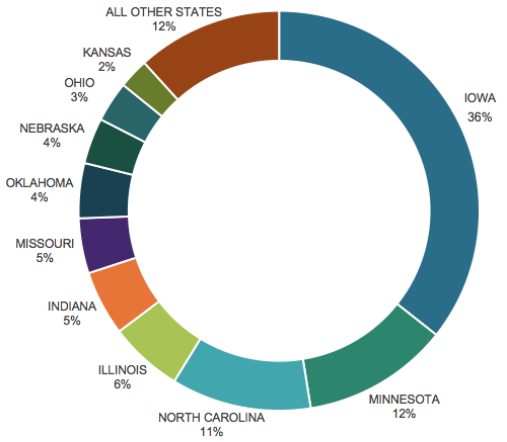
Executive Summary: Environmental Footprint Literature Review

Pork

Pork is the most popular meat consumed globally, representing 37% of total global meat production. The U.S. is second only to China in pork production, and is the largest global exporter, with 2.3 billion pounds of pork exported in 2013. In the U.S., pork is the third most popular meat, behind chicken and beef, with the average American consuming an estimated 29.2 pounds (boneless weight) in 2014. Oregon ranks 36th in hog production, with 3.6 million pounds produced in 2015.

The purpose of this summary is to highlight what is known about the environmental impacts of pork production, processing, distribution and consumption based on a review of publicly available life cycle assessment (LCA) studies. Such studies can identify those parts of the value chain with disproportionately high environmental burdens, allowing improvement efforts to focus where they are likely to have the most benefits.

Due to the diversity of pork production found in literature, we provide an "average" environmental impacts per kilogram boneless pork for the life cycle of pork production. The life cycle of pork production is depicted below. The GHGE of the pork life cycle are dominated largely due to feed production, and to a lesser extent, manure management. This conclusion– that production of feed is the largest contributor to environmental burdens in the pig supply chain–also holds true for water use and land use, and is consistent across all studies reviewed.



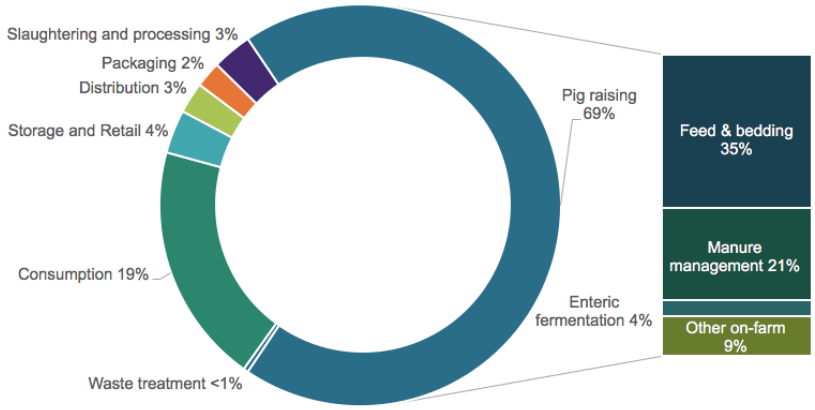
U.S. hog production by state (USDA 2015)

Key Findings

The chart to right shows the breakdown of life cycle stages of pork production and the average GHGE for each activity found in LCA literature, including studies from both inside and outside the U.S.

For the U.S. pork industry in the U.S., feed production represents 27% of the full life cycle GHGE, 96% of land occupation, and up to 93 % of the water use. Manure management contributed an additional 25% to GHGE. Packaging, distribution, and retail stages contribute minimally to the environmental impacts of the pork product chain. The consumer stage – refrigeration, cooking, and methane from food waste in landfill – accounted for 24% of the total.

Average pork life cycle greenhouse gas emissions from all literature reviewed



Feed

As previously indicated, feed production is known to be the largest contributor to environmental impacts in the pork supply chain. Feed rations for conventional growing-finishing pigs commonly include cereals (corn, wheat, barley) to fulfill the energy requirements of the animals and soybean meal to fulfill protein needs. Options for reducing environmental impacts could include shifting from soybean meal to lower impact feed such as peas and rapeseed meal, in combination with synthetic amino acids. Another option is the practice of using food waste as feed for pigs. Food waste has historically

been recycled as livestock feed, particularly for pigs, and it is thought that food waste in early human settlements attracted wild pigs, leading to their domestication. Cooked food waste fed to pigs is colloquially known as swill; sufficiently heating the food waste sterilizes it and prevents the spread of disease. Swill was a prevalent pig feed in the early 20th century, but fell out of popularity as abundant, cheap grains became available. One LCA study comparing food waste disposal methods, including conversion into dry and wet pig feed, anaerobic digestion, and composting found that recycling of food waste as wet pig feed had the best score for 13 of the 14 environmental and human health impacts considered. In Oregon, food served to people cannot be used as swill, but bakery by-products and select other manufacturing discards can be fed to hogs.

Pig Production Strategies

The bulk of U.S. pork production occurs in conventional, intensive systems, but alternatives do exist offering choices to the consumer. Comparisons of the conventional intensive commodity production with low-density techniques using alternative manure management (deep-bedded systems using straw, corn stalks, sawdust, etc. as an alternative manure management strategy to slatted floor pens in which manure falls through and is collected in pits) found small differences in GHGE. However, the differences in eutrophication potential (the result of excessive nutrient loading from manure) were substantial with conventional production performing better per kilogram live weight pork, suggesting that manure management is an important driver of GHGE.

Organic Production Practices

The literature suggests that organic pork production systems consistently have higher carbon footprints than conventional. While organically produced feeds have lower carbon footprints than conventional feeds, organic pork production requires higher quantities of feed per kilogram of pork produced. The study also found that GHGE associated with manure management of pigs raised outdoors on pasture can be greater than for pigs raised indoors because of the nitrous oxide emissions associated with manure excretions on pasture.

Manure Management

Much of the GHGE associated with manure management in pork production stems from the fact that the most common manure management system is storage of manure slurry in open tanks, which can result in large emissions of methane, a potent greenhouse gas. Alternatives include using enclosed anaerobic digestion systems and either flaring (burning) the captured methane, or using the methane to generate heat or electricity. Another alternative often used in deep-bedded production methods is to handle solid manure by composting.

Conclusions

The LCA literature on pork production and consumption offers the following conclusions:

- Environmental impact of the pork product chain is dominated by emissions occurring on or before the farm.
- The production of feed is the largest contributor to environmental impacts, including greenhouse gas emissions, energy use, water use, and land occupation. Lower-carbon feeds offer the potential to reduce carbon footprint, although they must be considered very cautiously as they may require more land.
- Manure management can also be an important source of impacts. Anaerobic digestion of manures presents an opportunity to improve environmental performance across multiple impact categories. Open, anaerobic manure lagoons without methane recovery likely represent the worst manure management option from a GHGE standpoint.
- Multiple studies indicate that when comparing environmental impact per kilogram of pork produced in conventional, commodity production systems versus alternatives such as deep-bedded, organic, or pasture-based, the conventional systems, which have benefitted from a long history of efficiency improvements, are generally favorable. However, similar efficiency improvements for alternative production systems could serve to lower their environmental impacts as well.
- Recycling food waste as pig feed shows promising environmental benefits, although may currently be restricted by policy and perception.
- Refrigeration and home cooking appear to be significant contributors to the overall carbon footprint of pork.
- Packaging, distribution and retail stages contribute minimally to the environmental impacts of the pork chain.

The full report created by Center for Sustainable Systems - University of Michigan can be downloaded from http://www.oregon.gov/deq/mm/food/Pages/Product-Category-Level-Footprints.aspx.