Integrated Resource Management Tool to Mitigate the Carbon Footprint of Swine Produced in the U.S.

NIFA Grant no. 2011-68002-30208

United States Department of Agriculture

National Institute of Food and Agriculture

Background/Rationale

The global agricultural system must feed an 2.5 to 3 billion more people in 40 years. Continued improvement in efficiency and productivity of agricultural systems is needed given indications of resource limitations. GHG emissions from agricultural systems are a current focal point. While agriculture has made progress in productivity over several decades, there are few system scale analyses of agricultural production combining economic and environmental concerns. We are taking an initial step towards developing experimentally validated fully integrated process-based systems analysis and decision support tools for agriculture. Our narrow goal is creating tools enabling swine production to maintain the trajectory of continued profitability and improvement (reduction) of adverse environmental impacts.

Program Overview

Life Cycle Thinking Principles

LCA as the framework for the project

Modeling

Barn, Animal, Manure, Supply Chain, Economic

Experimental

Rations, Health Status, Manure Management

Laboratory Scale: manure bioreactors

Pilot Scale: Solids separation, gasification, Algae biomass

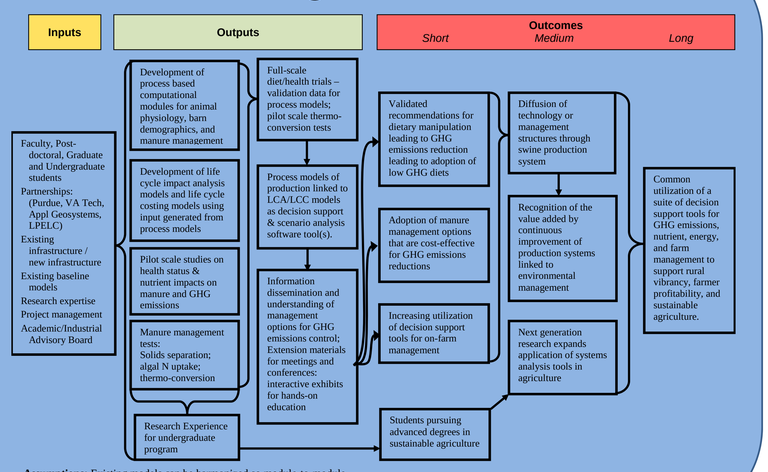
Full Scale: 720 animal: ration and health status

Education and Extension

Research Experience for Undergraduates

LPELC – outreach to research and extension communities

Logic Model



Assumptions: Existing models can be harmonized so module-to-module communication is seamless; education and outreach can result in change; improved productivity increases profitability and reduces adverse impacts

External Factors: economic considerations impacting adoption rates of GHG emissions reducing technologies; cultural resistance to change

Project Team Members

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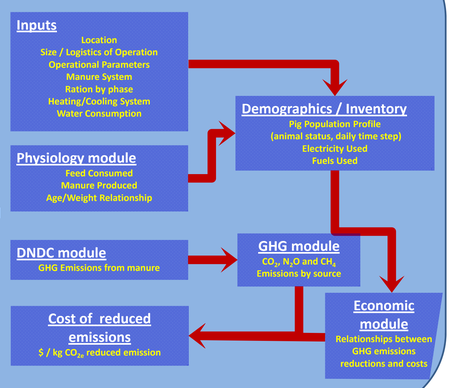
Research

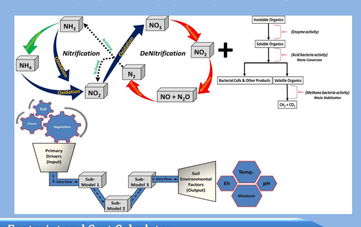
GHG Emissions Modeling with Economics

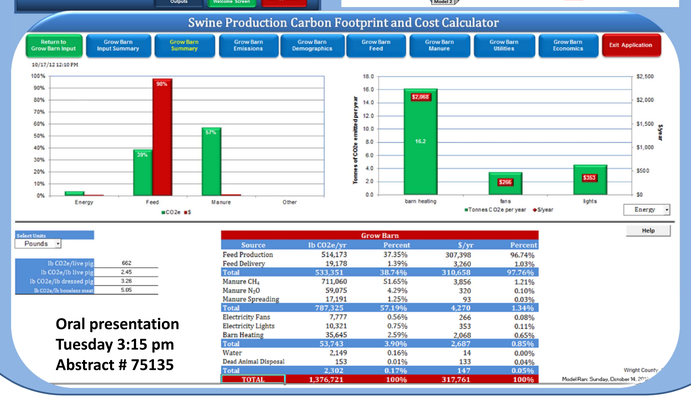
GHG mitigation decisions in the context of maintaining economical food production facilitated by a software tool that models complex interactions of GHG emission and economic factors.

- Linking economic analytics with GHG model for estimation of differential costs
- "What-If Scenarios" to support decisions regarding adoption of management practices.



GHG Calculator: DNDC & Economics





Oral presentation
Tuesday 3:15 pm
Abstract # 75135

Algal Turf Scrubber System

Inclusion of algal biomass production in liquid manure systems as an energy biomass crop could provide additional farm revenue while transferring excess nutrients off farm.

Solids Separation

Nutrient, especially P, management concerns suggest increased use of manure solids separation technologies; solids used for off farm land application or energy conversion

- Provide manure solids for energy conversion studies.
- Quantify system performance to enable GHG emission modeling and impacts on manure management

Thermo-Chemical Conversion

When available manure exceeds crop production needs, exporting dry manure or algae biomass for thermo-chemical conversion into bioenergy is of interest.

- Quantify energy production from manure and algae feed stocks and chemical composition of resulting bio-char

Amino Acid Substitution
UID: 75311

Health Status Studies

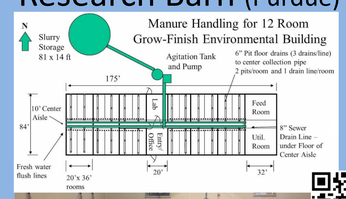
Animal health challenges reduce performance, increase nutrient excretion, and potentially increase emissions

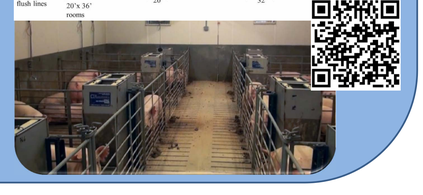
- Evaluate the effects of health status on GHG emissions
- Pilot studies at Arkansas and Virginia Tech
- Full-scale trials at Purdue

BSL-2 facility, Salmonella and PRRS challenges; manure fed:

- 12 Manure reactors
- 4L/min controlled airflow
- Temperature sensors, gas monitors

Swine Environmental Research Barn (Purdue)





Education & Extension

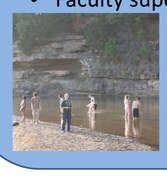
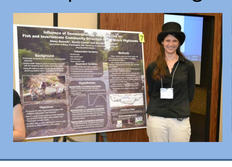
Research Experience for Undergraduates

10 week summer research program

- Ecosystem services, sustainability, and application of scientific method

Skills development workshops

- Microsoft excel®, statistics, technical writing, poster creation
- Faculty supervised postdoc and graduate student mentorship


National Extension Effort

Member of Livestock Environmental Learning Center leadership

Liaison approach to migrate project information to web

Information delivery over life of project

- Integrated Resource Management Tool to Mitigate the Carbon Footprint of Swine Produced in the U.S.
- Life Cycle Assessment Modeling for the Pork Industry"

Arkansas Ag-in–the-classroom

- Scenario based critical thinking exercise for implementation in Arkansas High Schools science classrooms

Expected Program Outcomes

Climate change is a complex issue with very large cost/benefit uncertainties.

The decision support tool built from:

Validated process models of animal performance and barn demographics including manure characteristics and biogeo-chemical models of manure management linking quantifiable GHG emissions reductions with economic analysis

Will enable extension agents and farmers to:

Assess management options' fiscal and sustainable outcomes
Optimize costs/benefits of GHG mitigation strategies
Benchmark and document GHG reductions

And provide research, education and policy support enabling:

Economic projection to guide policymakers in influencing new technology adoption, and implementation of education and outreach programs linking life cycle analysis, climate and swine science, to foster life cycle thinking in agriculture

This research is part of the program "Climate Change Mitigation and Adaptation in Agriculture," and is supported by Agriculture and Food Research Initiative Competitive Grant no. 2011-68002-30208 from the USDA National Institute of Food and Agriculture. Project website: http://www.agroclimate.org/seclimate/. The project team is comprised of faculty, staff, and students from the following: Purdue University, Virginia Technological University, and the University of Nebraska.

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