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WHAT IS YOUR TRUE COST OF PRODUCTION?

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MAKING SENSE OF FEED PRICES

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Introduction

There is a widespread perception that pig feeds are too expensive in Ireland and that prices are high compared with continental Europe. Since feed makes up 60 to 70% of the cost of producing pigmeat a competitive feed cost is essential for survival. It is important to differentiate between feed price (i.e. per tonne) and the cost of feeding (cost per unit of pigmeat). Value for money is the true measure of feed cost. Feeding more expensive diets is justified if pig performance is improved accordingly. Cheap feeds may be expensive if poor performance and health effects are added.

Minimising feed cost involves a combination of buying as competitively as possible and utilising the feed efficiently on the farm.

What makes up the feed price ?

The main elements of feed cost are:

- *Raw material*
- *Haulage (from port or store to mill and from mill to farm)*
- *Labour*
- *Energy (handling, grinding, pelleting)*
- *Mill overheads (sales, administration, insurance, depreciation)*
- *Financial charges (financing stocks, credit)*
- *Profit*
- *Miscellaneous (quality control, shrinkage, repairs and maintenance)*

Raw materials account for about 75 to 85% of the retail cost. Haulage is the next most expensive component followed by energy (electricity and oil). Delivery to farms is already a significant cost item in selling pig feed. Together with haulage to the mill from stores and ports overall delivery charges average about €15/t and are often higher. Larger truck sizes and full loads can help to minimise delivery costs but require more costly storage on the farm.

Over the past number of years, while ingredient prices have fallen, some miscellaneous cost items have increased substantially. These include insurance, general administration and quality control.

Prices paid by pig producers for apparently similar feeds show wide variation. In a recent study we have compared the prices paid for compound feeds with the estimated ingredient cost of feeds of equivalent nutrient content based on barley, wheat and soyabean meal. Manufacturing margins/tonne over the ingredient cost (retail prices published by CAI) of these "specimen diets" appear to be about €20 to 25 for finisher feed, €30 to 35 for sow feed and about €70 for weaner feed. The weighted average margin across weaner, finisher and sow feeds is about €40/t. This margin must cover all costs including delivery.

Since feed compounders may buy ingredients cheaper than the prices quoted by CAI the true margins are likely to be greater.

The most expensive nutrient in feed is energy, costing about 70% of the total followed by protein / amino acids (about 25%) and the minerals and vitamins (about 5%). Almost all protein feed ingredients are imported as is a significant amount of energy feed.

Medication can be a significant component in the price of feed (especially weaner) and may not always be transferred to the healthcare costs, which are then underestimated. For the mill, medicated feed represents a major risk of contamination of subsequent batches. There are additional costs in *the paperwork attached to the addition of drugs, extra storage, more difficult scheduling of formulations and increased idle time between batches. Recent proposals by DAFRD for avoiding contamination of other feed following manufacture of medicated feeds will greatly increase the cost to the mill and pig producer of adding drugs.*

Pig feed amounts to only 20% of the compound feed produced in Ireland each year. Pig and poultry together amount to 35%, which is well below the EU average of about 65%. Feed for pigs and poultry has an even year round usage and the low proportion of feed for these species is a sign of a huge excess in production capacity in summer even though the industry may be near capacity in spring. This imbalance in demand leads to inefficiency in the industry and higher production costs than might be the case in a specialised pig/poultry mill. While the entire pig and poultry feed requirement of the country could be produced by a very small number of specialised mills these would be widely dispersed and carry high delivery costs.

Phase feeding – the theory

The term "phase feeding" is used to describe feeding a sequence of diets of decreasing nutrient density during the life of the pig especially during the finishing stage. In theory at least the concept is attractive. Pigs receive a diet more appropriate to their needs, less nutrients are excreted and feed is less expensive. On the negative side, there are more storage bins required, feed deliveries are smaller and the feeding system may not be capable of delivering more than one feed to a particular pig house.

Finishing feed accounts for about 60% of feed used and at present most producers feed a single finisher diet from 35 kg to slaughter. The trend towards heavier slaughter weights makes the case for phase feeding more compelling. Possible options include the following (Tables 1 and 2) but unless significant reductions can be made in the price of the later diet (or diets) the savings will be small or non-existent.

The expected saving will not materialise unless the feed conversion efficiency shown is achieved, growth rate is not depressed and carcass lean content is not reduced.

In Tables 1 and 2 it is assumed that since the specification of a single diet is a compromise between the needs of the 30kg pig and the 90kg pig that a first stage finisher feed might be slightly higher in energy and amino acids than the single diet. It is also assumed for the purpose of this exercise that the total feed used from 30 to 92kg is the same on a three diet system as a one diet system. As shown below this assumption is not a safe one.

Table 1. Nutrient content of diets to be used in phase feeding finishing pigs

	Diet 1	***Diet 2***	***Diet 3***	***Diet 4***
	Single diet	*Early finisher*	*Mid finisher*	*Heavy finisher*
DE., MJ/kg	*13.5*	*13.8*	*12.5*	*12.5*
Crude protein, g/kg	*194*	*200*	*179*	*155*
Lysine, g/kg	*11.0*	*11.5*	*10.0*	*8.5*
Cost, €/tonne	*194.89*	*199.36*	*189.57*	*179.19*

Note: Amino acid content relative to lysine is as follows: Methionine – 30%; methionine plus cystine – 60%; threonine – 66%; tryptophan – 18%

Table 2. Assumed performance and feed cost in phase fed finishing pigs

	Single diet	***Two phase***	***Three phase***

Weight range in which diet is fed			
Diet 1	*30 to 92kg*	-	-
Diet 2	-	*30 to 55kg*	*30 to 50kg*
Diet 3	-	*55 to 92kg*	*50 to 70kg*
Diet 4	-	-	*70 to 92kg*
Usage of each diet, kg			
Diet 1	*161.2*	-	-
Diet 2	-	*60.0*	*47.0*
Diet 3	-	*101.2*	*52.0*
Diet 4	-	-	*62.2*
Total feed used	*161.2*	*161.2*	*161.2*
Total DE used, MJ	*2176*	*2093*	*2076*
Overall FCE	*2.60*	*2.60*	*2.60*
Overall feed cost €/t	*194.89*	*193.21*	*188.42*
Total feed cost €/pig	***31.42***	***31.15***	***30.36***

Since cereal prices have fallen over the past few years, by-products of medium to low energy density have become less competitive. As a result, cereal based diets are no more expensive than cereal-replacement based diets. This situation is likely to continue for the foreseeable future. There will be very little saving in reducing the energy density of a diet below the equivalent of a barley-based diet but some savings from reducing the protein / amino acid levels since protein feeds are at present relatively expensive. Table 3 illustrates the effect of reducing DE or lysine content on the cost of a finisher diet.

Table 3. Effect of varying DE or amino acid levels on cost of finisher diet

	Price €/tonne		***Relative price, DE basis***	
	Ingredients only	***Delivered***	***Ingredients only***	***Delivered***
Reduced DE (all diets have 11g/kg				

Lysine)				
DE = 14.5MJ/kg	*159.26*	*189.26*	*98.5*	*97.6*
DE = 13.5MJ/kg	*150.61*	*180.61*	*100.0*	*100.0*
DE = 12.5MJ/kg	*144.66*	*174.66*	*103.7*	*104.4*
DE = 11.5MJ/kg	*144.62*	*174.62*	*112.7*	*113.5*
Reduced Lysine, g/kg (all diets have 13.5 MJ/kg)				
Lysine = 12g/kg	*157.40*	*187.40*		
Lysine = 11g/kg	*150.61*	*180.61*		
Lysine = 10g/kg	*144.06*	*174.06*		
Lysine = 9g/kg	*138.81*	*168.81*		

Note: Amino acid content relative to lysine is as follows: Methionine – 30%; methionine plus cystine – 60%; threonine – 66%; tryptophan – 18%
Relative prices are calculated as cost per tonne divided by DE content relative to 100% for DE = 13.5.

Pigs eat to achieve a certain energy intake and feed conversion ratio expressed as units of energy per kilogram weight gain will be almost constant across a range of DE values. One can then compare diets more accurately on their relative price per unit DE. On this basis the high energy diet in Table 3 represents the best value for money and the low energy diet the worst value. The difference between diets (in cost per unit energy) is slightly wider when manufacturing and delivery costs are added since these are on a per tonne basis.

Phase feeding – the reality

Responses to phase feeding of finishing pigs in Moorepark would not suggest that major savings can be achieved by changing diet specifications. Table 4 shows the response of finishing pigs to reducing the DE of the diet with increasing weight while Table 5 shows the effect of feeding lower levels of amino acids (with threonine and methionine balanced in relation to lysine).

Energy density and performance of finishing pigs

In a recent trial with pigs from 42 to 90kg, we compared the following diets:

A. High energy - DE = 14.5MJ/kg

B. Medium energy - DE = 13.5MJ/kg

C. Low energy - DE = 12.5MJ/kg

D. High energy for 14 days, medium energy for 14 days followed by low energy to slaughter

The costs of the three diets (mid 2001) were €208.20, €189.25 and €190.23/tonne (ingredients plus €20/t). The high cost of the low energy diet was because sugar beet pulp was forced into the formulation in order to reduce the DE. Pigs were fed the pelleted diets in pairs of one boar and one gilt. All diets were barley-wheat-soyabean meal with the amino acid levels adjusted according to energy density. Results are shown in Table 4. Feed cost per kilogram pigmeat was lowest on the most expensive, high density diet while the low energy diet was the most costly. The cost of slower growth on the low density diets was not included.

Table 4. Response of heavy pigs to DE content of the diet

	High energy	***Medium energy***	***Low energy***	***Phase fed***
Feed/day, g	*2093*	*2269*	*2325*	*2234*
Carcass gain, g/d	*735*	*707*	*665*	*680*
FCE (carcass)	*2.85*	*3.22*	*3.50*	*3.30*
MJ DE per kg carcass	*41.3*	*43.5*	*43.8*	*43.8*
Kill out %	*76.2*	*75.4*	*75.0*	*75.2*
Carcass lean %	*59.5*	*59.4*	*59.6*	*59.1*
Feed cost, c/kg gain	*59.3*	*60.9*	*66.6*	*64.5*

O'Connell, 2002

Table 4 shows the importance of having accurate records in order to assess the true "value for money" of a particular feed. Regardless of the feed price or diet specification accurate performance records which are regularly analysed are essential.

Effect of amino acid level and ratios on pig performance

Earlier it was shown that reducing the amino acid content would result in a lower feed price. In a trial (Table 5) we compared the following four diet sequences from 40 to 95kg:

A. Lysine = 11g/kg to slaughter

B. Lysine = 11g/kg to 60kg followed by lysine = 9.5g/kg to slaughter

C. Lysine = 11g/kg to 60kg followed by lysine = 8g/kg to slaughter

D. As B but with threonine (THR) and methionine plus cystine (M+C) levels reduced from 66% and 60% respectively of lysine content to 62% and 57%.

Pigs were fed the pelleted diets in single sex groups of 14. All diets were barley-wheat-soyabean meal (DE = 13.5MJ/kg) with the amino acid levels adjusted according to lysine level. The costs of the four diets were €192.11, €183.46, €173.43 and €179.69/tonne for lysine levels of 11, 9.5, 8 and 9.5 (low THR and M+C) g/kg respectively.

While pig growth rate was maintained on the medium lysine diet there was a reduced growth rate on the low lysine diet and on treatment D (medium lysine with reduced THR and M+C).

Feed conversion efficiency was depressed on all three medium and low lysine diets while carcass lean content was reduced on two treatments. The poor performance (growth rate, FCE and carcass lean) on treatment D (low THR and M+C) has practical implications, since marginal to low levels of THR and M+C are frequently seen in home mixed feeds. These diets will have synthetic lysine added but not adequately balanced for other amino acids of which THR and M+C are the most likely to be marginal.

Feed cost per kilogram carcass (including the price penalty for reduced carcass lean but not for reduced growth rate) was lowest when the high lysine diet was fed. If reduction of nitrogen in manure is a priority then reduced protein diets are certainly important. The result of this trial should not be used to condemn phase feed feeding but rather to demonstrate that care must be taken with choosing the specification of the diets and with balancing for the essential amino acids

Table 5. Response of heavy pigs to lysine content of the diet

	High lysine	***Medium lysine***	***Low lysine***	***Med lysine (low THR, M+C)***
Feed/day, g	*2817*	*2053*	*1963*	*1964*
Carcass gain, g/d	*660*	*653*	*618*	*623*
FCE (carcass)	*3.06*	*3.14*	*3.18*	*3.15*
Kill out %	*76.8*	*77.1*	*76.8*	*77.2*
Carcass lean %	*59.6*	*59.6*	*59.0*	*59.3*
Feed cost, c/kg gain	*58.1*	*58.4*	*58.9**	*58.7**

** In both treatments the price penalty for lower carcass lean is included*
O'Connell, 2002

Weaner or finisher diet at 30kg

Weaner feeds, in Ireland, are expensive costing about 30% more than a good quality (high energy) finisher. In the Netherlands, pigs change to finisher feeds at about 25kg, yet the weaner feed costs only 15% more than good a quality finisher.

The weight of pigs at transfer from weaner to finisher stage has increased over the years and is now 35kg or more on many units (PIGSYS 2001). Since the difference between the prices of weaner and finisher feed is so wide, one obvious area for saving is by changing pigs on to a good quality finisher feed at 30kg or even earlier. An earlier changeover might be expected to be achieved without a drop in performance and at a lower cost.

Where can the most savings be made ?

Producers must always buy feed as keenly as possible but that is only the first step. Using that feed to maximum advantage is still the most important factor. Table 6 shows the potential savings to be achieved by changes to FCE and feed management. A lower price is of little benefit unless the FCE is good. Feed wastage is the principal cause of poor FCE. In the case of wet feed systems a feed curve that is too high will inevitably lead to feed wastage. Where feed conversion efficiency is poor then the contributory factors should be identified and remedied.

Table 6. Potential saving from management changes

	Feed saved, kg/pig	***Value of saving €/pig***
Improve weaner FCE by 0.1 (7 to 35 kg)	2.8	0.74
Improve finisher FCE by 0.1 (35 to 95kg)	6.0	1.20

Change pigs to finisher diet at 30kg rather than 35kg (FCE = 1.8)	0	0.59
Feed two sow feeds	0	0.20
Reduce weaner feed cost by €12/t (15 to 35kg)	0	0.41
Reduce finisher feed cost by €12/t (35 to 95kg)	0	1.87
Reduce sow feed cost by €12/t	0	0.65

Basic prices (€/tonne) assumed are weaner - 265; finisher - 200; pregnancy - 190; lactation – 205.

Pigs fed from dry or wet-dry feed systems should be checked daily and feeders adjusted, cleaned, repaired or replaced as required. When the amount and cost of feed passing through a feeder each year is examined (Table 7) the cost of feeder replacement is very small and the payback is rapid if FCE is improved.

Table 7. Amount and value of feed dispensed through a feeder (pen of 16 pigs) each year.

	Feed quantity, t/year	***Value of feed, €***
Weaner stage 1	2.1	1,100
Weaner stage 2	6.3	1,700
Finisher	10.0	2,000

Assume 16 pigs per group and the pen occupied for 330 days each year. Daily feed intakes 400g, 1200g and 1900g for stage 1, stage 2 and finishers.

The role of by-products

The amount of by-product feeds available in Ireland is small but for some producers they can supply a significant proportion of nutrients. If by-products are inexpensive and pig prices are poor then the temptation to feed more by-products is strong. Efficient utilisation of by-products requires that the material be legally permitted, wholesome, suitable for feeding to the stock, of consistent nutrient content and incorporated into a balanced diet to meet the nutrient requirements of the stock being fed. Additional costs incurred in feeding by-products cannot be ignored and include storage and handling equipment, deterioration of fittings including floors e.g. from acid corrosion and increased manure volume.

Suppliers of by-products may treat the material as a waste and its supply as a mere disposal operation. As accountants or food processing specialists many factory managers fail to appreciate the precision involved in present day pig feeding. Whey and whey derivatives provide a good example.

Cheese whey, casein whey, mother liquor, de-lactosed whey, deproteinated whey are different products and are very different from skim milk and waste whole milk. The pig feeder needs to know for sure what he is getting and must get material of the same composition in every delivery (unless agreed/notified in advance). Addition of whole milk and/or washings to a whey product being delivered to a pig farm is an easy option at the milk plant but may seriously lower its value as pig feed.

The nutritionist carrying out the formulation must know the exact composition of the product including contents of:

- *Dry matter*
- *Crude protein*
- *Amino acids*
- *Ash*
- *Minerals especially sodium, calcium, phosphorus*
- *Sugar or starch*
- *Any anti-nutritional or palatability factors such as low pH*

Given this information, many food industry by-products can be successfully incorporated into pig feed. With incomplete information the result may well be depressed pig performance which cancels out the expected savings.

Any change in the availability or composition of a by-product requires an immediate re-assessment of the formulation. Problems frequently occur *when usage of a by-product commences or ceases and the mineral vitamin supplement and/or the formulation are not adjusted accordingly.*

What can you do to minimise feed costs?

Pig producers must keep a close watch on feed price movements. This information is best obtained from other pig farmers and is used to shop around or bargain for a lower price. Purchased feed must then be used to best effect. Home compounders being fewer in number must be even more careful in watching ingredient prices.

The pig farmer has no direct control over the cost structure of the feed mill – the price paid for ingredients, production costs, delivery costs. Indirectly, by purchasing from the more competitive mill, efficiencies will follow.

For most pig producers, there is opportunity to shop around and get a better price if available. For some, choice is restricted by the need for long term credit. If possible and economic, credit should be switched to term lending. High tonnages will usually result in keener prices and smaller producers can improve their bargaining power by operating as a group.

Servicing the average pig account should be simple for the feed company. Large tonnages are involved, usage is predictable and evenly spread throughout the year.

Credit

The Irish feed industry has been very lax in allowing long credit terms. Feed credit is attractive at first sight (no security, quick decision) but makes it virtually impossible for the customer to change suppliers. It is desirable that credit costs be shown on invoices but this is seldom the case and the credit cost is built into a higher feed price and possibly poorer feed quality. Too often the long credit degenerates into a bad debt which *is spread over the remainder of the mill output resulting in higher prices for all other customers.*

CAN FEED DAMAGE YOUR PIGS

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Introduction

Mycotoxins affect up to 25 percent of the world's food crops (Devegowda et al., 1998). As well as being a health concern to humans they cause significant economic losses in animals due to reduced productivity, increased disease incidence, chronic damage to vital organs (e.g. kidneys, liver) and decreased reproductive performance (Lawlor & Lynch, 2001). Nichols (1983) estimated losses incurred by U.S. pig producers in 1980 due to they use of mycotoxin contaminated feed at $100 million.

As far back as 1952, McErlean reported sow reproductive problems in Ireland associated with the use of barley infected with fusarium mycotoxins.

What are Mycotoxins?

Mycotoxins are the toxic metabolites of fungi growing on cereal grains that are produced during growth, harvest, transport or storage. They are produced mainly by three genera or types of moulds – **Fusarium, Aspergillus and Penicillium.**

The present or absence of toxin-producing fungi is a poor indicator of the presence or absence of mycotoxins. The mycotoxins are believed to be produced in response to stress factors acting on the fungus – they require moisture, oxygen and carbohydrates to multiply and temperatures from $10^{o}C$ *to* $25^{0}C$.

Occurrence

Individual moulds, fungi or mycotoxins rarely occur in isolation and two or more mycotoxins together may have a greater toxic effect than any one alone.

Mycotoxins occur sporadically both seasonally and geographically. Table 1 shows the mycotoxins that may be found in feeds that come from different locations.

Table 1: Geographic occurrence of mycotoxins

Location	*Mycotoxin*
Western Europe	*Ochratoxin, Vomitoxin, Zearalenone*
Eastern Europe	*Zearalenone, Vomitoxin*
North America	*Ochratoxin, Vomitoxin, Zearalenone, Aflatoxin*
South America	*Aflatoxin, Fumonisin, Ochratoxin, Vomitoxin, T-2 Toxin*
Africa	*Aflatoxin, Fumonisin, Zearalenone*
Asia	*Aflatoxin*
Australia	*Aflatoxin, Fumonisins*

From Devegowda et al., 1998

Aflatoxins *are produced by some strains of* Aspergillus flavus and Aspergillus parasiticus**.** *As temperatures of 25^{o}C to 30^{o}C are required for optimum production of aflatoxins, they generally occur in cereals/feedstuffs coming from warmer climates.*

Fusarium *mycotoxins require lower temperatures for growth than the* Aspergillus *species, hence they are associated with cereals in temperate countries. The most common fusarium mycotoxins are zearalenone, vomitoxin, the fumonisins, T-2 toxin and fusaric acid.*

Fusarium Poisoning

Causes of Fusarium *poisoning include:*

- *purchase of mouldy, damp or badly stored grains*
- *mixing of contaminated and uncontaminated grains*
- *holding cereals in moist, damp conditions*
- *allowing grains to heat*
- *prolonged usage of feed bins, feed bridging across the bin and development of moulds*
- *placing moist warm compounded feeds into bins*
- *poorly maintained bins that allow water to leak in*
- *the bridging of feed in bins over long periods of time and their sudden descent*
- *prolonged use of automatic feeders and retention of mouldy feed.*

Zearalenone *is the most important* fusarium *mycotoxin produced. It is an oestrogenic toxin – it mimics the effects of the female hormone, oestrogen. At high concentrations (1-30 ppm) it can interfere with ovulation, conception, implantation and foetal development. In pregnant sows it can increase the incidence of abortions and still births, reduce litter size and piglet viability. It may increase the weaning to service interval.*

Young gilts are most sensitive, with concentrations as low as 0.5 to 1 ppm causing pseudo-oestrus and vaginal or rectal prolapse. The most striking clinical feature is the swollen red vulva of immature gilts.

Young boars may have reduced libido and decreased testicular size but mature boars are rarely affected.

Vomitoxin *is a potent inhibitor of feed intake and growth – 13 to 20 percent reductions in finisher pigs at a concentration of 4 ppm in the feed (Placinta et al. 1999)). Feed refusal may be complete at concentrations of 10 ppm or greater. Sometimes vomiting is seen, hence the name.*

As mentioned earlier, some mycotoxins can have a synergistic effect with each other. Vomitoxin and fusaric acid have been shown to reduce feed intake and average daily gain in weaned pigs.

Fumonisins *are linked with reduced growth rates in grower pigs – eight percent reduction at 1 ppm (Placinta et al. 1999). They can also have a detrimental effect on carcass quality via an increase in fat depth and reduced lean meat levels (Rotter et al, 1996).*

T-2 Toxin *causes a reduction in feed intake (via it's effect on appetite) in pigs at concentrations as low as 0.5 ppm*

Aspergillus Poisoning

The causes of Aspergillus *poisoning include:*

- *wet harvests allowing fungi to grow*
- *poor storage of feed ingredients*

Aflatoxins are the most common Aspergillus *mycotoxins produced. They require temperatures of* 25^0C *to* 30^0C *and therefore generally occur in warmer climates than Ireland. However, imported cereals/feedstuffs may pose a threat.*

Aflatoxins are immune-suppressors and have different effects on pigs, varying from poor growth rates in weaners and finishers to abortion and agalactia in sows. The first sign of an aflatoxin problem is decreased feed intake. Depending on the levels present, losses can result from deaths, reduced growth rates, poor F.C.E. and carcass condemnations. Levels in excess of 0.5 ppm in the diet of lactating sows will reduce piglet growth rates due to aflatoxins in milk. For grower/finisher pigs reduced growth rates can be expected at concentrations in excess of 0.2 ppm.

Aspergillus and Penicillium Poisoning

Ochratoxin and citrinin mycotoxins are produced by both Aspergillus *and* Penicillium *mould species. They are most prominent in cool wet climates and are associated with poor wet harvests and poor storage conditions.*

They affect the liver and/or kidney and result in poor growth rates at levels of 2.5 ppm.

Practical Implications

The possible consequences of a mycotoxin problem have been outlined above. The practical implications of this is that stored feed/ingredients on your farm can pose a serious threat to your pigs if not handled properly. How do we prevent potential mycotoxin problems from occurring?

The following should help:

1. *Purchase good quality ingredients from reputable sources.*
2. *Grain should be cleaned and stored at a low moisture content (14 percent)*
3. *Use a mould inhibitor (normally organic acids) where moist grain is stored.*
4. *If a pelleting process is involved, cool the feed before putting it into storage.*
5. *Completely empty bins on a routine basis or if feed shows signs of blockage.*
6. *Examine feed for signs of moulds and infestations. These include*
    - *musty smell*
    - *rise in temperature*
    - *feed flowing unevenly*

    Trouble spots are:
    - *caking on sides of bins*
    - *areas where feed can lodge*
    - *dead ends of augers*
7. *Clean thoroughly, dislodging any caked material and remove all dust and debris.*

    It is advisable to clean out feed bins at least twice yearly. The simplest way to do this is to work from the top of the bin. Allow *the feed bin to empty out. Then, working from the top of the bin, powerwash the insides and allow the bin to drip-dry. Ensure that the bin is completely dry before putting feed back in.*

It is important that that all Health & Safety procedures are followed with regards to cleaning out the bin. Use safety ladders for accessing the top of the bin. Where moulds are evident, use a respirator fitted with an appropriate filter, wear impervious clothing which will not trap spores or dust and remove exterior clothing and shake it before removing the respirator.

Summary

Mycotoxins affect up to 25 percent of the world's food crops, are a health hazard to humans and cause significant economic losses in pigs. The clinical response to mycotoxins depends on the concentration in feed, the duration of feeding, the presence or absence of other mycotoxins, and on the age and health status of the pig to which the mycotoxin is fed.
The response can vary from acute to chronic – zearalenone affects fertility, vomitoxin causes pigs to refuse feed, aflatoxins increase susceptibility to disease, and ochratoxins cause kidney damage.

Preventing mould growth and subsequent mycotoxin production is essential for good pig performance. This is achieved by storing clean grain at a moisture content less than 14 percent. If stored at higher moisture contents use a mould inhibitor. Ensure that feed is cool before storing. Empty bins completely and wash them out thoroughly on a routine basis.

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THE OPTIMUM PRICE FOR PIGS

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The price paid for pigs is often a contentious issue for pig producers. Pigsys records show prices ranging from 145.0c to154.4c/kg DW when the average in 2001 was 148.3c/kg DW.

This paper examines factors affecting price and looks at their implications on profitability.

Pig producers should sell all pigs at the highest sale weight allowed to maximise the price received. This may not be the most profitable way of producing pigs.

There are other factors that affect pig price to be considered. These factors include;

- *underweight pigs and overweight, lean meat %,*
- *kill out %,*
- *type of outlet,*
- *negotiating strength,*
- *marketing strategy,*
- *bonuses.*

Slaughter Weight

The three major slaughtering groups in Ireland have different weight range specifications (See Table 1 below)

Table 1. Specified weight range for different slaughtering groups

Group	*Dawn*	*Galtee*	*Glanbia*
Minimum kg	*55*	*55*	*55*
Maximum kg	*85.5*	*85*	*80*

These are wide weight range specifications when compared with other countries. For example the Danes are paid on a carcass weight range between 67 to 80kg.

Where pigs can be taken to a higher slaughter weight without price penalty, profit will be higher. This is due to the increase in the total deadweight sold and to a reduction in the cost of production per kg deadweight. Feed cost per kg is likely to be largely unaffected by increasing slaughter weight. However, non-feed costs per kg will be reduced as a result of being spread over the increased weight of carcass.

Optimum Sale Weight

It is possible to ensure that all pigs sold fall within the specified weight range. Where pigs are sold once weekly all pigs over 96 kg live should be sold if the upper weight is 80 kg dead. For upper limits of 85 and 85.5 kg the corresponding weights are 102 and 102.5kg respectively. These guidelines are based on individual pigs achieving kill out percentages of up to 79%.

If the average sale weight of pigs is increased it is likely that there will be more overweight pigs and a corresponding reduction in the average price per kg deadweight.

It is the extent of this reduction that determines what the effect will be on overall profitability.

A slight price reduction may well be more than offset by the increase in total sale of meat and reduction in production costs. The appropriate choice will also vary from slaughter plant to slaughter plant depending on the penalties for overweight pigs (Table2).

The optimum sale weight is that which maximises overall profit for the unit. It does not necessarily mean maximising the price per kg by eliminating overweight pigs. It is necessary to evaluate each unit on the basis of data from the slaughter plant to establish the optimum sale weights.

Overweight Pigs

Pigs that exceed the maximum specified weight are subject to a price penalty. These penalties differ for the different slaughtering groups (Table 2).

Table 2. Price penalty for overweight pigs c/kg

Above Maximum (kg)	**Dawn**	**Galtee**	**Glanbia**
0 – 1	*9*	*2.5*	*1.3*
1 – 2	*9*	*2.5*	*2.5*
2 – 3	*9*	*5.1*	*3.8*
3 – 4	*9*	*7.6*	*5.1*
4 – 5	*9*	*10.2*	*6.4*

As the percentage of overweight pigs increases the average price per kg will be reduced.

This is especially so if the overweight pigs are well above the maximum specified weight. Producers need to analyse in detail what proportion of pigs sold are overweight and what effect this has on the average price. A breakdown of pig sales by weight every quarter is required to carry out this analysis. The Teagasc spreadsheet should be used to analyse the sales for each individual unit every thirteen weeks.

Increased care and work in the selection of pigs for sale will be required to reduce the number of overweight pigs sold.

Underweight Pigs

The price penalties imposed by slaughterers on underweight pigs (less than 55kg) are large (See Table 3). Selling significant numbers of underweight pigs will cause a substantial reduction in the average price per kg.

Table 3. Price penalty for underweight pigs c/kg

Dawn		***Galtee***		***Glanbia***	
Weight kg	***c/kg***	***Weight kg***	***c/kg***	***Weight kg***	***c/kg***
18	*(b)*	*25*	*(a)*	*45*	*(b)*
18-45	*-17*	*25-45*	*(a)*	*45-50*	*-50.8*
45-49	*-12*	*45-49*	*10.2*	*50-55*	*-12.7*
49-51	*-9*	*49-51*	*7.6*		
51-53	*-4*	*51-53*	*5.1*		
53-55	*-3*	*53-55*	*2.5*		

(a) at valuation, (b) No payment

As far as possible, do not sell pigs under 55 kg deadweight. This translates to a liveweight of not less than 77kg (71.5% kill out).

Carcass Lean Meat Content

The main pig slaughtering groups pay for pigs on the basis of the lean meat content of the carcass as well as on weight. Carcasses with 49 to 54% lean meat are subject to a price penalty of 2.54c per kg for each 1 percentage point under 54%.

Carcasses with 54 to 59.5% lean meat are paid a bonus of 2.54c per kg for each 1 percentage point over 54%. Between 59.5 and 60% the bonus is 1.27c per kg per 1 percentage point. The average lean meat for pigs slaughtered in Ireland is 58.3% on an average slaughter weight of 72.9kg

(2001). This is quite close to the upper limit of 60% above which there is no additional payment for lean meat and means that many pigs exceed the 60% threshold.

As a result any attempt to increase the lean meat percentage in a herd with near or above average lean meat (58.3) will not produce a significant increase in average price per kg.

Increasing the Lean Meat percentage in a herd achieving 59% or more will result in a negligible increase in average price. By contrast, a herd with a low Lean Meat could expect an increase in price of close to 2.54c per kg for a 1 percentage point increase.

In Denmark the average Lean Meat content is 60% and producers are paid extra for lean meat up to 65% maximum. There is still an incentive there to increase the lean content of the carcass. However the grading system in Denmark is different to here.

Kill-Out Percentage

Pig producers continue to report differences in kill out between different outlets. At a price of €1.40 per kg a difference of one percentage point in the kill out of a 95kg liveweight pig is worth €1.33/pig.

A high price per kg but with a low kill out may not maximise profit.
A high price per kg deadweight is quickly offset by a low kill out.

There are quite a large number of factors that affect killing out percentage. For pigs weighed at delivery to the plant a kill out of 75.5% or over should be expected. Feed should be withdrawn at least 10 hours before slaughter.

Table 4. Price per kg deadweight required to maintain pig price at different kill outs (95 kg live pig)

Kill Out %	*Deadweight kg*	*Price Per Kg Dead*
75	*71.25*	*1.40*
76	*72.2*	*1.382*
77	*73.15*	*1.364*

Type of Outlet

Producers selling lighter pigs to a specific market must be compensated to maintain profit levels. When the producer has the finisher accommodation to bring pigs to heavier weights reducing the maximum weight by 1kg warrants an increase of approximately 0.9c/kg DW.

If extra finisher space is not available a premium of 0.75c/kg is still required. Extra finisher accommodation should be provided to bring pigs to a heavier weight if this premium is not obtainable.

Negotiating Strength

Producers selling as part of a producer group can have much smoother negotiations with slaughter plants. If a producer group has the sale of 1000 pigs/week or more it gives the group leverage when selling pigs. It also allows the slaughter plant to plan more efficiently and more opportunity to give information on market prospects etc than when it is dealing with individual producers. Information exchange is essential to assure consumers of quality standards at each link (ie pig breeder, pig producer, slaughter house/processor, retailer, consumer etc) of the food production chain. Producer groups re-inforce these links allowing processors more confidence in marketing the product.

Marketing Strategy

The sales pattern of pigs can have a significant effect on the throughput of pigs and hence profitability. Research work (Moorepark, 1996) showed that there was a significant difference in meat production per pig place per year when pigs were sold from pens on one, two or three days (at weekly intervals). This was a result of under-stocking of pens during the selling *period. There was some evidence that pigs left behind eat little and grew slowly in the first week, possibly due to a change in the dominance hierarchy.*

Bonuses

Bonuses are paid to individual suppliers for different criteria. For example some slaughtering plants may pay a bonus for early delivery of pigs so that work on the slaughtering line is properly distributed through normal working hours.

Boar taint

In Ireland and the United Kingdom male pigs are sold entire. This is acceptable as long as pigs are sold light and young enough to minimise the incidence of boar taint in the meat. Increasing slaughter weight does carry with it an increased risk of boar taint. It is vital that pig slaughter weights are specified that avoid the risk of taint.

Conclusion

The factors discussed above can have a significant effect on the price paid for pigmeat. They should be considered in order to ensure that that all is being done at producer level to achieve the optimum price.

BORD BIA: PIGMEAT MARKET UPDATE

Olivia Slevin, An Bord Bia

Introduction

Following a very difficult few months in the pigmeat industry, Bord Bia will give a presentation outlining the current situation in relation to market demand, production, consumption, trade and prices and the background to the current difficult period. Let us first begin by briefly explaining some of Bord Bia's services to the pigmeat industry.

Bord Bia was established by the Government in 1994 following the merger of CBF and the food section of the Trade Board and works in partnership with industry to promote Irish food and drink and to develop markets for Irish products. Bord Bia's primary function is to ensure the success of Irish food and drink at home and abroad through effective market development, promotion and information services. Main pigmeat activities include:

Market Development

- *Client Services: assisting pigmeat processors with developing their business to its full potential.*
- *Quality Assurance Scheme: for pigmeat*
- *Business Development: assisting in re-opening key international markets; generating new business for Irish producers; providing local market knowledge to Irish exporters.*
- *Liaison with Brussels & Embassies: ensuring the best interests of Irish producers and processors are met.*

Promotions

- *Retail: national pork campaigns; presentations; in-store promotions; recipe distribution.*
- *Catering: Féile Bia initiative.*
- *Trade Fairs: participation at international trade fairs; industry and corporate event receptions*
- *Media: press releases and enquiries; international journalist visits.*
- *Education: School presentations and distribution of nutritional information to schools, health professionals and the general public.*

Information

- *Market Monitoring*
- *Seminars*
- *Reports*
- *Enquiries*
- *Study Tours*
- *Consumer Research*

MARKET UP-DATE (IRELAND)

Production

In 2001 production levels in Ireland rose by 5% as a result of a reduction in exports of live pigs to Northern Ireland due to FMD restrictions in place. Production levels for 2002 were forecast to increase slightly however, in light of the increase in live exports to Northern Ireland and a reduction in pig supply due to poor pig prices, production levels may not increase for this year.

Exports

The UK continues to be Ireland's principal outlet for pigmeat exports.

Irish Pigmeat Exports, 1995 - 2001
('000 tonnes)

	1995	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***
Total	***100***	***101***	***108***	***125***	***135***	***129***	***128***
of which to:							
UK	***51.9***	***57.2***	***58***	***66***	***72***	***61.9***	***64***
Cont. EU	***36.9***	***29.2***	***38***	***50***	***41.7***	***40***	***53.8***
- Germany	*14.6*	*12.5*	*15*	*18*	*16*	*16*	*16*
- France	*10*	*6.2*	*10*	*13*	*10*	*5*	*13*
- Italy	*6.5*	*4.7*	*7*	*11*	*10*	*4*	*8.4*
- Other EU	*5.8*	*5.8*	*6*	*8*	*5.7*	*15*	*16.4*
Int. Mkts	***11.2***	***14.6***	***12***	***9***	***21.3***	***27***	***9.7***
- Japan	*4.6*	*7.1*	*8.2*	*4.2*	*10*	*12.3*	*3.1*
- USA	*1.4*	*1.3*	*1*	*1.5*	*1.5*	*2.6*	*0.4*
- Sth Korea	*1.8*	*1.1*	*0.8*	*0.4*	*2.5*	*0.2*	*0*
- Other non-EU	*3.4*	*5.1*	*2*	*2.9*	*7.3*	*11.9*	*6.2*

Source: Bord Bia estimates

Imports

Imports of pigmeat into Ireland have been rising over the past three years and causing growing concern on the home market. The presentation will take a closer look at imports – the type of products being imported and their source. We will also address measures undertaken by Bord Bia to create greater demand for Quality Assured pork and bacon.

Origin of Pigmeat Imports into Ireland: 1998 – 2000 (Tonnes)

	UK	***N. Irl***	***Holland***	***France***	***Denmark***	***Germany***	***Others***	***TOTAL***
1998	*11,347*	*6,586*	*5,238*	*3,999*	*4,177*	*2,396*	*1,236*	***34,979***
1999	*10,308*	*4,997*	*6,622*	*2,329*	*3,902*	*2,419*	*1,931*	***32,508***
2000	*12,475*	*5,109*	*8,782*	*4,791*	*3,876*	*2,675*	*2,216*	***39,924***
2001	*14,600*	*2,700*	*8,600*	*4,700*	*5,600*	*4,300*	*4,800*	***45,300***

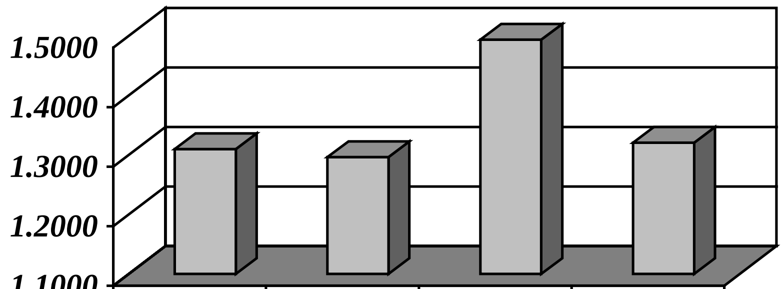
Composition of Pigmeat Imports into Ireland: 2000

Total Imports 2000 39,900 Tonnes	
Of which:	
Backs/Loins	*20,300 Tonnes*
Other Pork & Bacon	*3,800 Tonnes*
Processed	*11,250 Tonnes*
Sausages	*2,800 Tonnes*
Offal	*1,800 Tonnes*

Prices

2001 was an exceptionally good year for Irish pig prices due to the FMD situation in Britain. This year's price has performed poorly so far.

Average Irish Pigmeat prices 1999-2002 (prediction)



	1999	2000	2001	2002 (p)
Euro/kg dw	1.3094	1.2961	1.4932	1.3200

Industry Developments

This section will take a closer look at developments that have taken place in the pigmeat industry throughout the year and their likely impact on Ireland's pigmeat trade.

Customer Concerns

Boar Taint: Not of major concern to customers at present as long as pig carcasses remain below 75kgs. Ideal carcase weight (based on customer requirements) is 68-74kgs with an ideal lean weight percentage of ideally 59%.

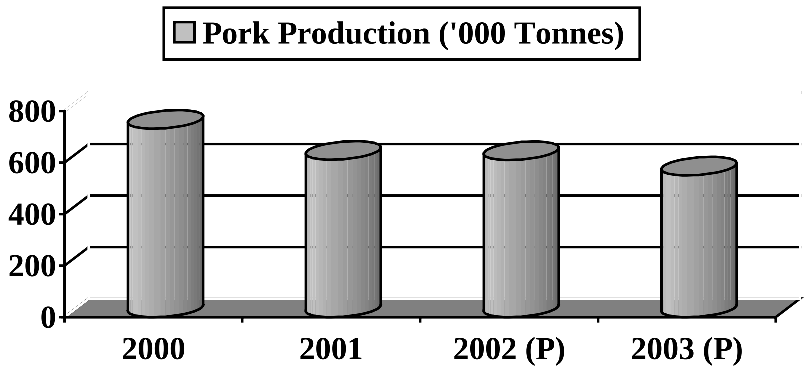
Salmonella: Farm categorisation planned to proceed in October. This will have implications for category 3 farms as pigs from this category will have to be killed last on any given slaughter day. Should have no immediate effect on sales as the programme will take 12-18 months to overcome start-up problems.

Product Quality: Irish product generally has a very good reputation in all export markets. Our specifications are quite tight and packaging is very good. On the home market, there are quality issues in relation to consistent quality and grading (especially for loins).

UNITED KINGDOM

Production

Pork production in the UK declined sharply in 2001 due to FMD and is forecast to continue this decline for 2002 and 2003.



Breeding Herd

In line with falling production, the UK breeding herd is also in decline.

Imports

With production in the UK declining, import requirements for the remainder of 2002 and next year will increase. Demand for pork and bacon in the UK will remain strong and Irish exporters should benefit from this.

Prices

British pig prices have been quite strong throughout 2002. However we have witnessed their decline in recent weeks. Prices should remain quite strong due to tight supplies on the British market.

DENMARK

Denmark's pigmeat production will increase 3-4% this year. Prices also set to drop dramatically during the latter half of this year due to restricted international market access and a more competitive EU market.

Danish Pig Production Forecast 2002 & First Quarter 2003 (x 1000 Head)

	2002	*2003*
1st Quarter	*5,993*	*6,100*
2nd Quarter	*5,855*	
3rd Quarter	*6,112*	
4th Quarter	*6,331*	
YEAR	*24,291*	

Danish Pig Prices Forecast 2002 & First Quarter 2003 (Euro/ KG DW)

	2002	*2003*
1st Quarter	*1.380*	*1.100*
2nd Quarter	*1.340*	
3rd Quarter	*1.180*	
4th Quarter	*1.100*	
YEAR	*1.250*	

THE NETHERLANDS

The Netherlands is expecting a 4-5% drop in production for 2002 due to stringent environmental restrictions in place. Prices are expected to remain low due to increased competition on EU markets.

Dutch Pig Production Forecast 2002 & First Quarter 2003 (x 1000 Head)

	2002	*2003*
1st Quarter	*5,052*	*4,600*

2nd Quarter	*4,822*	
3rd Quarter	*4,700*	
4th Quarter	*4,650*	
YEAR	*19,224*	

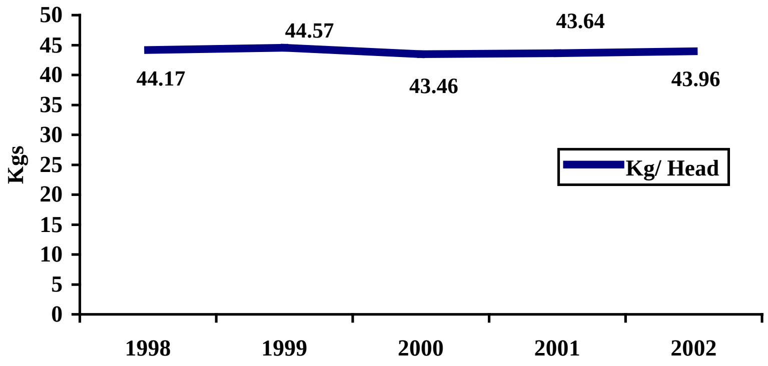
Dutch Pig Prices Forecast 2002 & First Quarter 2003 (Euro/ KG DW)

	2002	**2003**
1st Quarter	*1.266*	*1.130*
2nd Quarter	*1.220*	
3rd Quarter	*1.200*	
4th Quarter	*1.150*	
YEAR	*1.209*	

EU

Consumption ***– increasing and set to continue over the coming years***

EU Pigmeat Consumption 1998-2002 (prediction)



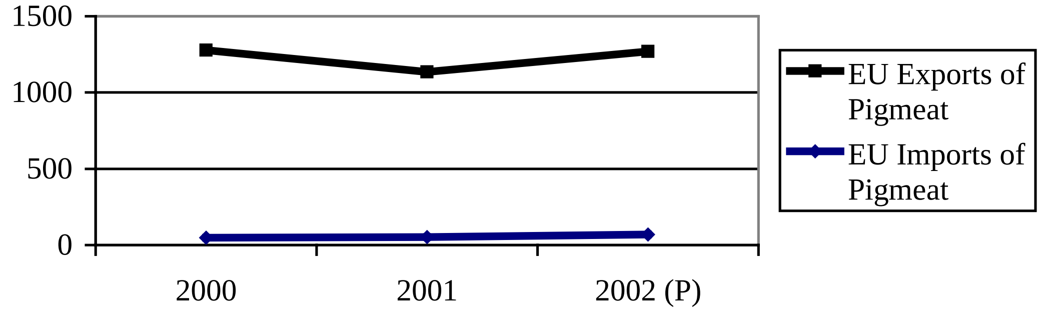
Production

Slight overall increase expected this year reflecting increased consumption

Denmark ⇧ 3-4%	*Netherlands ⇩ 5-6%*
Spain ⇧ 3-4%	*UK ⇩ 5%*
Germany ⇧ 1-2%	*Belgium ⇩ 2-3%*

***Trade** – imports and exports increasing but imports remain at minimal volumes*

'000 Tonnes



Future EU Projections ('000 Tonnes cwe)

	2002	**2003**	**2004**	**2005**	**2006**	**2007**
Production (gross)	*17,930*	*18,110*	*18,117*	*18,274*	*18,564*	*18,642*
Exports	*1,200*	*1,300*	*1,150*	*1,170*	*1,203*	*1,223*

Prices

EU Pig Prices (Euros/ Kg cw – grade "E")

	1998	**1999**	**2000**	**2001**	**2002**
1st Quarter	*1.3801*	*0.9794*	*1.2173*	*1.7390*	*1.3897*
2nd Quarter	*1.2856*	*1.1003*	*1.4228*	*1.8118*	*1.3777*
3rd Quarter (p)	*1.1575*	*1.2596*	*1.4871*	*1.6609*	*1.3659*
4th Quarter (p)	*0.9541*	*1.1507*	*1.5306*	*1.4495*	*1.2734*
Year	*1.1926*	*1.1248*	*1.4164*	*1.6610*	*1.4128*

Industry Developments

This section will take a closer look at developments that have taken place in the pigmeat industry in the EU throughout the year and their likely impact on the EU's pigmeat trade.

WORLD

USA

A marginal increase in production in the USA is predicted for 2002 (up 24,000 tonnes to 8.715 million tonnes) however it is expected that exports from the USA will be down by 5% on 2001 levels to 674,000 tonnes as the US is expected to face increased competition in its two main markets of Japan and Mexico from Canada in particular. In the second quarter of 2002 there was an appreciation of the euro against the dollar and this is giving US producers a price discount against Danish and other European producers. US processors are having problems slaughtering the increased hog numbers and therefore sharp price drops by year-end (prices below US$20
(€0.90c/ kg dw are a possibility) can be expected. The US government will buy up pork in an attempt to prevent prices falling too far.

Canada

Canadian production is due to increase by 5% in 2002 to 1.8 million tonnes. Canada will also benefit from the appreciation of the euro and is now a greater threat in international markets. Likewise exports are also expected to increase by almost 5%. The USA and Japan are Canada's principal importers so Canada will undoubtedly experience challenging market prices as a result of restricted access to Japan for the remainder of 2002.

Profiles

This section of the presentation will give a brief profile of the pigmeat industries and production trends in Eastern Europe, China, Brazil and Japan.

Imports

Import demand in major pigmeat importing nations is expected to increase gradually up to the year 2009.

Outlook for pigmeat net imports for major importing countries 2001-2009 ('000t cwe)

Importing Country	***2001***	***2009***	***Change in trade***
Japan	*920*	*1099*	*+179*
Russia	*600*	*775*	*+175*
Hong Kong	*335*	*428*	*+93*
Mexico	*240*	*311*	*+71*
South Korea	*120*	*155*	*+35*
China Mainland	*10*	*111*	*+101*

PRODUCING LARGER LITTERS – THE CHALLENGE

Jim Finn, Teagasc, Moorepark

Introduction

During the late 1980's and early 1990's Irish pig producers could take pride on being at the top of the European league on litter size. In the last 5-7 years, Ireland has fallen well behind its European counterparts. This has to be an area for concern.

Comparison

Table 1 shows the litter size comparison between Ireland and four other European countries.

Table 1 – Comparison of Litter Size in Different Countries – 2000

Country	***Ireland***	***UK***	***Denmark***	***Netherlands***	***France***
Source	*Teagasc*	*MLC*	*NCPP*	*DLV*	*ITP*
No. Born Alive/Litter	*10.85*	*11.02*	*11.81*	*11.30*	*11.90*
No. Born Dead/Litter	*0.76*	*0.92*	*1.10*	*0.90*	*0.90*
Total Born/Litter	*11.61*	*11.94*	*12.91*	*12.20*	*12.80*

Levels of Improvement in Born Alive

Table 2 shows the level of improvement in the period from 1991 to 2000 for the same European countries.

Table 2 – Improvements in Born Alive/Litter		
Country	***Change in Born Alive/Litter***	***% Change***
Ireland	*+0.1*	*1%*
Denmark	*+1.16*	*9.1%*
*France**	*+1.0*	*9.1%*
Netherlands	*+1.0*	*9.7%*
UK	*+0.26*	*2.4%*

** France 1994 to 2000*

The improvement for Ireland was miniscule and was only 10% of that achieved by our major European competitors.

Top Irish Herds

Data for the top 10% and 25% of Irish pig producing herds on litter size is shown in Table 3. This shows that the figures for even the top Irish herds are struggling to match the average for other European countries. There is scope for improvement.

Table 3: Litter Size from Top Irish Herds in 2001			
	Top 10%	***Top 25%***	***Average***
No. Born Alive/Litter	*11.81*	*11.53*	*10.78*
No. Born Dead/Litter	*0.73*	*0.79*	*0.75*
Total Born/Litter	*12.54*	*12.32*	*11.53*

Components of Litter Size

Litter size is made up of two components, namely:

Number born alive per litter

Number born dead per litter.

These two combine to give the total number born.

Setting Targets

Every unit needs to set realistic targets for the above two components. These will vary from farm to farm. Some guidelines are set out for different situations in Table 4.

Table 4: Targets for numbers born alive and dead

	Good	***Very Good***	***Excellent***
Born Alive Per Litter	*11.0*	*11.5*	*12.0*
Born Dead Per Litter	*0.7*	*0.8*	*0.8*
Total Born Per Litter	*11.7*	*12.3*	*12.8*

What Pre-Determines Litter Size?

1. *Ovulation Rate – number of eggs released*
2. *Fertilisation rate – number of eggs fertilised*
3. *Level of embryonic deaths – number lost in early pregnancy*
4. *Level of stillbirths.*

What means have pig producers at their disposal to improve ovulation rates, fertilisation rates and to reduce embryonic deaths and stillbirths?

Management Strategies

- *Sow records*
- *Genetics*
- *Breeding programme*
- *Gilt management*
- *Weaning age*
- *Service management*
- *Nutrition*
- *Parasite control*
- *Parity record analysis*

- *Health*
- *Environmental factors.*

Sow records

Reliable records are essential in identifying breeding problems and the simplest of these is the individual sow record card. Computerised recording is invaluable in analysing litter size.

Genotype and prolificacy

The heritability of litter size is low (10-15%). Improvements from within herd selection for litter size are therefore likely to be slow. Units with low litter size need to keep this in mind. There are, however, large breed and genotype differences in litter size. Litter size in cross bred sows is on average 0.25-0.5 pigs per litter larger than in pure breds. Chinese breeds e.g. Meishan are noted for their high litter size.

In recent years the French and the Danes have put a lot of research into developing hyper prolific breed lines. Improvements of 0.2-0.3 in litter size over a three to five year period have been achieved. This explains some of the reasons why they have overtaken us. Maybe it is time for us to evaluate our breeding lines on prolificy. The most recent breed evaluation trials at Moorepark on carcass traits showed considerable differences between breeding companies in growth traits. Are there similar differences in litter size ?

Herd Breeding Programme

Setting up a proper breeding for replacement stock is a crucial factor in improving litter size. The options are:

- *Home rear gilts using a criss cross system*
- *Home rear gilts using purchased dam line semen*
- *Purchase F1 gilts.*

Where natural service is being used, change boars every two years to avoid inbreeding. Inbreeding depresses litter size. The Halothane gene should also be avoided in female breeding stock.

Always start with a prolific female. F1 females are the ideal.

Gilt Management

The largest effect on gilt litter size is the sexual maturity of the gilt at breeding time. Gilts bred at the second oestrous will produce an average of 0.7 (range 0.4-1.2) more pigs per litter than gilts bred at first oestrous (puberty). To maximize ovulation rate, gilts should be fed dry sow diet ad libitum before breeding. Aim for a target weight of 140kg and age of over 30 weeks at service with a minimum back fat depth of 18mm. Having an adequate supply of maiden gilts (i.e. 12-15% of herd size) is important.

Weaning Age

Weaning at under 21 days can result in reduced litter size in the next cycle. Aim for a weaning age of between 24 and 28 days.

Weaning to Service Interval

The length of weaning to service interval is now recognised as being associated with reproductive efficiency. At a weaning to service interval of 4 to 5 days, the sow is highly fertile. It is important, therefore, in order to maximise fertility and litter size, to aim to serve 80% or more of sows weaned in this period. The service sheet used should have the facility to record weaning to service interval.

Service Management

(a) *Timing of mating.*

To maximise litter size, gilts and sows should be served 12-16 hours before ovulation occurs. Ovulation occurs on average at about 70% of the way through the oestrous period in sows and 85% for gilts. The length of the oestrous period varies from farm to farm. It can be influenced by many factors e.g. boar exposure, weaning to service interval. Mating must not be delayed until ovulation occurs. Weaning on Wednesday means some or many sows must be served on Sunday.

(b) Number of services.

On farms there is little difference in litter size between sows served two or three times. Serve sows twice. Mating too late in the cycle (as is likely if aiming for three matings) may be counter-productive and introduce infections.

(c) Boar usage.

Where boars are used for natural service, use one boar per female per week. Use each serving boar weekly. Always supervise boar services. Use service records to detect differences among boars used for natural service.

(d) Semen handling and storage.

Maintaining good hygiene is essential where A.I. is used. Use semen storage boxes set at the correct temperature of about $17^{o}C$.

(e) Semen quality.

Where on-farm A.I. is practiced regular checking of semen for motility and morphological appearance is essential.

(f) Operator efficiency at service

The efficiency of operator/technician at service can be crucial in reproductive performance. Differences of between 21% in *farrowing rate and 2.6 pigs in litter size between the worst and best AI technicians were recorded in US trials (Flowers 1998-2000). In that study technicians who mated more than 15 sows without a break had lower fertility in the sows bred last. It was concluded that no more than 15 sows be bred without a rest.*

(g) *Stress.*

Any form of stress at service or in the early weeks after service will result in early embryonic death and subsequently reduced numbers born alive. Avoid mixing and moving of sows and gilts in this period. If they have to be moved then it should be done within the first 72 hours.

Nutrition

(a) *Energy and Protein*

Feed intake either during lactation or prior to service of both gilt and weaned sows can influence litter size. It has been shown that the energy and amino acid intake during any week of lactation can influence the number and quality of follicles released after weaning. Also, their ability to be fertilised and survive as embryos in early gestation is affected. Excessive weight loss especially in gilts during first lactation is common on some units. This is often caused by gilts being overfat at farrowing resulting in poor appetite. The subsequent result is delayed oestrous and poor ovulation rate giving a smaller second litter.

(b) *Role of Vitamins in Litter Size*

Certain vitamins have been linked to litter size. Biotin, Folic Acid, Vitamin A/beta carotene and vitamin E/selenium have been found in some studies to influence ovulation, implantation and/or embryonic survival rate. The importance of having diets adequately balanced with minerals and vitamins cannot be over emphasised when looking at litter size problems. Mycotoxins and unsaturated fats in feed can result in the destruction of Vitamin E.

This fact should not be overlooked. High fat diets need higher levels of Vitamin E supplementation.

Table 5: Guideline Feeding Levels		
	Kg/Day	***Diet Energy MJ/day***
Maiden Gilts – Pre Service	*2.5-3.0*	*34-40*
Served Gilts – Post Service	*2.0*	*26*
Sows – Weaning to Service	*3.0*	*39*

Parasite Control

Research work in Nottingham University showed some advantage in litter size where there was effective control of internal parasites e.g. worms.

Parity

Litter size is usually smallest at first parity and rises to a maximum between the third and fifth litter. After the fifth litter, the number of stillbirths starts to increase with a decrease in the number born alive. A recent Teagasc analysis of parities on almost 53,000 litters over 30 Irish herds showed the following breakdown.

Table 6: Parity Distribution of 30 Farms

Parity	***No. Litters***	***% of Total***	***Ave. Born Alive/Litter***	***Ave. Born Dead/Litter***	***Ave. Total Born/Litter***
1	*11569*	*22.0*	*9.98*	*0.56*	*10.54*
2	*9035*	*17.2*	*10.74*	*0.54*	*11.28*
3	*8186*	*15.6*	*11.36*	*0.64*	*12.00*
4	*6942*	*13.2*	*11.53*	*0.81*	*12.34*
5	*5942*	*11.3*	*11.25*	*0.81*	*12.12*
6	*4969*	*9.4*	*11.02*	*0.96*	*11.98*
7	*3929*	*7.5*	*10.62*	*1.04*	*11.66*
8	*1667*	*3.2*	*10.22*	*1.04*	*11.26*

8+	*376*	*0.7*	*9.7*	*0.91*	*10.61*
Total	*52615*	*100.0*	*10.82*	*0.70*	*11.52*

Sources: Pig Champ; Easicare; Boots

The average number of pigs born alive and dead per litter for these 30 herds differs very little from what the Teagasc PigSys results show for 2000 and 2001. This would suggest that the above analysis is a representative one. Where litter size is presenting problems, a parity analysis over a three month period is worthwhile.

On Table 6 it is worth noting that:

- *11.4% of litters were 7th parity and over with an average born alive per litter of under 10.45*
- *There is a large fall out of sows from first litter to second litter – almost one quarter (22%).*
- *All parities could potentially have 0.25-0.5 more pigs born alive per litter.*
- *Only 49.5% of litters are in parities 3 to 6, the prime litters. The aim should be 57-60%.*

In the above study the average number born alive for all litters ranged from 9.4 to 12.3 on different farms. For gilt litters the range was from 8.8 to 11.4. These are huge variations.

An ideal distribution with litter size will look as follows (Table 7):

Table 7. Ideal parity distribution and litter size

Parity	***% of Sows***	***Born Alive Per Litter***	***Born Dead per Litter***	***Total Born Per Litter***
1	*20*	*10.2*	*0.6*	*10.8*
2	*18*	*11.0*	*0.5*	*11.5*
3	*17*	*11.5*	*0.6*	*12.1*
4	*16*	*11.9*	*0.7*	*12.6*

5	*14*	*11.9*	*0.8*	*12.7*
6	*10*	*11.5*	*0.9*	*12.7*
7+	*5*	*11.0*	*1.0*	*12.0*
Whole herd	***100***	***11.2***	***0.7***	***11.9***

Disease and Health Status

Various diseases can affect number liveborn by increasing the number of stillbirths and decreasing the born alive. Such diseases include Parvovirus, Aujeszky's disease, PRRS and Swine Fever. Vaccination is possible against Parvovirus and Aujeszky's disease. High health gilts often perform poorly when introduced to herds with a lower health status. Isolation and vaccination combined with gradual introduction to animals from the herd may help.

Environmental Factors

Provide adequate light in the service area (14-16 hours/day). Avoid draughts and maintain good hygiene.

Summary

Many factors influence litter size. When a problem exists, check the following:

- *Breeding Policy*
- *Gilt Management*
- *Service Management*
- *Nutrition Programme*
- *Parity Distribution*
- *Health*

TECHNICAL EFFICIENCY IN PIG PRODUCTION
HOW DOES IRELAND RATE?

Michael A. Martin, Chief Pig Adviser, Athenry

Introduction

Pig producers in Ireland have had a very good reputation for achieving high levels of sow output. This advantage over producers in other countries helped to offset some of the disadvantages such as higher feed costs. Growth rates and feed efficiency levels appear to compare less favourably with other countries.

Sow Productivity

The Teagasc Pig Advisory Service have collated the herd performance results for herds using Pigsys for more than 10 years. The most recent data available is for the year 2001 (Table 1).

The Number of Pigs Produced is defined as Live Births less All Deaths.

Table 1. Sow productivity in Irish pig herds 2001

No. Herds	*125*
Ave. Herd Size	*380*
Litters Per Sow Per Year	*2.28*
Average Weaning Age – days	*27*
No. Born Alive Per Litter	*10.78*
No. Born Dead Per Litter	*0.75*
Mortality % Piglets	*9.1*
Weaner	*2.6*
Finisher	*2.0*
No. Pigs Produced Per Sow Per Year	*21.4*

Source: Teagasc Pigsys 2001

During the last decade output per sow peaked at 22.2 pigs in 1997. However, there has been a significant decline in recent years (Table 2).

Table 2. Sow productivity in Irish pig herds 1991 – 2001

Year	***No. Pigs Per Sow Per Year***	***No. Litters Per Sow Per Year***	***No. Pigs Produced Per Litter***
1991	*21.0*	*2.31*	*9.48*
1992	*21.7*	*2.30*	*9.43*
1993	*21.8*	*2.29*	*9.52*
1994	*21.7*	*2.29*	*9.48*
1995	*21.6*	*2.28*	*9.47*
1996	*22.1*	*2.31*	*9.57*
1997	*22.2*	*2.32*	*9.57*
1998	*22.1*	*2.32*	*9.53*
1999	*22.0*	*2.31*	*9.52*
2000	*21.6*	*2.29*	*9.43*
2001	*21.4*	*2.28*	*9.39*

Source: Teagasc Pigsys

The number of pigs produced per litter has decreased from 9.57 to 9.39. This combined with a reduction of 0.04 in Litters Per Sow Per Year has resulted in sow output falling by 0.8 pig from 1997.

A reduction in the Number Born Alive Per Litter together with increased mortality levels has resulted in the reduced Number Produced Per Litter (Table 3).

Table 3. Sow output in Irish pig herds 1997 and 2001

	1997	**2001**
Litters Per Sow Per Year	2.32	2.28
No. Born Alive Per Litter	10.86	10.78
Mortality % Piglet	8.8	9.1
Weaner	2.1	2.6
Finisher	2.1	2.0
No. Pigs Produced Per Sow Per Year	22.2	21.4

International Comparison

The information is available to compare sow productivity in different countries (Table 4)

Table 4. Comparison of sow productivity in different countries (2000)

Country	**No. Pigs Per Sow Per Year**	
	Weaned	**Produced**
Ireland	22.6	21.6
UK	22.4	21.2
France	n.a.	19.4
Denmark	23.4	21.8
Netherlands	23.0	21.9
Germany	21.2	19.8

These results indicate that sow output in both Denmark and the Netherlands is now higher than in Ireland. A more detailed analysis shows why this is so (Table 5).

Table 5. Components of sow output in different countries 2000

	Ireland	***Denmark***	***Netherlands***	***France***
Source	***Teagasc***	***NCPP***	***DLV***	***ITP***
Litters Per Sow Per Year	*2.29*	*2.25*	*2.34*	
Weaning Age – days	*27*	*30*	*-*	*25.8*
No. Born Alive Per Litter	*10.85*	*11.81*	*11.30*	*11.9*
No. Born Dead Per Litter	*0.76*	*1.1*	*0.9*	*0.9*
Mortality % Piglet	*9.0*	*12.7*	*13.4*	*12.7*
Post Weaning	*4.6*	*7.3*	*4.4*	
Weaned Per Litter	*9.87*	*10.4*	*9.8*	*10.4*

Litter size in Ireland falls considerably short of that in other countries by 0.5 – 1 pig per litter. The figures reported for the UK 11.02 (MLC 2001) are higher than for Ireland.

Both piglet and post-weaning mortality levels in Ireland compare very favourably with other countries. The higher levels of piglet mortality in other countries is, in part, a consequence of the higher Number Born Alive.

International Trends in Sow Productivity

Increases in the number of pigs produced per sow per year in other countries means that Ireland is, no longer, the leader in this efficiency factor.

Increased NBA is responsible for increased sow output in Denmark (Table 6), France (Table 7) and Netherlands (Table 8)

Table 6. Changes in sow output in Denmark 1991 – 2000

	1991	***1995***	***2000***
No. Pigs Weaned Per Sow Per Year	*21.4*	*22.3*	*23.4*
No. Born Alive	*10.74*	*11.1*	*11.9*

Source: NCPP

Table 7. Changes in sow output in France (1994 – 2001)

	1994	***2001***
No. Pigs Produced Per Sow Per Year	*18.2*	*19.5*
No. Born Alive	*11.0*	*12.0*
Weaned Per Litter	*9.6*	*10.5*

Source: ITP

Table 8. Changes in sow output in Netherlands

	1991	***1995***	***2000***
No. Pigs Weaned Per Sow Per Year	*18.8*	*21.6*	*23.0*
No. Born Alive	*10.3*	*10.9*	*11.3*

Source: DLV

Sow Productivity in Irish Herds

There is considerable variation in the level of sow output in the herds recorded in Pigsys. Herd have been grouped into quartiles on the basis of Number Pigs Produced Per Sow Per Year. The results are in Table 6.

Table 9. Performance of herds grouped on the basis of Number Pigs Produced Per Sow Per Year 2002

	Top 25%	***Second Highest 25%***	***Second Lowest 25%***	***Lowest 25%***
No. Herds	*35*	*30*	*30*	*33*
Ave. Herd Size	*476*	*413*	*364*	*277*
No. Pigs Produced Per Sow Per Year	*23.7*	*21.6*	*20.4*	*18.1*
Litters Per Sow Per Year	*2.37*	*2.30*	*2.24*	*2.15*
Weaning Age – Days	*26*	*27*	*28*	*27*
Empty Days Per Litter	*13*	*17*	*20*	*30*
No. Born Alive	*11.24*	*10.77*	*10.52*	*10.15*
No. Born Dead	*0.76*	*0.77*	*0.71*	*0.77*
Mortality %				
Piglet	*8.2*	*8.8*	*9.3*	*11.1*
Weaner	*1.81*	*2.62*	*2.78*	*3.67*
Finisher	*1.9*	*1.63*	*1.85*	*3.03*
Range	*<19.9*	*19.9 – 20.9*	*21.1 – 22.3*	*>22.3*

The top producing herds not alone have more Litters Per Sow Per Year (2.37) but also have more pigs produced per litter (10.)

These results also suggest that large herds produce more pigs per sow than smaller herds.

The larger herds (>500 sows) produce more pigs per sow per year but only slightly more than herds of 150 – 500 sows (Table 10).

Table 10. Sow productivity in herds grouped by herd size 2001

	Largest ***25%***	***Second Largest*** ***25%***	***Second Smallest*** ***25%***	***Smallest*** ***25%***
No. Herds	*32*	*33*	*33*	*32*
Ave. Herd Size	*903*	*319*	*187*	*88*
No. Pigs Produced Per Sow Per Year	*21.6*	*21.0*	*21.3*	*20.5*
Litters Per Sow Per Year	*2.31*	*2.24*	*2.25*	*2.19*
No. Born Alive	*10.75*	*10.77*	*10.96*	*10.81*
No. Born Dead	*10.75*	*0.72*	*0.81*	*0.82*
Mortality % Piglets	*8.9*	*8.9*	*9.9*	*9.8*
Post-weaning	*4.6*	*4.4*	*4.4*	*4.5*
Range	*>500*	*248 – 498*	*138 – 246*	*<136*

Pig Performance Weaning to Sale

Performance results for weaners and finishers can be usefully combined to assess pig performance from Weaning to Sale (Table 11)

Table 11. Pig Performance Weaning to Sale in Ireland 2001

Average Sale Weight – live kg	*92.1*
Daily Feed Intake g	*1416*
Average Daily Gain g	*585*
Feed Conversion	*2.42*

Source: Pigsys Report 2001

FEED is used later rather than food

Pigs, on average, take 146 days from weaning to reach a slaughter weight of 92.1 kg live or about 69.6 kg dead. Growth rates in 2001 have not increased significantly and compare unfavourably with those of the early 1990's when slaughter weights were substantially lower (Table 12).

Table 12. Growth rate and feed conversion ratio (weaning to slaughter) on Irish pig herds 1992 – 2001

Year	***Sale Weight - Live kg***	***Growth Rate g per day***	***Food Conversion***
1992	*83.8*	*578*	*2.41*
1993	*85.6*	*578*	*2.38*
1994	*85.6*	*582*	*2.39*
1995	*86.8*	*585*	*2.39*
1996	*87.7*	*603*	*2.35*
1997	*89.6*	*595*	*2.40*
1998	*90.1*	*596*	*2.41*
1999	*90.5*	*596*	*2.41*
2000	*90.1*	*584*	*2.32*
2001	*92.1*	*585*	*2.42*

Source: Teagasc Pigsys

Pig slaughter weights have increased steadily over the last decade – by 8.3 kg live. Feed Conversion has improved in real terms when allowance is made for the increase in sale weight. However, there has been no sustained improvement in growth rates recorded. The introduction of Mycoplasma vaccination in 1994 and now used widely on units, appears to have successfully substituted for the use of in-feed medication without an overall increase in pig growth rates.

Grower/Finisher Comparison

When comparing growth rates and feed efficiency data for Ireland with that of other countries allowances must be made for differences in slaughter weights. In addition, other countries, with the exception of the UK, use castrates rather than entire males.

Table 13. Growth Rates and Feed Conversion Weaning to Sale in selected countries

Country	***Year***	***Slaughter Weight (Live) kg***	***ADG g***	***FCE***
Ireland	*2001*	*92.1*	*5858*	*2.42*
UK	*2000*	*85.7*	*603*	*2.48*
Denmark	*2000*	*101.0*	*658*	*2.62*
Netherlands	*2000*	*112.0*	*618*	*2.57*
France (a)	*2001*	*110.2*	*654*	*2.60*

(a) Performance Weaning to 105 kg

FCE *Slaughter weights are higher in Denmark and, especially in the Netherlands and France. Having made allowance for these higher sale weights. Feed Conversion in Ireland is better than in the other countries. Feed Conversion is the number of kg of feed required to produce 1 kg of liveweight gain. It does not take account of any differences in the nutrient density of the diets fed in the different countries. At least some of the difference found between Ireland and other countries may lie with the use of lower nutrient density diets in these countries. (Hanrahan 1994).*

Castrates convert feed less efficiently than do entire males (Table 14).

Table 14. Performance of entire males and castrates from weaning to slaughter

	Entire Males	***Castrates***
Start Wt. kg	*8.3*	*8.3*
Sale Weight Live kg	*102.0*	*101.9*
Daily Feed Intake g	*1705*	*1878*
Ave. Daily Gain g	*748*	*756*
Feed Conversion	*2.28*	*2.49*

Source: P. Lawlor 2002

ADG *Tuite (2001) estimated that growth rates weaning to sale in Ireland were 35g per day below that of pigs in continental countries. This means that pigs in Ireland take 8 days longer to reach 93 kg liveweight.*

Conclusions

Technical efficiency on Irish pig farms is no longer better than that reported for other countries. Sow productivity in Ireland has declined in recent years. In other countries sow output has increased due to significant increases in No. Born Alive Per Litter.

Growth rates in Ireland compare unfavourably with that in other countries even when allowance is made for the lower slaughter weights here.

Feed conversion in the period weaning to slaughter is better for Ireland than other countries. However, this advantage will be, largely, cancelled out when allowance is made for lower slaughter weights, use of entire males and, probably, higher nutrient density diets.

CHOICE OF TERMINAL SIRE (AI)

Peadar Lawlor, Teagasc, Moorepark Research Centre.

Introduction

"The boar is half your herd" is a long used adage of pig producers. And it is as true today as it ever was. However, few producers are giving sufficient attention to choosing this half of the herd. This could be costing you money !

Pig production is characterised by rapid turnover of stock allowing for rapid genetic improvement. This genetic improvement must be harnessed by careful selection of boars to ensure unit profitability. This is particularly true in Ireland, a country with few natural advantages when it comes to producing pigs.

This paper will consider only the terminal sire and its introduction to the herd as purchased artificial insemination (AI). AI provides unique genetic opportunities by allowing producers access to the very best or most *advanced genetic material available to the industry. It is estimated that breeding companies make available the top 5-7% of their boars for distribution as AI. The selection criteria that will be discussed include: source, breed, pooled semen, health, genetic improvement and presence or absence of gene markers.*

Source

The source of AI for producing finisher pigs will depend on many factors, some of which will be discussed under other headings. However, the past performance record and professionalism of a supplier can be very important. Producing quality terminal sires with important economic traits can not be done overnight. On the contrary, this is a long term process which requires dedication to detail, discipline and a considerable investment of capital.

Two breeding companies (Hermitage and PIC Ireland) are now the principle suppliers of sireline semen to pig producers in the Republic of Ireland. Appendix 1 details the types of boars available from each of these suppliers.

Hermitage recommend the use of purebred Hylean Large White semen on Landrace type sows and the use of purebred Hylean Landrace semen on Large White type sows in a rotational breeding programme. They recommend the use of selected Hylean Landrace and Large White semen when pigs are destined for plants in Northern Ireland where payment is made on P2 fat depth. Hylean 26 is recommended for use on F1 sows or in a rotational breeding system to get the benefit from hybrid vigour and improve meat eating quality. This breeder also has a pure Duroc line which is recommended to improve the eating quality of meat and hybrid vigour. They also have pietrain line for research purposes.

PIC have three terminal sire lines for use in Ireland. Their line 62 is purebred Pietrain but is halothane negative which should improve greatly their meat quality. Line 11 is a purebred Large White line and it is *recommended by PIC for use when pigs are destined for plants in Northern Ireland where payment is made on P2 fat depth. PIC's line 402 is a cross between line 62 and line 11. This line is recommended by PIC for use on F1 sows or in a rotational breeding programme to produce slaughter pigs that will be paid for on the basis of lean meat percent as is the case in the Republic of Ireland. The PIC F1 (Camborough 15) is the result of a 3 way cross ((Large White x Duroc) x Landrace). This means that when mated with a PIC terminal sire the progeny of Camborough 15s will be 12.5% Duroc.*

Breed

Genetic differences in pork quality among swine breeds have been known for some time. This presents the industry with an opportunity to design superior pork products for specific markets. The Duroc breed has received particular attention due to its positive contribution to the eating quality of pork (Table 1). This is thought to be due primarily to its relatively high level of intramuscular fat (marbling). A high level of intramuscular fat has been linked with improved eating quality of pork (Table 2).

Table 1. The influence of % Duroc genes on pork eating quality (MLC, 1992)

	% Duroc genes			
	0	***25***	***50***	***75***
Tenderness[1]	*4.96*	*5.03*	*5.32*	*5.38*
Juiciness[1]	*4.09*	*4.11*	*4.18*	*4.38*
Flavour[1]	*3.88*	*3.99*	*3.96*	*3.98*

[1]Evaluated on an 8 point scale (lower = undesirable)

Table 2. Effect of increasing intramuscular fat % on eating quality of pork loin chops (Wood, 1993).

Intramuscular fat %	*Flavour*[1]	*Tenderness*[1]	*Juiciness*[1]	*Acceptability*[1]
1.47	*2.5*[a]	*1.3*[a]	*1.7*[a]	*0.6*[a]
2.89	*2.9*[b]	*3.1*[b]	*3.2*[b]	*2.0*[b]
4.34	*2.8*[b]	*2.4*[c]	*2.5*[c]	*2.0*[b]

[1]Taste panel scores on a scale from –5 to 5 with low = undesirable. [a,b,c]Values within columns with different subscripts differ significantly.

In 2002 we carried out an experiment in Moorepark comparing Landrace and Duroc sire line semen. The meat quality component of this experiment is not yet complete. However, Table 3 gives a summary of pig performance to slaughter. It appears (at least in this case) that selection for improved eating quality may reduce pig performance.

Table 3. Effect of Breed on grower finisher performance (Lawlor et al., 2002)

	Breed		
	Duroc	***Landrace***	***Significance***
Days on trial	*133*	*124*	*****
Intake (g/day)	*1813*	*1829*	*NS*
Daily gain (g/day)	*655*	*703*	*****

*[1]from 48 days post-weaning to slaughter at 104 kg. *** P<0.001, NS = non-significant.*

The parent sows in Ireland are generally of Landrace x Large white origin. When a third breed (e.g. Duroc or Pietrain) is used as a terminal sire, pigs can benefit from hybrid vigour (heterosis). This hybrid vigour may be seen in increased growth rate and viability of progeny. Problems with the use of Pietrains is that they were traditionally halothane positive (stress sensitive) and that their growth rate tended to slow down when they reached 70 to 80 kg liveweight. Pietrains sold by PIC (line 62) are now *halothane negative. According to PIC significant improvements in growth rate with this breed has been achieved in the last five years through intensive selection for this trait (a high heritability trait). Hermitage also have a source of halothane negative Pietrains but see little benefit from using this breed.*

A recent report by McCann and Beattie (2002) looked at boars of eight types (LR, LW, Dr, LR x LW, LR x Dr, LW x Dr, LR x LW x Dr, LR x LW x P). No difference in performance was seen between purebred and crossbred sires. However considerable within sire type variation was observed in this study (Table 4)

Table 4. Variation in pig production performance from weaning to slaughter (McCann and Beattie, 2002).

	Average	*Top 15%*	*Bottom 15%*
Daily gain (g/day)	*720*	*884*	*614*
FCE	*2.31*	*1.74*	*2.52*

Pooled semen

Mixing or pooling semen from different boars is now common practice when processing semen for commercial AI. The benefits of pooling semen include:

(1) allows a large number of boar ejaculates to be processed simultaneously rather than individually thus increasing processing efficiency.

(2) reduces / eliminates inherent differences in fertility between boars.

Hermitage use pooled semen from 4 boars.

The disadvantages of pooling semen include:

(1) If a boar has a viral infection (e.g. PRRS), the virus can be shed in the semen. With pooled semen, the virus will be spread across more doses than if it were used pure.

(2) If one ejaculate is contaminated with bacteria, where this is added to a pool, the contamination is spread further.

PIC do not pool semen

Health

Purchased breeding stock can introduce new diseases and parasites into commercial herds. This is particularly important with regard to stock boars purchased but some diseases can also be carried in semen. Therefore, it is important to identify breeding companies that have implemented a comprehensive herd health program. This includes a veterinarian who makes routine on-farm inspections, conducts blood tests and other diagnostic procedures, examines animals, counsels, and makes recommendations. The breeding company should minimise opportunities for new disease organisms to enter the herd by blood testing, and enforcing strict bio-security measures.

Customers should obtain up to date veterinary reports from their AI supplier as part of their bio-security programme.

Heritability

In general, reproductive traits are considered to have low heritability, growth rate, feed efficiency traits are of moderate heritability while carcass traits are highly heritable (Table 5). This is important in terms of a selection programme for sire line stock as the economically important traits are likely to be highly heritable. A selection programme in this case will lead to fast genetic progress relative to a selection programme for reproductive traits within a dam line.

Table 5. Heritability of performance and body composition traits

Item	***Heritability (h^2)***

Reproductive traits	*Total born*	*0.10*
	No. born alive	*0.07*
	Pre-weaning survival	*0.05*
	Pigs weaned	*0.06*
	Rebreeding interval	*0.23*
Post weaning to sale	*Daily gain*	*0.30*
	Feed intake	*0.24*
	Feed conversion efficiency	*0.30*
	Days to slaughter	*0.25*
Carcass composition	*Backfat thickness*	*0.41-0.52*
	Loin muscle area	*0.47*
	Lean percent	*0.48*

Genetic improvement

Sire line AI should only be purchased from suppliers where genetic improvement programmes are utilised. This is so because the rate of genetic improvement in a commercial herd parallels the rate of genetic progress made by the supplier. Purchase of AI from the highest ranking boars available from the breeding company enables the commercial herd to approach the genetic level of the breeding company's herd.

When selecting suppliers, review their genetic improvement program. A sound genetic improvement program should include four features:

(1) accurate, complete ***performance records*** *including animal identification, <u>consistent measurement</u> of all boars and ranking of animals within defined contemporary groups. Individual performance test results and records must be available for all pigs in a contempory group. The traits recorded should be the important economic traits.*

(2) assessment of the genetic merit of economically important traits (growth rate, feed efficiency, fat depth, muscle depth and lean meat percentage) based on the individual's ***expected progeny difference (EPD).***

Expected progeny deviations (EPDs) are estimates of genetic merit that are more powerful in driving genetic progress than selection based on individual performance records alone. EPDs are defined as the difference from the average in performance of subsequent progeny if an individual is mated to an average sow.

Some breeding companies use the term ***Estimated Breeding Value (EBV)****. The EBV is an estimate of the genetic merit of an individual. The EPD can be calculated from the EBV by halving the latter (i.e. EPD = EBV / 2).*

The calculation of EPDs, the individual's performance record is used along with the performance record of other relatives, such as full sibs or half sibs, sire, grandsires, dam, granddams and progeny. All performance records are deviated from their contemporary group average and weighted by the heritability of the trait.

An EPD may have a positive or negative sign. EPDs with positive signs signify more or greater while EPDs with a minus sign indicate less or fewer. For example a boar with an EPD of –70 for daily gain if mated to average females; resulting progeny would be expected to grow at 70g/day less than the average for that line. However if the EPD was +70, the daily gain of progeny would be 70g more than the average for that line.

(3) ***indexes*** *weighting EPD's of traits relative to their economic importance in commercial pork production.*

The use of a selection index for the comparison or ranking of boars allows traits to be weighted on the basis of economic worth. This provides an overall single value which balances the strong and weak aspects of the traits that are considered in the index. A selection index will therefore include EPDs for all traits that are considered important *in the selection process. Selection of a boar on the basis of a single trait (e.g. lean meat) is unwise. Some of these pigs will be very lean due to poor appetite and slow growth, which is obviously undesirable.*

(4) ***selection*** *of the highest-ranking boars based on selection indexes of EPD's (Schinckel et al., 1999)*

Breeding companies should be able to describe and document their genetic selection programme.

Gene markers

Some sources suggest that major advances in biotechnology are set to bring about huge changes in animal breeding. Already several gene markers[1] have been patented for pork quality characteristics and growth performance traits (e.g. carcass leanness, litter size etc.) Others are being investigated and are likely to be available in the near future. PIC now claim to be supplying boar semen to the Irish market with a gene marker for leanness. In the future it is likely that markers for disease resistance will also be available in Ireland. PIC have already identified a disease resistant marker which identifies pigs that are genetically resistant to specific strains of E.Coli (i.e. E.Coli F18; not an important disease causing strain in Ireland).

Some experts claim that in the future breeding companies will recoup the cost of R & D into these markers by charging extra for AI doses that contain them. We are in the very early stages of this technology and it will be some time before we know how effective some of these markers are under commercial conditions. Hermitage have been following a programme of parental imprinting as part of their selection procedure.

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[1] A gene marker is a segment of DNA with an identifiable physical location on a chromosome and whose inheritance can be followed. A marker can be a gene, or it can be some section of DNA with no known function. Because DNA segments that lie near each other on a chromosome tend to be inherited together, markers are often used as indirect ways of tracking the inheritance pattern of a gene that has not yet been identified, but whose approximate location is known.

Comparing sources of boars / semen

Indexes prepared by different breeding companies cannot be compared as these indexes are probably calculated differently and the performance tests that the indexes are based on were carried out in different environments and with different diets.

The Department of Agriculture operated pig performance testing programme ceased and the test stations closed Cork (1984) and Dublin (1988). It was not until 1998 with the publication of the breed evaluation programme report (Lynch and Allen, 1998) that objective and independent information on the quality of terminal sires available in Ireland was once again available to the industry. This programme was extremely important to the industry. Its success stemmed from the fact that it tested boars from all seven of the major suppliers on the island. Semen from these suppliers was used on one source of females at Moorepark Research Centre and the progeny were then tested for growth rate, feed intake, feed conversion efficiency and carcass traits.

The results of the Breed Evaluation Programme were widely used by the industry. However, there is no way of knowing how reliable these results are 4+ years down the line. To have accurate and up to date information on the relative performance of terminal sires in the country it would be necessary for such a programme to be conducted again and at set intervals into the future. Such a programme would have to be funded by the industry, however, the investment would be very quickly recouped by producers.

Summary

Producers must select genetic stock to maximise their profits. Genetic selections in the case of terminal sires will affect profits for pigs sold one year later. Producers should select stock using the economic values that are currently available to them. Pigs in the Republic of Ireland are paid for on a weight and lean meat basis. Daily gain in Ireland is low relative *to our continental competitors and it appears this trait in particular may need increased selection.*

Selecting for meat quality still holds many unknown variables; and until there are price premiums or discounts for differing pork quality, there will be no rush to select genetics based on pork eating quality. However if pork producers and processors alike are serious about increasing / maintaining pork consumption among consumers, then the pricing structure for pigmeat will have to be redressed. In the past, the direction given by pork processors to breeding companies and producers alike with regard to meat quality requirements has been poor.

Acknowledgements

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Line AI in the Republic of Ireland

Source	***What is available ?***	***What is it ?***	***Use where ?***	***Benefits***
Hermitage	*Hylean Large White*	*Sire line pedigree Large white*	*To increase lean meat % in plants in the Republic*	
	Hylean Landrace	*Sire line pedigree Landrace*	*To increase lean meat % in plants in the Republic*	
	Hylean 26	*Hylean Large White x Duroc*	*To increase lean meat % in plants in the Republic*	*Hybred vigour*
	Duroc	*Sire line pedigree Duroc*	*To increase meat quality*	*Hybred vigour, meat quality*
	Pietrain	*Pedigree Pietrain*	*Research line*	*Hybred vigour*
			(All are selected on ADG, Intake, FCE, carcass Lean and fat)	
PIC	*Line 11*	*Sire line pedigree Large white*	*To reduce P2 in plants in Northern Ireland*	
	Line 62	*Pedigree Pietrain*	*To increase lean meat % in plants in the Republic*	*Hybred vigour, Halothane -ve*
	Line 402	*Line 11 x Line 62*	*To increase lean meat % in plants in the Republic*	*Hybred vigour*
			(All are selected on ADG, Intake, FCE, carcass Lean and fat)	

RESPONDING TO THE SALMONELLA CONTROL PROGRAMME

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What is the Salmonella organism?

Salmonella is a bacterium of which there are over 2,500 types which can be found in the intestinal tract of animals, birds and humans. For this reason it is not possible to state that a herd is free of infection as infection could be introduced at any time from a variety of sources. If infection is introduced into a herd, it can become widely established unless good husbandry and hygiene measures are in place (3).

Do they cause disease in pigs?

Some types e.g. Salmonella choleraesuis, salmonella typhimurium, and salmonella derby can cause disease in pigs. This is most commonly seen in growing pigs (1st and 2nd stage weaners) and generally manifests itself as diarrhoea or septicaemia and can result in death if untreated (4).

However it is much more common for pigs to become "intermittent shedders" following infection rather than develop disease. S. typhimurium has the ability to infect every species of bird and mammal including humans, which makes it important from a public health point of view, and is now the most frequently isolated serotype among pigs in Europe.

What are "Intermittent Shedders"?

These are animals that become infected with Salmonella but do not develop disease. Most cases of Salmonella in pigs are sub-clinical. They become infected mainly by oral uptake of salmonella, and excrete *salmonella in their faeces consistently for one week to several weeks, followed by a period of weeks to many months with intermittent excretion in faeces. However, once infected, the pig contaminates the environment and so infects other pigs. Pigs that are stressed are more likely to pass Salmonella in the faeces. These animals will also develop antibodies which will be identified in the meat juice or blood-tests subsequently. However, it must be stated that the carcasses of those animals are perfectly safe for human consumption as long as they are not contaminated by intestinal contents or faeces during the slaughtering process. Fasting of slaughter pigs before slaughter is essential to minimise the risk of intestinal contents contaminating the carcass during the slaughter process.*

If Salmonella are not a common cause of disease in pigs, why is there such emphasis on their control?

Certain types of Salmonella present in animals (including pigs) can cause disease in humans if they consume food contaminated with the bacterium or through contact with the faeces of clinically ill or carrier pigs. It is actually the toxins produced by the bacteria that cause the typical food poisoning in humans. However, actual bacterial infection can become established in children, elderly people and people with compromised immune systems with fatal consequences in some cases.

Also, certain types of salmonella present in pigs are highly resistant, e.g. S. typhimurium DT104 is resistant to up to 7 common antibiotics and the treatment of human cases of these infections will become increasingly difficult. ***Therefore, from the outset it must be stressed when S. typhimurium and S. enteritidis are involved, we are dealing with a notifiable disease with serious public health implications.***

Salmonella food poisoning is easily prevented by proper handling of meat e.g. correct cooking procedures and preventing contact between cooked and raw meat. However, consumers are now demanding "no risk" products and to provide these, the Food Safety Authority of Ireland will *insist that the pig industry must target the salmonella problem. Denmark, which has 20% of the world's pig meat export market has been running a very effective salmonella control programme since 1993, in which pig herds are tested on a monthly basis.*

Table 1. Salmonella levels in Danish herds as of January 2001 (5)

	Category 1	***Category 2***	***Category 3***
No. of herds	*14,961*	*445*	*139*
(%)	*96.2*	*2.9*	*0.9*

How widespread is the problem in Ireland?

Since September 2001, the meat juice ELISA test has been re-introduced by the Veterinary Research Laboratory at Abbotstown, with approximately 500 pig herds tested to date. Initial indications would suggest that approximately 50% of herds are in Category 1, 40% in Category 2 and 10% in Category 3 (1).

Pig salmonella control programme – New legislation

The Minister for Agriculture and Food made regulations concerning the monitoring and control of salmonella in pigs, which came into effect on 1 August 2002. The purpose of the regulations is to reduce the risk of public health problems arising from the consumption of pork and pigmeat products and thereby to maintain consumer confidence in these products. Everybody involved in the supply of food (producers, processors, retailers etc.) must take responsibility for its safety and it is in this context that this programme has been established. Following are the main points of this legislation:

Every pig herd in the country must be tested on an on-going basis for the purpose of establishing its salmonella status

- *Sampling will take place at slaughter plants where samples will be taken by factory staff. Samples will be tested at a laboratory approved for this purpose (currently the only approved laboratory is the Veterinary Research Laboratory in Abbotstown). The test results will be fed to a designated data processing centre (the SWS Group, Bandon).*
- *The data processing centre will calculate the up-to-date salmonella status of the herd after each test and will issue to the herd-owner a certificate of categorisation that will be valid for 5 months from date of issue. This certificate will indicate whether the herd is Category 1 (i.e. showing the least evidence of exposure to salmonella), Category 2 or Category 3 (the worst status).*
- *At slaughter, pigs from Category 3 herds will have to be slaughtered separately from other pigs and in a manner that minimises the risk of cross-contamination.*
- *The headmeat and offals of Category 3 pigs may not be sold in the raw state and must be either heat-treated in an approved manner before being passed fit for human consumption or destroyed.*
- *Pigs with no valid category certificate will be treated as Category 3 in slaughter plants. These provisions in regard to the slaughter of Category 3 pigs, or pigs without a valid category certificate, will come into effect at a date yet to be announced.*

What pig producers need to do

Producers must ensure that they are in possession of a valid certificate of categorisation for their herd and to make it available on request at pig slaughter plants and to officers of the Department of Agriculture and Food. ***For this purpose a set of samples must be taken three times each year at intervals of not less than 3 months and not more than 5 months.***

A set of samples will consist of samples from 24 pigs from the herd submitted together. If the size of the herd is such that fewer than 24 pigs *are presented for slaughter on any individual day then samples should be taken from 24 pigs in every 4 month period. Once again, it is the responsibility of herd-owners to ensure that the required level of sampling is undertaken and that a valid certificate of categorisation exists for his/her herd.*

Calculation of salmonella category

When a set of samples is tested, the result of the test will be the percentage of the samples in the set that tested positive for exposure to salmonella (e.g. if 6 of the 24 samples are positive, the result is 25%). The initial herd categorisation will be based on a simple average of the first 2 test results for the herd (e.g. if the first 2 test results are 25% and 50%, the average of these is 37.5%).

Thereafter herd categorisation will be established by calculating a weighted average of the three most recent test results as follows:

Test	***Weighting***
Most recent	*0.5*
Second most recent	*0.3*
Third most recent	*0.2*

For example – Categorisation based on 3 acceptable results:

Test Date	***Test Result***
16 June 2002	*2 pigs positive out of 24 = 8.3%*
02 March 2002	*3 pigs positive out of 24 = 12.5%*

05 October 2001 4 pigs positive out of 24 = 16.3%

The weighted averages can be calculated as follows:

*(8.3 * 0.5) + (12.5 * 0.3) + (16.3 * 0.2) = 11.26%*

Most Recent Test	*2nd Most Recent Test*	*3rd Most Recent Test*

As 11.26% falls in the range of "exceeding 10% but not more than 50%" this herd is categorised as Category 2 based on these results.

And these certificates of categorisation will be updated and re-issued after each acceptable set of test results.

A herd will be categorised as-
Category 1 if the result of this averaging is 10% or less
Category 2 if the average result is more than 10% but not more than 50%
Category 3 if the average result is more than 50%.

Breeding pigs - Replacements

It is a requirement of the salmonella legislation that all breeding pigs being introduced into a herd come form Category 1 herds and that producers maintain a record of the origin of their breeding animals.

Financial aspects of the programme

The current financial arrangements for the programme are that pig processors will pay for the testing for an initial period and that the IFA will pay for the operation of the data operating centre. The Department has expended significant resources on developing the testing programme. The Department will not be bearing the testing and data processing costs arising under the programme in the future and this will be a matter for producers and processors on an ongoing basis.

The above details on the Pig Salmonella Control Programme are based on an information leaflet issued to pig producers by the Department of Agriculture and Food in July 2002.

How can I assess the situation on my unit?

There are different tests available to check the level of infection in herds.

Culture tests:

Samples of faeces are collected from pigs or the floors of pens and the laboratory then tries to grow the actual bacteria. These tests are time consuming and a negative result may not be meaningful. Also, if pigs spend more than 4 hours in the lairage prior to slaughter, they may pick up infection which could give a positive result if samples are taken on the slaughter line. Obviously this result would not be representative of the situation on the farm.

ELISA tests:

In these tests antibodies to the Salmonella bacteria are identified in meat juice or blood samples. Positive results indicate that the pigs were exposed to Salmonella infection at some stage during their lifetime. These antibodies appear 7-10 days post-infection, reaching maximum levels within 2-3 weeks, persisting for about 5 weeks and then slowly declining.

Salmonella control and its effect on slaughterhouse procedures

When the control programme is being implemented, processors will be required to slaughter pigs from Category 3 herds at specific times to avoid contaminating carcasses from cleaner herds. They will also be required to discard the pluck (i.e. lungs, heart and liver), abdominal contents and heads, with a resultant financial loss to the producer.

In Denmark pigs from Category 2 herds are liable to carry a penalty equal to 2% of the slaughter value of the carcass, while a 4 % penalty is imposed on Category 3 herds.

Furthermore in the Danish situation with regard to Category 2 and Category 3 herds the producer in conjunction with both his or her veterinary and production advisors will have to submit an intervention plan to the Danish Bacon and Meat Council aimed at reducing the prevalence of Salmonella within one month of being declared in Category 2 or Category 3. In our Irish situation to date, very little attention has been paid to this aspect of the Salmonella Control Programme.

What can I do to reduce levels?

How does salmonella persist on units?

'All-in / all-out':

Operate all farrowing weaner and finishing houses strictly on an 'all-in / all-out' system, because as one can assume the pen environment has been contaminated by the older pigs and so readily infect the younger pigs when they are moved in (2).

Overstocking of units:

When referring to "overstocking" one is really highlighting the inadequate down-time allowed on most units to rest rooms between batches. 'All-in / all-out' on the same day (or hour!) is not strictly the proper approach to an 'all-in / all-out' system.

As well as the time needed for cleaning, washing and disinfecting, the room must be given time to dry out properly and to allow the disinfectant time to act adequately. The time needed for this rest period will vary depending on the season of the year and whether or not supplementary heat is available to speed up the process. Having sprinkler systems installed to soak the pens after the pigs are removed will reduce the workload during this part of the operation as well as decreasing the volume of slurry produced.

Stress reduction:

If pigs are stressed in any manner the excretion rate of Salmonella from their intestines will increase significantly. Therefore, avoid overstocking, draughts and temperature fluctuations, inadequate feeding systems, control other diseases (e.g. enzootic pneumonia, Aujeszky's, mange and swine dysentery) and make every effort to control problems such as tail-biting and damage to feet or limbs. Mycoplasma and viral diseases such as Aujeszky's and PRRS cause disease by surpressing the pigs immune system and so in turn allow other organisms like Salmonella to proliferate during a crisis period. For example in the case of Mycoplasma, where active infection may become apparent at the 55 – 70 kg range, Salmonella production, will increase in the animal's intestine and these animals are more likely to be positive at slaughter.

Hospital pigs:

Strict 'all-in / all-out' also means that poor-thriving pigs are not moved back in with younger pigs. Pigs, once moved to a 'hospital' section should not be moved when recovered, back into the main cycle of pigs. Hospitals should operate on small modules of five or six pens alongside one another. However, the individual pens need to be washed and disinfected regularly. Chronically ill pigs should be humanely destroyed on a regular basis as part of an efficient unit management system.

Correct flows of pigs, people and equipment from low-risk to high-risk areas:

In general, Salmonella levels increase as pigs move closer to finishing age. Pigs should move in a one way flow from farrowing/weaner area to the growing/finishing area. If people are moving back and forth separate footwear and / or properly maintained disinfectant footbaths should be in operation. Preferably, there should be no movement of equipment; dedicated equipment should be provided for each section. Passageways should be washed and disinfected after each movement of pigs is complete.

Provision of disinfectant footbaths (regularly replenished) at all points of entry is an important psychological tool to keep unit operatives reminded of the controls required.

Rodent control:

This is essential for two reasons:

They are frequently carriers of Salmonella. Thus, they introduce the infection into clean areas.

Secondly, they play a part in carryover of infection from batch to batch on infected premises.

A farm bait plan should be drawn up for each farm. Bait should be laid down on a regular basis and this should be the responsibility of a designated individual. The immediate surroundings of each building should be cleared of all rubbish and debris.

Fly control:

Operate an efficient fly control system as they can mechanically spread Salmonella. Heavy fly infestation may also indicate poor air circulation within a particular building.

Other animal control:

Dogs and cats should not be allowed access to pig buildings, as they are potential carriers of the infection.

Even contact between pigs and cattle / sheep should be avoided as infection is liable to be transmitted in either direction.

Bird control:

Birds can carry Salmonella and other bacterial infections. All sections of the unit should be bird-proofed, especially where the birds could gain access to feed troughs or bins. On a number of Irish pig units the lack of a bird-proofing system remains a major deficiency.

Water systems:

All water tanks should be covered to prevent contamination by birds or dust. Likewise, drinking troughs and bowls should be positioned to avoid faecal contamination.

Slurry management:

Avoid contact between pigs and slurry which can occur via slurry overflows and / or spillages, as slurry is definitely contaminated. In Denmark where the Salmonella DT 104 is identified in a particular herd there is a requirement for a specific approach to slurry disposal.

Hygiene facilities on units:

Because of the public health significance of salmonella infection the provision of satisfactory washing, canteen and toilet facilities on pig units need serious examination. Unfortunately it is an area that leaves a lot to be desired on too many of our units.

Rearing Replacement Gilts:

With many of our producers home rearing a high proportion of their replacement stock, it must be recognised that in Category 2 and Category 3 herds these gilts may be responsible for maintaining a level of infection within the herd. In future, gilt rearing accommodation will require more attention with regard to cleaning, disinfection and resting as in the past, gilt acclimatisation practices were the converse of what good pen hygiene practices should be. In such herds also, younger sows may be carriers and at stressful periods such as post-weaning they may recommence shedding the organism so service areas should be washed and disinfected after each batch. As already stated, specialist breeding farms supplying breeding stock for sale must achieve Category 1 status.

Transport Aspects:

Loading ramps should be washed and disinfected after use.

Pig transporters should be washed and disinfected before they leave the slaughter plants, if this is possible on the flat concrete bases which are meant to serve as washing bays at many of our processing plants. Why these areas cannot be slatted so that solids are readily washed from the surface is a serious deficiency in my opinion.

Lorries with pigs from another farm, for example, collecting pigs / sows from multiple sources should not be allowed on your premises.

Fasting pigs before transport:

Avoid feeding within 12 hours of slaughter. Pigs should be slaughtered within 24 hours of their last feed. Keep duration of transport to the slaughterhouse to a minimum. The carrier rate increases as transport and lairage time increase.

Standings for carcass disposal skips:

These areas should be washed and disinfected regularly and should be sited strategically a distance from the unit.

The crucial role of feedstuffs and feeding systems in salmonella control

In Denmark compound feedstuffs are heat treated at 81^{o}C to eliminate Salmonella bacteria from feed. Nevertheless, conflicting consequences have emerged. On the positive side, it eliminates feed-borne exotic type Salmonella infections, but on the other hand, Danish research has demonstrated the use of heat treated pelleted feed is a major risk factor for a high level of Salmonella in herds that employ that type of feeding system. This latter occurrence seems to be due to the fact that heat treated, pelleted feed produces a suitable micro-environment for Salmonella in the gut. Conversely, the use of non-heat treated coarse ground meal with at *least 25% barley improves the microbial ecosystem in the pig's intestine. A high level of lactic acid bacteria, fewer coliform bacteria, a high acid concentration and lower pH in the stomach characterise a good microbial ecosystem which inhibits Salmonella growth.*

Organic acids

Acid has a restrictive influence on Salmonella because it does not grow at pH levels below 4.5. Recent Danish results (6) have shown that different acid products based on lactic acid and / or formic acid added in pelleted feed benefit the microbial ecosystem in the gastro-intestinal tract in a similar manner as standard meal feed. Equally, Dutch research had demonstrated that using organic acids in drinking water in the finishing period reduces Salmonella prevalence. It is possible that "protected" acid products with a slow release formulation will be of most benefit when acids are being included in a pellet or dry meal diet.

The exact changes in feed formulation due to meal feeding and acidification will need to be addressed by the nutritional advisors to the pig industry. However, I feel these changes will play an important role in the Salmonella Control Programme even though there may be downsides in relation to lower FCE figures and the corrosives effects of acids.

Wet feeding systems

Research has shown the beneficial effects of wet feeding in reducing the risk of Salmonella. The fermentation process inherent in the system produces a lower pH in the feed delivered to the animal, thus inhibiting Salmonella growth. The same benefit applies when whey feeding is practised. But it must be stressed that the benefits of wet feeding could be negated by lack of attention to the pig husbandry and hygiene aspects of the Salmonella Control Programme.

Conclusion

In conclusion, it must be stressed that only a thorough, constructive and persistent approach by all sections of the industry over the next couple of years will ensure that this Salmonella programme will succeed. No doubt but that we will have problem herds and this is where an understanding approach by all concerned will be essential. As the Control Programme proceeds it will become apparent that certain houses or sections will be identified as problem areas where weaners / finishers will be exposed to constant infection. Problematic slurry channels, damaged floors, poor insulation, inadequate environment controls, lack of attention to bird-proofing and rodent control and high levels of dust are just some of the factors that may be contributing to the problem.

All of the above measures are self-financing in that they improve the efficiency of pig performance as well as helping to control other diseases. In turn these measures will help reduce further the use of antibiotic therapy, which is another objective the industry will be forced to tackle almost simultaneously with the Salmonella Control Programme.

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WHAT IS YOUR TRUE COST OF PRODUCTION?

Pat Tuite, Teagasc, Drogheda

Introduction

Figuring out pig production costs can be very confusing where differing cost calculations are used. I wish to define the real cost of pig production. This will allow greater accuracy in comparisons among producers. It will also promote greater understanding among feed compounders, processors and retailers with regard to the complexity of pig production costs.

Pig production costs vary widely from one unit to the next. It is important that each pig producer knows his real cost of production. This information will allow him make decisions about his unit. For example, should he reinvest, expand, contract, diversify, etc?

It is convenient to express production costs in cent per kg. deadweight. Costs can then be related easily to the sale price of pigs, which is quoted in cent per kg. deadweight.

The majority of Irish producers underestimate their production cost because they overlook some of the less obvious fixed costs. This provides a false picture to other sectors of the industry that may take advantage of incomplete information.

Feed cost

This is the largest cost in pig production. It can normally vary from approx. 55% to 70% of total costs. This will include the cost of all feeds used and any infeed medication used. Where infeed medication costs are invoiced separately they should be included under Healthcare costs.

Common costs

In addition to feed costs there are certain costs which arise in the vast majority of herds. These are often referred to as "common costs".

*(a) **Labour** is the biggest common cost on pig units after feed. But it is rarely fully recorded. There are three main categories of labour to be costed.*

*(i) **Hired Labour** is the cost of all regular labour and manager(s) employed by the enterprise. The cost will include PAYE, PRSI, pensions and any benefits such as health insurance, accommodation or vehicle allowances.*

*(ii) **Casual Labour** is the cost of any casual or part-time labour, including PAYE & PRSI.*

*(iii) **Family Labour** is the number of family members directly employed on the pig enterprise and an imputed cost based on their estimated salary. Where the owner is the full time manager of the pig enterprise his annual salary is unlikely to be less than €40,000. Where family labour is split between other farm enterprises the cost should relate to the proportion of hours spent on the pig unit. Family labour is rarely properly included in production costs.*

*(b) **Healthcare** costs include all medicines, veterinary visits, inspections and prescription costs. Vaccine costs now make up about $^2/_3$ of all medicine costs.*

Wormers and mange treatment are part of healthcare costs. Associated equipment such as needles, syringes, etc. are included here.

(c) ***Power and Heat*** *include all electricity and gas costs relating to the enterprise. Fuel used for stand-by generating electricity is included.*

(d) ***Transport*** *includes all expenditure on contract transport for the movement of pigs. Where own transport is used for pig haulage include all vehicle road tax, DOE, insurance, lease payments and repair costs relating to pig transport.*

(e) ***Manure Handling*** *costs include all costs associated with the transport and spreading of pig manure. It can include expenditure on contract transport/spreading or all the cost of operating the unit's tractor(s) and spreader(s). Include all machinery repair costs, lease payments, tools and workshop material costs relating to manure handling.*

(f) ***Repairs and Maintenance*** *costs include repairs and maintenance costs on all property, buildings and equipment relating to the pig enterprise. These costs increase as the unit ages. In general, where repayment of VAT is claimed on pig buildings and fixed equipment, this expenditure would be classified as capital rather than repairs.*

(g) ***Artificial Insemination*** *costs include expenditure on semen and all equipment used for insemination and semen handling.*

(h) ***Stock Depreciation*** *costs are calculated using all expenditure on the purchase of breeding gilts and boars, including internal transfer of homebred gilts from the finishing herd. The income from the sale of cull sows and boars is deducted from the expenditure and allowance is made for any changes in breeding stock numbers.*

(i) ***<u>Insurance</u>*** *costs include the premia for insuring the pig buildings, permanent fixtures and fittings, house contents, pigs, public liability, employer's liability, loss of income, suffocation, etc. (See Jim Finn's paper at this conference in 1999 for detailed insurance costs on pig units).*

(j) ***<u>Office costs</u>*** *cover telephone, stationary, postage, computer and office equipment and secretarial costs. These should be applied proportionally where they relate to a number of enterprises rather than specifically to the pig enterprise.*

(k) ***<u>Miscellaneous costs</u>*** *include all other variable costs relating to the pig enterprise, e.g. water charges and testing, bedding material, straw, dead pig disposal, vermin and fly control and sundry equipment such as dust masks, eartags, spray markers and inkpads.*

Herd specific costs

These costs are not common to every unit but can add significantly to the total cost of production. They do require a little extra explanation.

(a) ***<u>Depreciation on Buildings & Equipment</u>***

Pig buildings and equipment lose value during use through wear and tear, corrosion and obsolescence. Buildings normally have a useful life of 20 years, while equipment has a useful life of only 10 years. Approx. 55% of the cost of a pig unit will be spent on the structure, while about 45% is used on fittings or equipment. Each unit will have its own breakdown which must be used and updated as new buildings or equipment are added. Pig units which are heavily loaded with equipment will have higher depreciation costs.

(b) The depreciation charge for buildings and equipment may be available from the most recent set of accounts for the pig enterprise.

(c) ***Interest Payments.*** *These should include interest payments on all forms of borrowing related to the pig enterprise. They will include bank overdrafts, bank and private loans and hire purchase schemes. Bank charges will normally be included with interest payments.*

(d) ***Imputed Finance Costs.*** *This puts a opportunity cost on the financial investment in the unit which is not borrowed. It represents an estimate of the interest on assets owned in the business. It is calculated by taking the approximate value of all major assets related to the pig unit (i.e. buildings, stock, machinery and land) less total borrowings for pigs, less compounder credit in excess of 30 days. This figure is then multiplied by the prevailing interest rate. The less one has borrowed the higher will be the imputed finance costs. If this money were not invested in the pig enterprise it could be earning an income elsewhere. For a new unit with 50% borrowings (ie €1,550 per sow @ 6% interest) this item could cost about €4/pig or 5.5c/kg. In a case of negative equity there will be no imputed financial cost.*

(e) ***Environmental Charges.*** *IPC licence application cost, annual EPA contribution and annual compliance costs, including soil sampling, recording, monitoring, reporting. The reports will include the annual environmental report, nutrient management plans, manure registers and other reports demanded by the IPC licence. In the few cases where odour control systems operate the costs are included here.*

(f) ***Rent.*** *The cost will comprise rent on buildings and property used by the pig enterprise including rent for the accommodation of employees of the unit.*

(g) ***Contract Finishing.*** *This is an expanding practice where the pig producer supplies weaners and feed and pays the owner of the finishing house a fee per pig (€6-7). In return for the fee the house, labour, water, power bedding and manure spreading are provided.*

(h) ***Consultancy & Professional Fees.*** *This category includes accountancy, consultancy, legal and other professional fees.*

In this paper I have looked at over 20 cost headings related to pig production. While no one unit will have costs under every heading, few units can avoid using at least 10 headings.

There is no point in ignoring costs. It has to be every producer's aim to control all costs. If you do not measure you can't control. Therefore all costs must be measured or recorded. Margins are too tight to rely on the state of the overdraft or the length of the compounder credit for making informed decisions.

A detailed recording system is indispensable for recording costs. After recording they must be analysed on a per kg dwt basis.

Appendix

Some income/profit terms are explained here.

Total Income ***is a statement of total income from pig sales from the pig unit. It includes income from internal sales of stock.***

Cash Income *represents the difference between inflow and outflow of cash relating to the pig enterprise. It takes no account of changes in stock numbers, family labour (unless wages are paid), depreciation on buildings and quipment or imputed finance costs.*

Final Net Profit *represents the profitability of the business allowing for the cost of family labour and management, and for capital invested in the business.*

True breakeven price per kg. is the total real production costs per kg.

Teagasc Services to the Pig Industry

Teagasc provides a range of services to the pig industry in research, advice and education, as well as confidential consultancy on all aspects of pig production, meat processing, feed manufacture, economics and marketing. For further information contact the appropriate office or:

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