Nutrition and management practices to reduce environmental footprint on-farm

Neil S. Ferguson
Trouw Nutrition Innovation Modelling Manager

Abstract

With the increasing demand for animal protein projected for the next decades as world's population increases, the perceived antagonism between intensive animal production and climate change will intensify. Social pressure, policy making, carbon tax and sustainable financial investing will necessitate implementing more sustainable and efficient nutrition, production and management practices. To help facilitate more sustainable nutrition and management practices at the farm level, a holistic farm management tool is proposed that integrates an animal biology model, a feed formulator, and a life cycle assessment (LCA) as well as a dynamic simulation of the system interactions, with particular reference to swine. The LCA (SimaPro, using GFLI 2020 database) quantifies the environmental emissions, land use, and natural resource extraction throughout the life cycle of the pig until shipped from the farm. The LCA system boundary included the environmental impacts of crop production, animal feed processing, feed production, animal husbandry and manure storage. To test the veracity of the proposed integrated system, the predicted outcomes from 9 different global regions were compared with recent published literature. The results showed the accuracy of prediction were mostly within 1 s.d of mean published results across all impact categories. Although the program predicts the main environmental impact categories (Climate Change, Acidification, Eutrophication, Land Use, Water scarcity and Non-renewable energy resources) attention will be given to only Climate Change (CC) (kg CO_2 equivalent/kg live weight). A number of practical nutrition and management scenarios that provide opportunities to reduce the environmental footprint on farm are highlighted.

The results from simulating nutrition practices showed: 1) sourcing local ingredients as opposed to imports will reduce CC anywhere from 2-14% depending on source of imported ingredients; 2) use of co-products can have both a positive and negative effect depending if they promote fermentation or not, or replace ingredients with high CC values. For example, replacing corn with wheat middlings/bran and bakery meal will increase CC while introducing the same ingredients into European type diets could reduce CC by 9%, because of the replacement of imported soyabean meal; 3) synthetic amino acids and low protein diets at the expense of high soyabean meal inclusion can reduce CC by 2-3%; and 4) feed additives can reduce CC in proportion to their effect on improving feed efficiency but typically they can reduce CC by 2-4%

Results of the predictions from different management practices suggested: 1) achieving more from less by providing environments that allow animals to express their genetic potential can have a positive impact on CC. For example, better management and nutrition in early life of a piglet can reduce CC by 2%; 2) manure management has the potential to significantly reduce CC, especially moving away from open lagoon storage to closed tanks, or even enclosing open tanks can reduce CC by 6%. Likewise, underfloor pit management can also help reduce both NH_3 and CH_4 emissions by 9% but depends on the storage facility; 3) Improving herd health status from poor to typical commercial status can reduce CC by 5%, while reducing mortality by 1% point can reduce CC by 1%; 4) reducing pig space and particularly feeder space per pig through high number of pigs per pen can increase CC by at least 1%, therefore providing adequate feeder space is essential to improve the environmental footprint of the farm; 5) Similarly reducing feed waste through pellets and paying close attention to feeders and feed dispensing can reduce CC by 0.7% per 1% point reduction in feed waste. Commercial farms typical have between 3-12% feed wasted into pits and/or floor; and 6) lastly pay close attention to operational efficiency during feed manufacturing to reduce resource waste such as spillage at loading ingredients, maintaining ingredient quality to reduce decrease in complete feed nutrient digestibility, reduce fines and rework of diets, and monitor and control energy utilization especially steam and condition temperatures.

In conclusion, with the increase in awareness of livestock's environmental footprint it will be necessary going forward, to have tools that can help producers make informed decisions on how to improve the productivity or efficiency and reduce their footprint on their farms at similar or lower costs. The proposal of including an animal biology model, feed formulator and LCA access into an integrated system provides the means by which alternative nutrition and management practices can be designed and implemented to reduce the environmental footprint at the farm level.