RESEARCH ABSTRACT

ENVIRONMENT

Title: Integrated GHG Emissions and Tradeoff Cost Model for Swine Barn Operations – **NPB #11-086**

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Abstract

In 2009 the National Pork Board (NPB) funded a group at the University of Arkansas to develop a greenhouse gas (GHG) calculator that would estimate the total emissions from all significant sources in a swine barn operation. This first phase concluded in March 2011 with the release of Live Swine Carbon Footprint Calculator Version 1, which was distributed freely beginning in June 2011. That calculator was designed to estimate the amount and sources of greenhouse gas (GHG) as CO_{2e} emissions associated with swine production activities. The calculator included separate models for sow barns and grow barns, the latter covering nursery, nursery/finish and grow/finish operations. The program was designed to run on a PC and no data were sent through the internet or stored within the program. It was the most comprehensive GHG emissions calculator in agriculture. However, the model did not estimate the economic costs associated with these activities that generate emissions. By adding economic cost components, both emissions and costs can be compared across multiple production strategies so that cost-effective methods to reduce farm-level GHG emissions may be identified.

In 2011, the University of Arkansas was awarded a grant from the National Pork Board to facilitate the development of Version 2 of the Calculator which would include the development of an economic component and further improve its overall capabilities and scope. Specifically, the work promised consisted of three tasks:

- **Upgrade Version 1** with a translation of all code from MatLab to C# and improve the GHG emissions code to include a wider range of manure handling systems, feeds, temperature control strategies, barn constructions and other types of hardware and operational variations not covered in Version 1.

- **Create and add in the economic model** to calculate the costs associated with activities that generate GHG and also asses the cost (or reduction in cost) associated with reducing the carbon footprint of swine production operations.

- **Improve the animal physiology model** to better link animal feed, growth rates, and manure production/composition.

Version 2 of the calculator, (now titled the Pig Production Environmental Calculator) was delivered on time to the National Pork Board late May 2013. This version contained most of the specified upgrades including:

- Translation of the code from MatLab to C# for faster runtimes and better compatibility with a wide range of computers.
- Development of an improved Excel-based, user friendly interface that allows input scenarios to be saved and results to be printed.
- Development of a detailed user guide with step by step instructions for data input and explanations of all model output.
- Addition of water usage and GHG emissions from its acquisition and distribution, counties expanded to match the 2010 census, and addition of code for emissions due to manure delivery and application.
- Improvements to the animal physiology model.
- Expansion of the available feeds for diet development to 162 ingredients
- Integration of an economic module that calculates costs associated with production activities that generate greenhouse gas emissions
- Integration of a comparison module that calculates the changes in emissions and costs that result when production activities are changed

We intended to include DNDC into Version 2 but the DNDC group was unable to provide working code in time for it to be added to the project. We instead utilized our own set of manure system Tier 2 models for subfloor, deep pit, lagoon and outside storage. Without DNDC we could not include emissions after field application, although we were able to calculate emissions from manure transport and land application. In the proposal we indicated that we would perform a

substantial update to the animal physiology equations. Some of that was accomplished for Version 2 but the inclusion of NRC equations was not completed by the release date. However, the NRC equations have been successfully added to the model under this contract period and will be in Version 3.

Additionally we have provided educational opportunities for two PhD students, three MS students and two undergraduate student throughout the project. Fifteen oral and poster presentations have taken place or been accepted related at regional, national and international professional meetings. The Calculator will be used extensively in an undergraduate environmental economics class in Spring 2014. Journal articles are targeted for submission early in the new year. Details related to these activities are described in the report below.