

Energy Balance in Pig Production Systems: A Progress Report

A.S. Leaflet R2355

Peter J. Lammers, Ph.D. candidate and
Mark S. Honeyman, professor,
Department of Animal Science

Summary and Implications

Energy is used in all aspects of pig production, from the manufacture of materials used in building construction to the cultivation and processing of feedstuffs. Historically the availability of fossil fuels has minimized pressure to consider all uses of energy in pig production. Rising energy prices, uncertain access to petroleum supplies, and recognition of the environmental impacts of fossil fuels are increasing awareness and incentive to reduce consumption of limited resources. Comprehensive, accurate information is critical to informed decision making. Analysis of energy use by modern pig farms in Iowa, the Midwest, and the U.S. is needed.

The project focuses on pig production–cropping system interaction with methodology developed through the project that will be adaptable to evaluating energy consumption and ecological impact of other livestock systems. This project addresses a need for energy and resource use information by policy makers and community members as they strive to make informed decisions.

Introduction

United States pig production is concentrated in Iowa, and is a major influence on the economic and ecological conditions of the state. A pig production system includes buildings, equipment, feed ingredients, feed processing, and nutrient management at the individual farm level. Energy is used in all aspects of pig production, from the manufacture of materials used in building construction to the cultivation and processing of feedstuffs. Historically the availability of fossil fuels has minimized pressure to consider all uses of energy in pig production. Rising energy prices, uncertain access to petroleum supplies, and recognition of the environmental impacts of using fossil fuels are increasing awareness and incentive to reduce the use of limited energy resources. Comprehensive, accurate information is critical to informed decision making. Analysis of energy use by modern pig farms in the state of Iowa, the Midwest region, and the United States is lacking.

Nutrient cycling within an agricultural system can greatly impact energy use by that system. Internal cycling of nutrients, which occurs when pig manure is returned to fields producing the grain that ultimately feed the growing pigs, may lower the need for synthetic sources of fertility. Synthetic forms of fertility typically require significant amounts of energy to generate and transport. Utilizing

locally produced, animal-based sources of fertilizer can lower the energy use of crop production.

The emission of greenhouse gases by agriculture is impacted by both crop and livestock sectors. Consumption of energy results in emission of greenhouse gases. If energy use in the construction and operation of a pig farm can be minimized, greenhouse gas emissions may decline. Both carbon sequestration and soil erosion potential are heavily influenced by cropping systems and indirectly affected by diets fed to pigs. If a perennial crop such as alfalfa could be incorporated into the feeding regime of pigs, there may be potential for decreasing losses of soil due to erosion and generation of soil organic matter through carbon sequestration.

Much of the literature addressing energy use in agriculture was written prior to 2001 and does not comprehensively evaluate modern pig production systems. Recent work has examined energy use by pig production systems in Europe. However, in those studies, the diet ingredients considered are not commonly grown or fed in Iowa and only the finishing phase of pork production was examined. The analysis did not compare energy use in the construction and operation of different types of facilities.

Materials and Methods

Energy use, nutrient cycling, and ecological impacts of agricultural systems are not isolated events. Rather they are interconnected influences which must be considered simultaneously when evaluating the desirability of a given production system, or when designing an agro-ecosystem suitable for a particular landscape. Thus, to determine the energy use and ecological impacts of pig production systems, a complex, interconnected model must be developed. In order for the results of the model to positively impact the sustainability of the region, they must be communicated in a manner that is understandable by nonscientists.

The model will be developed using ‘process analysis’ methodology where all energy inputs (direct and indirect) into a pig production system are considered based upon physical material flows. Direct energy is used within the system for agricultural production. Diesel fuel, electricity, and feed use are examples of direct energy. Energy used to produce farm inputs such as mineral fertilizers, seeds, livestock equipment, and building materials are examples of indirect or embedded energy. For this project, indirect energy use will also be included which includes the step immediately preceding the farm e.g. the energy used to produce gates and feeders will be included but not the energy used to manufacture the equipment to produce the gates and feeders. Energy and material flows within and out of a pig production system will be compared with energy

Iowa State University Animal Industry Report 2008

and material flows into the system in order to calculate energy use, nutrient cycling, and ecological impact.

Literature values for energy embedded in different materials will be combined with surveys of contractors and engineers to determine the amount of energy consumed in the manufacture and construction of buildings and equipment. On-farm energy use audits will be performed for several types of buildings considered on multiple sites to determine direct energy use. Literature values for energy embedded in crop production inputs will be combined with ISU Extension recommendations and historic production records to determine energy use in production of grain used as animal feed. Literature values for processing techniques

will be complemented with energy audits of feed ingredient processors to determine energy use and ecological impacts of feed ingredient production. Literature values of growth and performance of pigs housed in specific facilities and fed different diets will be used to determine amount of feed required for a given level of production in a specific pig production system.

Results and Discussion

This is a progress report of an ongoing project by the authors. Model development is ongoing with final results expected in 2009. Project results will be communicated to producers, policy makers, and the general public through publication in appropriate academic journals and ISU Extension bulletins. Participation in on-farm field days and other in-person outreach will occur as appropriate following completion of the project.