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Economic Feasibility of the use of Feed Additives

by Professor Dr. Jacques Viaene and Wim Verbeke,
University of Ghent, Department Agricultural Economics, Belgium

Literature review indicates a potential positive impact of using feed additives on growth, feed conversion, nitrogen, phosphorous and manure production in pig farming. The analysis of the technical, farm economic and environmental impact results in opportunities to farmers towards decreasing production costs and improving farm labour income. The impact of using feed additives is analysed based on calculation models, taking into account the regional environmental policy and its implications for pig farming. The labour income with and without feed additives are compared. Three groups of feed additives are considered: performance enhancers, phytase and amino acids. The calculations and figures in this article apply to the situation on typical pig farms in Flanders, Belgium. The approach and conclusions are however generally applicable on the condition of adapted assumptions, input parameter values and environmental policy of other regions. From the evaluation of the alternative feed systems, environmental policy and farm size, the optimal solution for the Flemish farmer is discussed.

Potential impact of feed additives on performance parameters

Agriculture and livestock production are nowadays to a growing extent confronted with responsibilities regarding the natural environment. In many regions with high specialisation and concentration, intensive livestock faces discussions due to excessive mineral emissions and manure disposal problems. A review of the literature indicates that performance enhancers can increase pig feed conversion with 2.5% to 7.0% depending on the age of the pigs, type of performance enhancer (e.g. avoparcin, tylosin, virginiamycin) and specific research methodology. The increase in daily growth varies between 3.3% and 8.8%. Improvements of feed conversion rate and daily growth with respectively 3.0% and 3.5% are considered to be representative. Both effects directly result in a decrease of nitrogen, phosphorous and manure production, which amount to respectively 6.1%, 6.2% and 4.4%. Phytase supplements lead to a decreased phosphorous excretion. Supplementing 500 FTU per kg fattening pig feed, improves phosphor digestibility with 20% to 30%. Better phosphor digestibility combined with a lower phosphor content in the feed, decreases phosphorous excretion with 25% in practice, without significant impact on the zootechnical performance or carcass quality. Realising a decrease of nitrogen excretion with 20% for fattening pigs is feasible through supplementing synthetic amino acids to the feed. The reduction of the feed protein content results moreover in a decrease of total manure production, as water intake considerably falls. No impact on technical performance or carcass quality is perceived as long as the need for essential amino acids is met. The technical impact of the considered feed additives is summarised in Table 1.

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Flanders' pig production situation

Flanders counts about 7.5 million pigs on 12,000 pig farms. Total manure production amounts to 75 million kg P_2O_5. About one third of this total production consists of farm surpluses: manure that can not be spread on self-owned land in accordance with the manure disposal regulations. The largest manure surpluses are found on specialised fattening pig farms. The Flemish Manure Act of December 1995 includes a multi-stage manure production taxation system, excretion standards and manure disposal obligations. The system of production taxation includes levies for N- and P_2O_5-production. No levy is implied for the first 1.5 ton of P_2O_5 and the first 3 tons of N. The maximum levy of 0.081 \$/kg is implied for each kg of P_2O_5 produced above 15 ton and for each kg of N produced above 30 ton. Minerals which are processed or exported are taxed at the lowest levy of 0.034 \$/kg. The excretion norms for calculating mineral production per farm are set at 5 kg of P_2O_5 and 9,91 kg of N per fattening pig place per year. The Manure Act further obliges farms with a P_2O_5-production of more than 10 ton to process or export mineral surpluses from 1999 on. A quarter of the fattening pigs are produced on +10 ton P_2O_5-farms. This regulation implies a cost of 18.4 \$/ton for processing or exporting, compared to a cost of 4 \$/ton for transport and disposal on neighbouring land. Representative performance parameter values and prices for fattening pig production in Flanders are included in Table 2. These values are used as input in the calculation of the farm cost-benefit analysis of using feed additives. It is important to notice that the economic results presented in this article apply under these conditions in Flanders.

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Cost-Benefit analysis

Without accounting for the environmental policy

The impact of using feed additives is quantified as the impact on labour income: gross return minus production costs, labour costs excluded. The use of performance enhancers increases labour income with 1.7 \$/fattening pig, without incorporating the impact of the Manure Act. This positive result is due to better feed conversion, lower feed costs despite the price increase through supplementing the additive and lower non feed costs through an improved rotation coefficient. The use of phytase and amino acids leads to a decrease of labour income with respectively 0.57 \$/fattening pig and 0.62 \$/fattening pig. This is due to increasing feed costs without improvement of the feed conversion or rotation coefficient. The difference in labour income due to the use of feed additives is indicated in Table 3 as the result 'With - Without'.

Taking the environmental policy into account

The environmental policy and its restrictions to pig framers are based on farm structure and size, expressed in number of animal places. In order to include environmental costs, assumptions are made according to farm size. Table 4 gives an overview of labour income per animal place per year for three different farm sizes:

- Farm A: 1,800 fattening pig places / P_2O_5-production less than 10 ton;
- Farm B: 2,100 fattening pig places / P_2O_5-production just exceeds 10 ton;
- Farm C: 2,500 fattening pig places / P_2O_5-production considerably exceeds 10 ton.

As farm B and C exceed the 10 ton P_2O_5-limit, both farms have to process or export their surplus minerals starting from 1999, which implies a cost of 18.4 $/ton manure. Through this, labour income per animal place without the use of feed additives falls to 10% of the labour income on farm A. The direct farm economic impact of feed additives' use is split up in three parts. The return effect is the result of the impact of a change in rotation coefficient. The cost effect results from a change in feed and non-feed costs. The ecological effect finally results from changes in environmental and manure disposal costs. Summing up these three effects leads to the figures indicated as 'With-Without' in Table 4, that express the overall change in labour income per fattening pig place per year thanks to the use of animal feed additives.

Performance enhancers have a positive impact on labour income in fattening pig production. This is almost solely the result of an improvement of growth and feed conversion, which is quantified in the return effect that clearly outweighs the cost effect. The ecological effect is small as compared to the return effect.

The use of phytase results in a decrease of the P_2O_5-excretion. The resulting ecological effect is by far insufficient to outweigh the corresponding cost increase. An important exception is farm B with a P_2O_5-production exceeding 10 ton without feed additives' use. The use of phytase allows in this case to meet the 10 ton limit and to avoid the obligation to process or export surplus minerals. Through this a considerable ecological effect is realised.

The use of amino acids increases farm labour income per fattening pig place, mainly thanks to a decrease of manure production and hence decreasing transport, processing or export costs.

Conclusions

The economic feasibility of the use of feed additives is heavily determined by the farm structure and the restrictions and costs imposed by the regional environmental policy. The use of performance enhancers leads systematically to increases in labour income, although more driven by return increases than by cost decreases. The use of phytase has a positive impact on labour income through environmental cost decreases, as it allows pig farmers to meet the 10 ton P_2O_5-production limit. Amino acids' use decreases manure disposal costs and hence results in direct farm economic benefits. The paper includes calculations applied for the Flemish situation. The models used are however generally applicable on the condition of adapted assumptions and input parameter values for the environmental policy, technical impact and performances and prices.

TABLES

***Table 1**. Technical impact of feed additives in fattening pig production, based on literature review, effect in %*

	Daily growth	Feed conversion	Manure production	N-excretion	P_2O_5-excretion
Performance enhancers	+ 3.5	- 3.0	- 4.4	- 6.1	- 6.2
Phytase	x	x	x	x	- 25.0
Amino acids	x	x	- 33.0	- 20.0	x

+ : increase ; - : decrease ; x : no effect or no data available

***Table 2**. Parameter values used in the models : Technical performances and Prices, 1995/96*

Weaned weight	23	kg / head
Finished weight	104	kg / head
Average daily growth	0.58	kg / day
Rotation Coefficient	2.61	rounds / year
Feed Conversion	3.13	kg feed / kg weight increase
Total Feed intake	253.5	kg / head
Fattening pig price	1.35	$ / kg live weight
Performance enhancer price	2.16	$ / ton
Phytase price	2.16	$ / ton
Amino acids price	2.43	$ / ton

***Table 3**. Farm economic impact per fattening pig, $ / head*

	Without	Performance enhancers	Phytase	Amino acids
Labour Income	11.38	13.08	10.81	10.76
With - Without		+ 1.70	- 0.57	- 0.62

***Table 4.** Farm economic impact per fattening pig place, $ / animal place*

	Without	Performance enhancers	Phytase	Amino acids
Farm size A: 1,800 places				
Labour income	23.32	29.08	21.92	23.73
With - Without		+ 5.76	- 1.40	+ 0.40
Return effect (+)		12.81	0	0
Cost effect (-)		7.10	1.43	1.62
Ecological effect (+)		0.05	0.03	2.02
Farm size B: 2,100 places				
Labour income	2.46	8.44	21.86	9.76
With - Without		+ 5.98	+ 19.40	+ 7.30
Return effect (+)		12.81	0	0
Cost effect (-)		7.10	1.43	1.62
Ecological effect (+)		0.27	20.83	8.92
Farm size C: 2,500 places				
Labour income	2.46	8.44	1.06	9.76
With - Without		+ 5.98	- 1.40	+ 7.30
Return effect (+)		12.81	0	0
Cost effect (-)		7.10	1.43	1.62
Ecological effect (+)		0.27	0.03	8.92