-1074 members formed an initial network of collaborators for the INFEWSer project. In turn, the cohorts have shared back team science and technical approaches and outcomes that provide direction for S-1074 - particularly in the area of livestock siting and community relationships.
- *Assessing and Addressing Nutrient Imbalance*: Almost all S-1074 members are engaged in some form of research, Extension or outreach related to nutrient balances in their respective states. In comparing and contrasting the different state and regional work through S-1074 events (online and annual meetings), two primary questions arose: (1) what constitutes an imbalance? and (2) what are solutions? By coming together, pooling expertise, time and resources, we compiled a summary of nutrient balance approaches for different scales. In many cases, this involved bringing in partners of individual members to engage with the issue-focused team.
- *Collaborative Growth*: Through collaboration with LPELC, S-1074 was able to reach an audience more than double an internal webinar. In return, S-1074 members took on organizational roles for LPELC's activities and expanded LPELC's network as well. We are looking to future collaborations to coordinate a program within the 2022 Waste to Worth Conference to explore next steps for addressing Nutrient Imbalance. This reduces time and travel resources and expands the potential audience for both S-1074 initiatives and Waste to Worth programs.

**Evidence of multi-institutional and leveraged funding with examples of sources:**

Grants attributable to the project demonstrate relevance of the research and demonstration with a total of over $10.4 million with 66.2% of those funds from federal sources since 2018. Details are available upon request.

**Participating institutions and units**
Cornell University
Iowa State University
Kansas State University*
Michigan State University
North Carolina State University
North Dakota State University
Ohio State University
Oklahoma State University
Purdue University*
South Dakota State University
Texas A&M University
University of Arkansas
University of California Davis
University of Georgia
University of Idaho
University of Illinois at Urbana-Champaign
University of Minnesota
University of Missouri
University of Nebraska-Lincoln
University of Wisconsin
Virginia Polytechnic Institute and State University
*participated but not an official institution of the S1074