

Reduce manure disposal costs with enzymes

by Gwendolyn Jones, technical services manager, Danisco Animal Nutrition.

Compliance with environmental regulations is increasingly playing a larger role in total pig production costs. The use of feed enzymes offers solutions to meet nutritional requirements of pigs and manure nutrient management targets for more sustainable pig production at a reduced cost.

A major challenge facing the pig industry in Northern Europe and North America relates to the environmental impact of undigested nutrients in the manure.

Land application

Land application is the most common and most desirable method of utilising animal manure because of the value of the nutrients and organic matter. However, environmental regulations require animal operations to meet nutrient application standards when disposing of their manure by spreading it on cropland.

Due to the rich phosphorus content of pig manure (Fig. 1), application to meet crop nitrogen requirements can result in a net accumulation of phosphorus in the soil. Although phosphorus is much less prone to leaching out of soils than nitrogen, there are concerns that over-enrichment can lead to environmental problems.

Phosphorus erosion from soil can enrich surface waters, causing algae bloom, upsetting the flora and fauna balance and degrading water quality.

There are many factors which can affect nutrient excretion into the environment from agriculture (Fig. 2). Nutritional management strategies offer the most cost effective means to reduce the negative envi-

Table 1. Development in nitrogen and phosphorus excretion per pig in Denmark, 1985-2010 (Danish Pig Research Centre).

	1985	2010	Change (%)
kg nitrogen per finished pig	5.1	3.02	-41
kg phosphorus per finished pig	1.05	0.57	-46

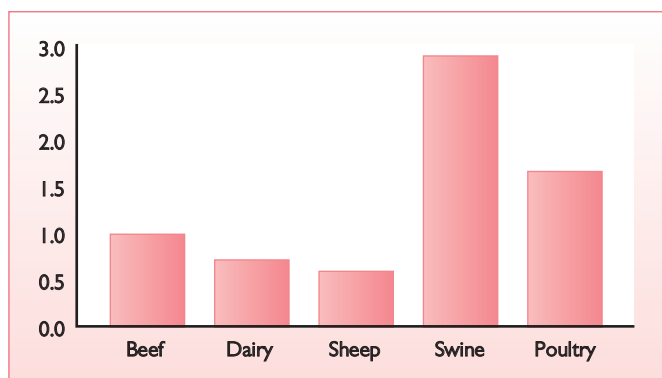


Fig. 1. Phosphorus in livestock manure (%). (Cromwell et al, 2002).

ronmental impact associated with pig production.

Focusing solely on input costs in feed formulation ignores the cost of overfeeding specific nutrients, such as phosphorus, which can be the case with using cheaper protein and energy sources.

Overfeeding nutrients leads to increased nutrient excretion in manure, which results in increased cost in order to meet the environmental regulations on manure disposal.

Therefore feed formulations should take into account the effect of feed composition on manure disposal costs to minimise total pig production costs.

Economics of disposal

One of the challenges of trying to implement regulations or recommendations to control agricultural pollution is to evaluate the economic impact on the livestock sector. Implementing a nutrient management plan to meet a nutrient standard of environmental regulations adds to the cost of producing pigs.

A study carried out in Belgium

comparing economic data of pig farms from 1993 to 1997 showed that manure disposal costs per pig farm ranged from 700 000 BF/year (lowest cost level) to 1.5 million BF/year (highest cost level).

This resulted in loss of investment possibilities for all farms and, at the highest cost level, resulted in financial problems for almost 50% of farms.

In the Netherlands the disposal of manure currently represents 5% of pig production costs. The costs in the Netherlands are markedly higher than in other European countries and are set to increase further between now and 2013 (Fig. 3).

These costs amount to 23 euro cents per kg of slaughter weight.

Table 2. Average incremental cost of compliance for phosphorus manure management strategies with and without phytase in the feed on pig operations in Manitoba (\$/marketed pig). Adapted from Silvano et al (2006).

Strategy for compliance	Control	Phytase	Cost reduction with phytase (%)
Annual application on land	0.09	0.05	-44
Multi-year land application	0.27	0.22	-18.5
Transport with tank for 20km	1.64	0.93	-43
Transport with truck for 20km	0.77	0.44	-43
Transport with truck for 40km	1.33	0.75	-44
Solid-liquid separation	1.65	1.65	-
Manure aerobic treatment	5.23	5.23	-

In the US switching from nitrogen based livestock manure policies to phosphorus based policies has also been shown to increase the cost for compliance, ranging between \$0.56 and \$21.74 per unit of pig production capacity.

The larger estimates represented the farms with the least flexibility in meeting regulations.

Nutrient standards

For most farms trying to meet a nutrient standard, the most immediate problem is finding enough land to spread manure on. Meeting the standard is closely related to how much manure must be moved off the farm to surrounding cropland and how much land they have available to spread the manure on to.

The costs to pig producers will depend greatly on where farms are located, whether they have to pay third party contractors to remove excess manure which cannot be spread due to lack of land availability, and whether cropland operators are willing to accept or pay for manure.

Manure disposal costs are highest where pig densities are greater and cropland is not as available. Farms with a small land base relative to animal numbers will face a higher cost

Continued on page 19

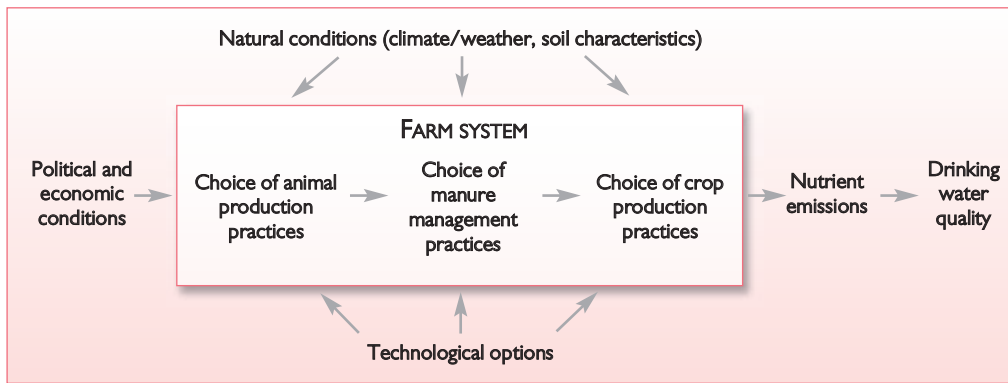


Fig. 2. Conditions and processes determining nutrient excretions from agriculture (adapted from Wossnik and Wefering).

Continued from page 17 of compliance because they are more likely to have to hire custom hauliers. Manure management costs will also vary among operations of different sizes, based on ownership structure and type of manure handling system.

Danish strategy

The ability to manage modern pork production systems for minimal environmental pollution has improved dramatically during the past decade in Denmark. According to a study by the Danish Pig Research Centre (2010) Denmark is now one of the world's most environmentally efficient pig producing countries. The study shows that nitrogen and phosphorus excretions from Danish pigs have been cut by 41% and 46% respectively since 1985 (Table 1).

These reductions were made possible by five major factors:

- 1 The use of amino acids in feed, with consequent lower feed protein (nitrogen) contents.
- 1 Improved feed efficiency via genetic development, with an improvement of 0.1 feed units per kg growth every four years.
- 1 Altered housing systems and production methods, for example the replacement of traditional flooring

by slatted floors and slurry systems. 1 A higher body protein retention, with consequently lower levels of nitrogen excretion.

1 The addition of enzymes to feed; carbohydrases enable better digestion of nutrients such as protein (nitrogen), while phytase enables pigs to better utilise phosphorus in raw materials.

Lower cost with phytase

About 60-70% of the total phosphorus in feedstuffs commonly used in pig diets exists as phytate phosphorus. Pigs are unable to use this phosphorus because they cannot break down the phytate molecule.

As a result, a lot of the phosphorus contained in pig feed will end up in manure. To meet the pig's phosphorus requirements, inorganic phosphates such as dicalcium or monocalcium phosphate are added to the diet as a source of highly digestible and available phosphorus to the pig.

The use of the enzyme phytase in pig diets helps to break down most of the phytate complex in the pig's digestive system, releasing phosphorus and other nutrients such as amino acids and calcium.

Phytase used at higher doses (for example ~1000 FTU/kg feed) improves phosphorus digestibility in

a typical pig diet by around 20 percentage units.

Consequently, supplementation of phytase to growing-finishing pig diets allows feed formulators to reduce inorganic phosphate inclusion rates by over 50%, while maintaining animal performance similar to that observed with traditional formula-

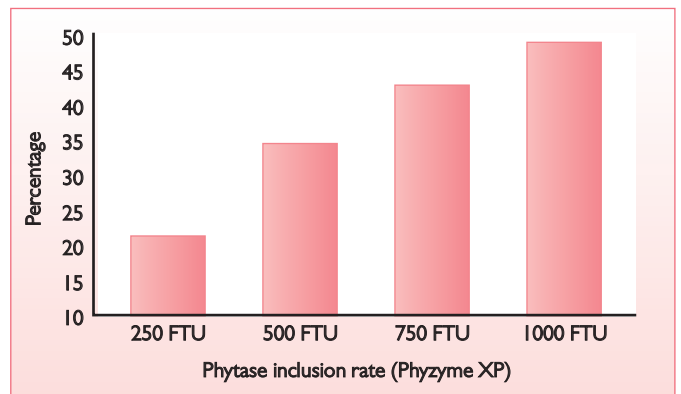


Fig. 4. Reduction in phosphorus excretion in pigs in response to a commercial phytase (Phyzyme XP).

tions containing higher levels of inorganic phosphate.

This helps to reduce the cost of feed and can reduce phosphorus excretion in manure by around 50% (Fig. 4).

Reducing the phosphorus in manure will help to reduce the amount of land required for spread-

ing to meet nutrient standards for land application.

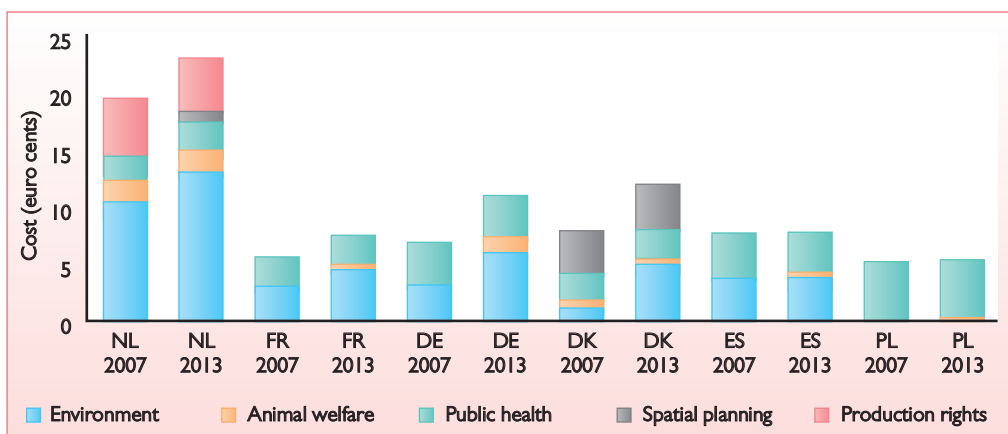
A study published by the Manitoba Livestock Manure Management Initiative in 2006 compared the incremental cost of compliance for different phosphorus manure management strategies per marketed pig for farms with and without phytase in their feed in Manitoba, Canada (Table 2).

The lowest average incremental cost of compliance was for annual application on land and for the multi-year land application. As for the strategies where no extra land was available and manure needed to be transported over a certain distance, increased cost per marketed pig averaged \$1.1.

For the strategy where no additional spreading land was available, incremental cost for manure treatment with solid-liquid separation technology averaged \$1.08 per marketed pig and with aerobic technology \$3.50 per marketed pig.

By adding phytase to the pig feed,

Fig. 3. Additional pig production costs resulting from policy measures for 2007 and 2013, per country (in euro cents per kg slaughter weight). Adapted from Wageningen University (2011).



Conclusions

Environmental issues associated with animal production, and the disposal of manure, are becoming more regulated and complying with the resulting legislation is expensive and time consuming.

Advances in feed management increase the options available to pig producers for reducing nutrients in manure. Economic analyses show the large potential for phytase in feed to reduce overall manure management costs resulting from environmental regulations. ■

References are available from the author on request