Greenhouse Gas Emission Study and Model for Swine Barn Operations

Dr. Rick Ulrich
University of Arkansas
ruulrich@uark.edu
(479) 575-5645
June 15, 2012
Webinar

Two Topics for This Talk

How much GHG is emitted from pig farms?
From where?
Univ. of Arkansas Study, 2009 - 2010
Greg Thoma was lead, gthoma@uark.edu

What can be done to lower those emissions?
The Live Swine Carbon Footprint Calculator
Rick Ulrich is lead, ruulrich@uark.edu.
Version 1 released by the NPB May 2011

Both efforts were funded by the National Pork Board

The Emission Study

Purpose: Determine the amounts and sources of GHG emissions from the pork supply chain.

Focused on GHG emissions, expressed as CO₂eq
CO₂, CH₄, N₂O, refrigerants

Scope was “cradle-to-grave”
= from growing feed to throwing away the bones

Data obtained from literature, government, NPB, databases, but not from actual farms.

The archived presentation is available at:
http://www.extension.org/pages/21819/chronological-webcast-archive
Where are GHG's Emitted from the Pork Supply Chain?

Relative Contributions from the Supply Chain

Pig farms contribute only 0.35% of U.S. GHG emissions.

Pork Compared to Other Protein Sources

We calculated:
- 2.87 lb CO₂e/lb live weight
- 3.83 lb CO₂e/lb dressed carcass
- 5.90 lb CO₂e/lb boneless meat

The archived presentation is available at:
http://www.extension.org/pages/21819/chronological-webcast-archive
Conclusions from the Emission Study

**Manure and feed are the most important contributors of GHG from the pork supply chain.**

Energy savings would not have a profound impact on GHG emissions for the pork farm. Solar cells on top of barns won’t help much.

Emissions from manure can be profoundly affected by farm location due to temperature effects.

Emissions from feed are affected by farm location due to fertilizer, transportation, and availability effects.

The Model

A predictive tool for determining the impact of choices in farm operations and hardware.

You describe your farm, it tells you how much GHG emitted and from where.
The NPB GHG Model Predicts Emissions From . . .

Feed Production
- fertilizer production, crop production
- raw materials, fuels, delivery from mill to pork farm

Manure Systems
- CH₄, N₂O from various treatment and holding systems
- application to field by truck or umbilical hose

Barn Heating and Cooling
- database of temperature and humidity for 630 locations in U.S.
- natural gas, liquid propane
- vent and forced cooling fans
- cooling cells
- piglet heaters by lamp or pad (for sow barn)

Barn Lighting

Water Acquisition
- well, piped-in

Disposal of Dead Animals
- incineration, composting, rendering

Gilt Delivery (for sow barn)
- trucking fuels

Example:

Sow Barn in Wright County, IA

Inputs are designed to be information the farmer would know or could easily find out.

The archived presentation is available at:
http://www.extension.org/pages/21819/chronological-webcast-archive
User doesn’t have to know the quantity of feed used, the program knows how much a pig eats.

The program has 63 feeds in its database.

The program calculates the amount of electricity and heating fuels required to meet the barn’s heating/cooling requirements for the local climate.

The archived presentation is available at:
http://www.extension.org/pages/21819/chronological-webcast-archive
The program predicts feed consumption based on published animal models and barn population profile.
Output: Greenhouse Gas Emission Summary

The Demographic Model, What’s Going on in the Barn?

The calculator does not use an “average pig” approach. Our philosophy is to track: Every Pig Every Day . . . to get a one-year average for the operation.

Emissions from Barn Heating and Cooling

The model calculates the electricity to the cooling and venting fans and the gas or propane to the barn heaters every hour of every day based on local hourly temperature and relative humidity.

The archived presentation is available at:
http://www.extension.org/pages/21819/chronological-webcast-archive
Emissions from Manure Storage/Handing

The demographic model calculates the amount of manure produced and this is passed on to an emission model.

- **Input:** kg manure produced
- **Output:** kg CH4/year, kg N2O/year

**Calculate Gas Emissions**
- **Subfloor then Lagoon**
- **Subfloor then Outside Storage**
- **Deep Pit**
- **Deep Bedding**

Calculate to CO2e

We’ll run the example case I just showed you in Wright County IA and change just the manure handling method:

- Subfloor then Lagoon
- Subfloor then Outside Storage
- Deep Pit

Manure Handling: Subfloor then Lagoon

The archived presentation is available at:
http://www.extension.org/pages/21819/chronological-webcast-archive
Manure Handling: Subfloor then Outside Storage

We'll compare Subfloor then Lagoon in Wright County IA and in Duplin County NC.
Wright County, IA Duplin County, NC

Subfloor then Lagoon

Warmer climate in NC results in increased manure decomposition to methane in the lagoon.

Warmer climate in NC requires more electricity for cooling fans but less natural gas for barn heating.

Net emissions from heating + cooling less in NC.

The archived presentation is available at: http://www.extension.org/pages/21819/chronological-webcast-archive
Let's look at the environmental economy of scale.

Sow Barn with 100, 200, 1000 and 5000 sows

Wright County, Iowa
80% replacement/yr with gilts
5% sow mortality/yr
8 ft²/pig
subfloor + lagoon
spreading by truck
natural gas, forced ventilation, cooling cells, piglet heating pads

Emissions per kg market sow decreases with the size of operation

![Graph showing emissions per kg market sow decreases with size of operation]

Cost of Reduced Emissions

Inputs
Emissions
Size of Operation
- # pigs, culling, delivery
Barn Characteristics
- Type of Manure System
- Treatment, spreading
Types of Feed
- Heating/Cooling System
- Water Consumption

Farm Model Predicts
- Pig population
- Age, weight, farrowing
- Feed consumed
- Manure produced
- Electricity used
- Fertilizer used

GHG Model Calculates
- CO₂, N₂O, CH₄ emissions by source in barn

Economic Model
Operating cost calculations

Coming Soon: We're adding an econ module.

The archived presentation is available at:
http://www.extension.org/pages/21819/chronological-webcast-archive
Conclusion

The Univ. of Arkansas + National Pork Board Emission Study and Greenhouse Gas Emission Model provide detailed understanding and prediction of GHG releases from pork operations.

Taken together this is one of the most comprehensive treatments of GHG issues in agriculture.

The model predicts resource consumption on the farm, and will soon be mated with an economic module to estimate cost tradeoffs.

The archived presentation is available at:
http://www.extension.org/pages/21819/chronological-webcast-archive