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Proceedings

A Review of Selected Teagasc Pig Conference Papers

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It is useful to review previous conferences to examine whether we are effective in our aims. The aim of each Teagasc Pig Conference is to provide clear and concise information on specific subjects that are relevant to pig producers. This is the eleventh Teagasc Pig Conference and it is an opportune time to review some of the information presented at previous conferences.

This paper reviews four different topics that have been considered at Teagasc Conferences. Indeed some of these topics have been dealt with a number of times over the past ten years. The aim of the review is to assess whether the "message" from the presentation has been acted upon at farm level. If it has not been adopted at farm level the questions for each of us are: What was wrong with the message? Was it not understood? And why was it not acted upon?

I have selected four topics that are as relevant today as they were when the papers were delivered at conferences. The four chosen topics are:

1. Reducing Phosphorus Excretion
2. Gilt Management on Farms
3. Creep and Link usage on Farms
4. Two Stage Finishing System.

1. Phosphorus Reduction

Reducing Phosphorus (P) excretion by use of enzymes was dealt with in 2000 and 1997 as well as at various Conferences for Nutritionists.

Feed formulation combined with efficient usage of feed offers the potential to greatly reduce the amount of P excreted by pigs.

As pigs grow the optimum concentrations of protein and P in the diet for maximum growth rate decrease. This allows the use of a sequence of diets, which closely match the nutrient needs of the animal, each of lower nutrient content than the previous diet – a practice known as phase feeding. Nutrient excretion is then lower than using a single diet.

A nutrient balance approach to estimation of manure nutrient output

Prediction of manure quantity and composition from the feed and water consumption data and pig or pigmeat production offers advantages of accuracy and easier auditing. A nutrient balance involves measurement or estimation of nutrient *inputs* to the unit (incoming pigs and feed) and *outputs* (pigs sold) with the remainder being excreted in the manure. Using best practice (low nutrients diets and efficient production practices) the output of P per sow per year (including 20.5 pigs per sow to slaughter at a carcass weight of 71.5kg) would be 15.1kg. On high nutrient diets and slighter poorer feed conversion efficiency the figure would rise to 23kg P. In each case the figure is the amount available for application to land.

Uptake of nutrient reduction technology

The use of diets of low P content with phytase included has been rapidly adopted by the Irish Pig Industry. The requirement to minimise nutrient excretion in licensed units has been a major influence. As a result many units are achieving P output values of 15 to 18kg per sow per year compared with values of 26 to 28kg in the early 1990s. This decision at farm level needs to take account of diet and ingredient costs as well as the benefits in reducing manure costs. The result has been a reduction in P excretion per sow of over 40%.

Changes to pig feed formulation and efficient production practices have the potential to reduce P excretion. This strategy reduces the amount of land required on customer farms and reduces the rate of buildup of soil P. The uptake of this technology was very positive. Why? Was the legislation (EPA Act and Regulations, etc.) the driving force? Or, was the fact that the use of the phytase enzyme did not add any substantial cost to the feed (once based upon least cost ration formulation principles) the reason for the very good uptake of this technology on farms?

2. Gilt Management on Farm

The subject of Gilt Management was dealt with specifically in 2003, 2001 and 1996. The aim is to have gilts that produce six litters during their lifetime as sows in the breeding herd.

Each year almost 50% of the sows on Irish pig farms are replaced. Many of these are young sows that have produced only 1 or 2 litters. In addition, a significant proportion of the gilts introduced into the breeding herd fail to breed or fail to produce a litter. Improvements to herd performance in these areas would lead to increased sow productivity and a reduction in production costs.

Sow Replacement Rates

The annual sow replacement rate on Irish pig farms has been rising steadily and reached 51.6% in 2003.

Table 1. **Sow replacement rates on Irish Pig Farms**

Year	*Sow Culling %*	*Sow Mortality %*	*Sow Replacement %*
1999	41.4	5.8	46.9
2000	43.5	5.5	49.0
2001	45.3	5.4	50.7
2002	43.5	6.2	49.7
2003	45.5	6.1	51.6

Source: Teagasc Pigsys Reports

Further analysis of Pigsys data shows that about 13% of gilts introduced into the breeding herd for service are culled or die before service.

It should be noted that not all of the 87% of gilts that are served will produce a litter. Allowance must be made for served gilts that are culled or die before farrowing. Analysis of data from 8 herds showed a farrowing rate of 80% in gilts with 6% of gilts served being culled (5.5%) or dying (0.5%) before farrowing.

The actual number of gilts required will vary from farm to farm. Each unit needs to establish how many gilts must be purchased/selected to produce 100 gilt litters.

There is a lack of recorded information on units on why gilts are culled. However, the two main reasons are:

a) failure to come on heat
b) leg problems.

Oestrus Stimulation in Gilts

The following guidelines were proposed in the 2001 Conference:

1. Until about 115kg gilts should be reared in total isolation from mature boars.
2. Feed a gilt diet (13.5MJ DE/kg, 0.75% Lysine) or a dry sow diet (12.5 MJ DE/kg, 0.65% Lysine).

3. Feed levels should maintain a growth rate of 5kg per week. The daily feed requirement can vary from 2.5kg to 3.25kg or more.
4. At not less than 115kg move gilts to comfortable pens within smell, sound and sight of a mature boar. Old boars are more effective in oestrus stimulation than young boars.
5. Facilities should be such that the boar and gilts have full contact (in the pen) for 20–60 minutes per day depending on the number of gilts in the group.
6. Gilts should be provided with 14-16 hours continuous light per 24 hours followed by about 8-10 hours of darkness. The intensity of light is adequate if you can read a newspaper in the darkest corner.
7. Gilts should be penned in small groups with about 1.4m^2 of floor area per gilts.

Reducing Wastage of Young Sows

To try to minimise the culling and deaths in young sows the following guidelines were suggested at the same conference:

1. Serve gilts at about 140 – 145kg liveweight i.e. about 225 days old.
2. Aim for a P_2 fat depth of 18mm at service.
3. Carefully regulate feed levels for pregnant gilts to ensure that they do not get too fat i.e. 25 MJ DE per day.
4. Maximise feed intake in lactation in first litter sows to minimise weight loss. Target for 140kg of feed (**1925 MJ DE**) over 25 days lactation. This is an average of 5.6kg or 77 MJ per day.
5. Ensure that gilts are not required to rear more than 10 pigs, as far as possible.
6. Delay weaning first-litter sows until about 28 days but not later.
7. Maximise feed intake between weaning and service.

To date a small number of pig units have tightened up their management of gilts as per the above recommendations. This is difficult to understand given the benefits outlined. Has this message been delivered properly? What other factors have prevented pig producers from acting upon this message? Is it easier with purchased gilts?

3. Creep Feeding

The feeding of expensive Starter and Link diets to weaner pigs was specifically dealt with in 1996 and 1998. Over emphasis can often be placed on maximising performance by feeding high levels of these expensive diets.

The aim in practice is not to exceed 2.5kg of starter creep (15.5 MJ DE per kg: 1.4% Lysine) on pigs weaned at 26 to 28 days of age. This may increase for pigs that are weaned earlier. The aim with the link diet (14.5 MJ DE per kg: 1.3% Lysine) is not to exceed 4.5kg per pig weaned.

This is not being achieved on a large number of units. The Pigsys data show usage figures of 3.4kg and 6.9kg for Starter and Link diets in 2003(average weaning age on the Pigsys report is 28 days in 2003). This was the first year that the quantity of each specific diet could be identified on the Pigsys recording system. The combined usage of Starter/Link diets which was 7.9 kg/weaner in 1993, rose to a high of 11.0 kg/weaner in 1997 and dropped to 8.7 kg in 1999 and 2000. It is rising again (9.2 kg in 2001,9.4 kg in 2002 and 10.3 kg in 2003).

In practice, where this is examined on individual farms the Link diet is usually the diet contributing to over-usage figures. Where Link feed is being purchased in bulk the temptation is to keep the pigs on this diet until they are transferred to the second stage weaner house. This has been a response to the shortage in labour supply experienced by most farms over the last few years.

Discussion

The message appears to have been received but there is still movement towards higher usage levels because of other issues on the farm. This needs to be closely monitored on each farm. "If you don't measure you cannot control".

4. Two Stage Finishing

There is a definite trend towards the production of heavier pigs. The liveweight (LW) of finished pigs at sale has risen from 85.3 kg in 1993 to 94.1 kg in 2003. This is mainly because the total production costs per kg are reduced by producing heavier pigs.

Topics such as Phase Feeding (1999), Diet Specifications for Finishing Pigs (2000), Selecting the Optimum slaughter Weight to Enhance Margins (2001), Effects of Housing on Feed Intake of the Growing Pig (2003) and Issues with Heavier Pigs (2003) dealt with the topics that should be considered when producing heavier pigs.

The practical areas that have been discussed but have not been adopted widely at farm level are use of a number of finisher diets, and, a two-stage finisher house.

The feeding of a number of diets in sequence will result in a significant reduction in nutrient excretion and a better utilisation of a cheaper diet. Feeding two diets may require two separate feed lines in a dry feeding system. This may be an obstacle on some farms. It is possible to adapt computerised wet feed systems to blend two diets (one of high density and one of low density) to reduce the feed costs.

Two stage finishing involves stocking finishers at $0.55m^2$ ($6.0 ft^2$) per pig up to 60kg LW and then transferring them to larger pens giving $0.74m^2$ ($8.0 ft^2$) up to 100 kg LW. Two- stage finishing can increase the effective floor area by over 10% (depending on the growth rates achieved in each stage). It requires moving the pigs from the first to the second stage house and also may involve an extra power-washing in the finishing section. Both of these require some extra labour. This can be minimised by having a good passage layout and the use of a sprinkler system.

Discussion

Only a small number of pig farms use two or more diets in the finishing section of their farm. Relatively few have two-stage accommodation. The increased labour input may well be the reason for the poor uptake of two-stage finisher accommodation.

Overall Discussion

All communication is a “two-way” process: you have the communicator (in this case the presentation at each Conference) and the message receiver (each person in attendance). In order that a message is acted upon both must understand the message and decide how best to act so that the message becomes part of a plan. This should effect change to improve the situation in the long-term. Monitoring the situation (through records of performance) will establish if the change has been positive or not.

In the case of the four selected topics two were acted upon (ie Reducing Phosphorus Excretion and Starter and Link usage on Farms). There has been a very poor uptake on Gilt Management and Two Stage Finishing Systems on most farms.

Tighter controls in legislation (requiring Fertiliser Plans for farms utilising pig manure) combined with the fact that feed costs have increased marginally by using phytase (unless some cheap feed ingredients are available in specific cases) has helped encourage its use.

The Starter and Link usage did reduce but is rising on farms again. The usage of these expensive diets should be carefully monitored at farm level. This appears to be done more conscientiously when pig prices are poor. Does this suggest that pig producers take their eye off the ball when prices improve?

Improvement in gilt management on farms has not been great. This requires a very focussed plan on each unit. It is an area that will show benefits in the long-term. It requires discipline to adhere to the recommendations described above. It will pay in terms of herd performance where it is implemented correctly.

The issues with two-stage finishing are worth serious consideration on each pig farm. Some units are making savings by using more than one finishing diet and/or having a two stage finishing house. If they can do it you should examine whether your unit can benefit accordingly.

Conclusion

The aim of each Teagasc Conference is to disseminate information that may impact upon your business. It is an important means of communication. Make sure that you get the best benefit from each Conference by examining each topic as it relates to your business. The Conference Proceedings are a very useful document to refer to long after the Conference has ended.

When should sows be weaned?

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The age at which pigs are weaned influences not alone the performance of the weaned pig but also the subsequent reproductive performance of the sow. The choice of weaning day may also influence herd reproductive performance.

Minimum Weaning Age

The minimum weaning age for piglets is specified in European Communities (Welfare of Calves and Pigs) Regulations 2003.

- *Piglets shall not be weaned from the sow at less than 28 days of age unless the welfare or health of the dam or the piglets would otherwise be adversely affected.*
- *Piglets, if accommodated in specialised housing that has been thoroughly cleaned and disinfected immediately before the introduction of those piglets, may be weaned from the sow at no less than 21 days of age.*
- *This housing shall be separate, in a manner that adequately prevents the risk or spread of disease, from housing containing sows.*

No such restrictions apply to production in North America where early weaning is practised to prevent the spread of certain diseases from the sow to her piglets. There the weaned pigs are moved immediately to a separate location i.e. multi-site production. Weaning piglets at 14 days or less is facilitated by the availability of products such as blood plasma for creep diets.

Average Weaning Age

On-farm computerised recording systems record the lactation length of the sow. This does not necessarily coincide with the weaning age of the piglets. If some piglets are removed from the sow early or there is a substantial amount of cross fostering or if lightweight piglets are held back the average lactation length of the sows may differ significantly from weaning age of the piglets.

The average weaning age in PIGSYS recorded herds is based on the average piglet stock number and is an **estimate** of actual piglet weaning age. In 2003 the weaning age was 28 days. This is 1 day higher than the 27 days recorded for each of the previous 10 years.

Weaning Age Distribution

Pig units usually wean on Wednesday or Thursday. Most sows are first served on Monday or Tuesday. With a 115day average gestation length, Thursdays and Fridays will be the main days on which farrowing occurs. In herds weaning at about 28 days the majority of sows will be weaned at about 28 days. Relatively few sows will, normally, be weaned at over or at less than 28 days. See Figure 1.

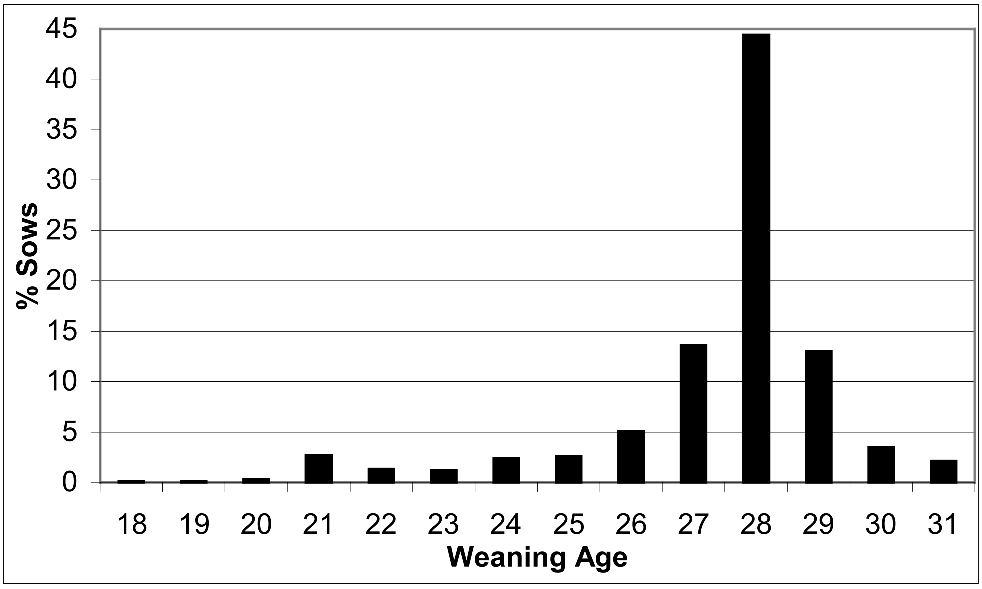

Figure 1. Distribution of sows by Weaning Age: Herd A, 27day weaning

As average weaning age is reduced, the percentage of litters weaned at about 21 days is increased. See Figure 2.

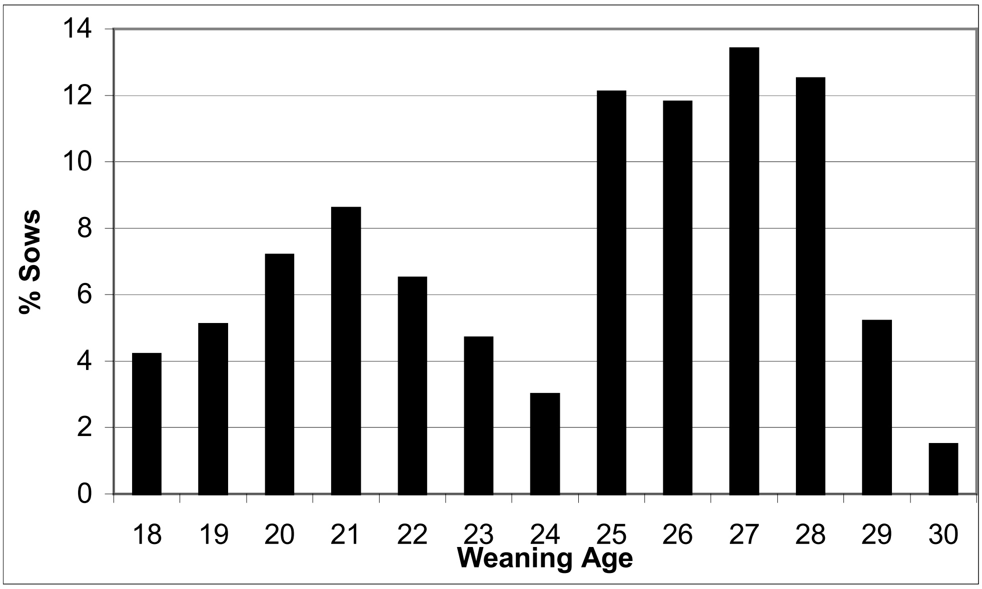

Figure 2. Distribution of sows by Weaning Age: Herd B, 24day weaning

As weaning age is reduced the proportion of the litters being weaned one week earlier than normal is increased. This effectively means that there are two weaning ages within this herd. One group is about one week younger than the remainder of the pigs at weaning. The data for the two herds is summarised in Table 1.

Table 1. Weaning age profile of two herds with different average weaning ages.

Average Weaning Age days	*27*	*24*
Lactation Length days	*Percentage of sows*	
18-24	8.1	39.3
25-31	84.3	56.9

On-farm computerised recording systems such as Boots and Pigchamp enable producers to analyse the distribution of sows by lactation length and to check if too many sows are being weaned too early.

Weaner Performance

The housing, feeding and management of weaned pigs must be adequate for these earlier weaned pigs if problems with weaner thrive and health are to be minimised or avoided. Major improvements have been made in housing and nutrition of newly weaned pigs. However, there are still far fewer problems when pigs are weaned at about 28 days of age.

Tokach et al (2003) found that the youngest pigs at weaning gained the least from day 0 to 42 after weaning. Their data showed that weaning weight is important with all ages of pigs but that the impact of weaning weight was not as important as weaning age.

The advent of Porcine Multi-systemic Wasting Syndrome (PMWS) means that all pig units need to fundamentally reassess existing herd management procedures and routines. This review must include the management of farrowing accommodation and in particular, weaning age and weaning procedures.

Weaning to Oestrus Interval

An increase in weaning to oestrus interval from 3 to about 8 days is associated with a decline in subsequent litter size and farrowing rate. From about 10 days post-weaning, an increase in weaning to oestrus interval is associated with an increase in these parameters.

Increasing the length of lactation from about 10 to 30 days results in a decrease in the weaning to oestrus interval. This positive effect is due to mainly to the increased recovery of the uterus from the previous pregnancy. The longer the lactation the greater is the recovery and this results in better fertilisation and embryo survival rates.

With short lactations more sows fail to ovulate at first oestrus.

Earlier weaning is very likely to lead to an increase in the weaning to effective service interval or the number of empty days per litter.

Potential Litters Per Sow per Year

As weaning age is reduced the potential to produce more litters per sow per year is increased despite the likely increase in the weaning to effective interval (empty days).

Table 2. Effect of Weaning Age on Potential Litters per Sow per Year

Average Weaning Age, d.	*No. Empty Days per Litter*	*Potential Litters/ Sow / Year*
35	12	2.25
28	13	2.33
21	14	2.43

Reducing the average weaning age by 7 days may increase the number of litters produced per sow per year by about 0.09 This assumes that the weaning to effective service interval or empty days per litter will increase by 1 day for a 7day reduction in lactation length. For each 1day reduction in lactation length the potential litters per sow per year is increased by just over 0.01.

Litter Size

The length of the previous lactation influences the subsequent litter size. As the lactation length is reduced, litter size in the subsequent litter decreases. Table 3 summarises the analysis of litter size by previous lactation length for 12 herds.

Table 3. Effect of Previous Lactation Length on Total Number Born per Litter.

Previous Lactation Length, days	*<25*	*>24*
No. Litters	15,592	30,778
Average Weaning Age – days	21.5	27.5
Total Born per Litter	11.88	12.42

The litter size is 0.54 pigs higher for sows weaned at 25 days or over compared to sows weaned at 24 days or less. The 6day increase in average lactation length results in 0.54 pigs more born or an average of 0.09 pigs per 1day delay.

This data is presented as a graph in Figure 3.

For each 1day increase in weaning age the Total Number Born in the next litter will increase by almost 0.1 pig.

Table 4. Effect of Weaning Age on Total Number Born per Sow per Year

Weaning Age days	*21*	*28*
Potential litters per Sow per Year	2.43	2.33
Total Number Born per Litter	11.5	12.1
Potential Total Number Born per Sow per Year	27.9	28.2

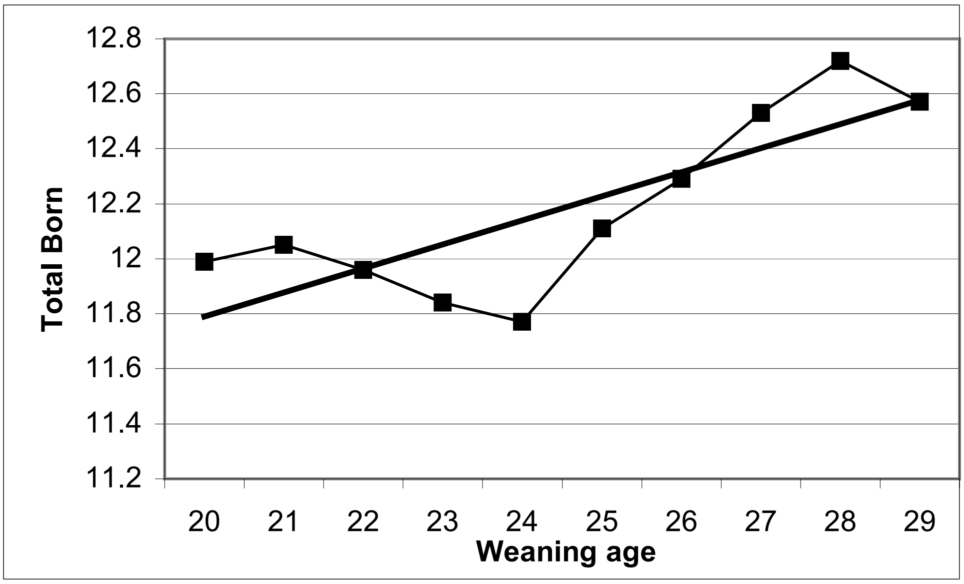

Figure 3. Relationship between weaning age and next litter size

Reducing the lactation length/weaning age is unlikely to significantly increase the Number of Pigs Produced per Sow per Year. The increase in Litters per Sow per Year is likely to be, largely, offset by the reduction in the number of piglets born alive per litter.

When To Wean

To minimise the variation in weaning age within a herd, wean on the weaning day all litters 25 days old or over. This will give an average weaning age of 27-28 days.
Herds that wean twice per week can maintain an average weaning age of 27-28 days. They could, on the other hand, effectively achieve an average weaning age of about 24 days but with very few sows weaned at 21 days. This means weaning about 50% of sows on Monday and 50% on Thursday.

Ideally, first litter sows should not be weaned before 28 days of lactation. However, these sows may experience severe weight loss. The number of piglets these sows are required to rear will exert a considerable influence on the weight loss.

Farrowing Accommodation

Weaning age is often determined by the amount of farrowing crates available. A shortage of crates results in sows being weaned earlier than is intended. Based on 4week weaning a 35day/5 week cycle is required to allow for washing and disinfecting of pens and to have sows in crates well in advance of farrowing. This is 27-28 days at weaning plus 7-8 days for washing and filling pens. The number of farrowings per week dictates the number of crates required. If the number of farrowings per week exceeds 20% of the number of crates weaning age will have to be reduced by weaning more litters at about 21 days rather than at about 28 days.

Weaning Day

Traditionally weaning has been carried out on Thursdays. With very few sows coming on heat in less than 4 days serving of sows is then carried out from Monday (day 4).
For sows that were weaned on Thursdays, the largest litters are produced by those sows served on Mondays (Table 5).

Table 5. Effect of Weaning to Service Interval on Total Born per Litter (Thursday weaning).

Day of Service	*No Litters*	*% of Litters*	*Total Born per Litter*
Sunday	730	2.0	11.90
Monday	17915	50.9	12.39
Tuesday	13057	35.7	11.91
Wednesday	2134	5.7	11.64
Thursday	897	2.4	11.53
Friday	687	1.8	11.74
Saturday	567	1.5	11.77

Source: Farm Data 36,000 litters

Sows first served 4 days after weaning (Mondays) produced, on average, 0.48 pig more total born compared to those sows first served 5 days after weaning (Tuesdays). Very few sows were served on Sunday and these had lower Total Born than the sows served on Monday.

This raises questions for herds weaning on Wednesdays. These herds are serving on Mondays i.e. day 5. If sows that were on heat on Sunday were served on Sunday the number of pigs born per litter would be expected to increase.

Service must take place before ovulation occurs. When service is delayed so that eggs are not fertilised within 4 hours of release there is an increase in the embryonic mortality (Table 6).

Table 6. The influence of time of mating on subsequent fertility in pigs

Estimated age of eggs at fertilisation – hours	*Eggs fertilised normally %*	*No.viable embryos at 25 days*
0	90.8	12.0
4	92.1	11.7
8	94.6	8.7
12	70.3	6.8
16	48.3	4.8
20	50.9	5.0

Source: Hunter, 1983

Late inseminations are also associated with an increased risk of urogenital tract disease. In turn this results in increased repeats and NIPs and reduced farrowing rates.

For herds weaning on Wednesdays but not serving until Monday the weaning to first service interval is 5 days. The convenience of Wednesday weaning in allowing more time for washing/disinfecting and moving sows in before the weekend must be considered in relation to a possible reduction of about 0.48 pig per litter in total born on 55% of litters. Delaying service can contribute to a reduction in the number of pigs born per litter.

Day of Farrowing

The average gestation length in most herds is close to 115 days. Sows served on Mondays will normally farrow on Thursdays. However within each herd there is some variation in the length of gestation. Sows carrying smaller litters tend to have a longer gestation. Sows with larger litters will have shorter gestations. Farrowing sows well in advance of the weekend provides a greater opportunity to supervise and manage newborn piglets and thereby reduce piglet mortality. With the majority of first services carried out on Monday irrespective of day of weaning (Wednesday or Thursday) the day of weaning does not affect the distribution of farrowings over the week.

Summary

1. There are now legal restrictions on when pigs can be weaned.
2. The average weaning age is determined by the distribution of sows weaned at about 21 and about 28 days of lactation.
3. As lactation length is reduced, the total number of piglets born in the subsequent litter declines.
4. Reducing weaning age is unlikely to significantly increase sow output.
5. Wean all litters 25 days old and over on each weaning day.
6. Wednesday weaning and serving on Mondays is likely to lead to a reduction in litter size.

Optimum Herd Size

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Introduction

What is the optimum herd size? Traditionally pig units were established as 50 or 100 sow units, or multiples of that. The size of the unit became a function of the number of farrowing places available. So, a unit would have 23 farrowing places per 100 sows. The remainder of the accommodation required on the unit was determined by estimated performance levels, based on the number of farrowing places. For example, the accommodation requirements per 100 sows for a unit producing 20 pigs per sow per year are shown in Table 2 below. The estimated performance figures used in the example are 20 pigs produced per sow, 2.25 litters/sow/year, weaner A.D.G. 400g, weaner transfer weight 32kg, finisher A.D.G. 700g, and finisher sale live weight 83kg.

As time progressed and profits improved, re-investments were made. Extra sows were added to the herd, with extra farrowing and dry sow accommodation. This was not always accompanied by extra weaner/finisher accommodation. This in turn resulted in overstocking problems on many units or pigs being sold at lightweights.

Another factor which compounded these problems, even where no increase in sow numbers occurred, was improvement in performance. Improvements in terms of the number of litters/sow/year, pigs weaned, pigs sold, and the general increase in sale weight of pigs (see Table 1) have all impacted on the capacity of a unit to carry pigs.

Table 1**: Average Pig Sale Weight (1994-2003)**

	1994	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*
Ave. Live wt. (kg)	85.6	86.8	87.7	89.6	90.1	90.5	90.1	92.1	93.5	94.1
Ave. Dead wt. (kg)	64.7	65.5	66.2	67.5	67.7	68.4	68.1	69.6	70.6	71.3

Source: Teagasc PigSys Analysis

An example of how these changes have impacted on the accommodation required per 100 sows in Table 2 shown below. These requirements are based on 22 pigs produced per sow, 2.35 litters /sow / year, weaner A.D.G. 450g, weaner transfer weight 35kg, finisher A.D.G. 750g, and finisher sale live weight 100kg.

Table 2: **Accommodation Required per 100 Sows**

Type of Accommodation	*20 Pigs / Sow / Year*	*22 Pigs / Sow / Year*
Farrowing	22	23
Dry Sow	83	82
Gilts	10	12
Boars	5	2
Weaner 1	168	185
Weaners 2	168	222*
Finishers	418	545

* 5 week accommodation

So, in trying to identify the optimum herd size for a unit, we really need to relate it to the actual carrying capacity of the unit based on **current** performance and **current** slaughter weight requirements. We must also take account of the existing floor area available and the cost of depreciation of buildings and fittings.

Begin at the End!

What we are trying to do is relate the sow capacity to the weaner / finisher of the unit and adjust accordingly to remedy any imbalance between the two. Many units do not have the correct balance, i.e. too many sows and too little weaner / finisher space (resulting in overstocking or light pigs at slaughter), or excess weaner / finisher space and too few sows (resulting in inefficient use of this excess space). This will be dealt with in more detail further on. However, in order to establish the optimum herd size for your unit capacity we need to begin at the end.

1. Decide on your optimum sale weight.

The optimum sale weight is that which maximises overall profit for the unit (McCutcheon, Teagasc Pig Conference 2002). 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.

The various slaughter plants specify different weight ranges within which no price penalties apply (see Table 3).

Table 3: Weight Range Specifications by Company

Company	Minimum Kg	Maximum Kg
Dawn	55	85.5
Glanbia	55	80
Glanbia	55	85*
Grampian	65	95

* *Average load weight >73kg*

The average carcass weight in the main pig slaughtering plants in Ireland in 2003 was over 73kg. Looking at the weight range specifications in Table 3 there is substantial scope to increase slaughter weights within the specified weight ranges. Where pigs are sold once weekly all pigs over 96kg live weight should be sold if the upper carcass weight is 80kg. For upper carcass weight limits of 85 and 85.5kg the corresponding live weights are 102 and 102.5kg, respectively. These guidelines are based on individual pig kill out percentages of up to 79%.

2. Calculate the Accommodation Requirements to achieve this optimum sale weight.

This calculation must be based on current unit performance. Therefore, the following information is required:

- Average herd size
- Maiden gilts as % of herd size
- No. pigs produced / sow/ year
- Weaning age and weight
- No. litters / sow / year
- Weaner A.D.G. and weight at transfer to finishers
- No. days in Stage I weaner house
- Finisher A.D.G. and sale weight
- No. days between litters or batches for the different accommodation.

Teagasc have developed a "Housing Accommodation Calculator" which will enable you to quickly determine your accommodation requirements based on the above information.

3. Determine how many weaners / finishers your unit can hold.

You now need to relate the accommodation requirements (determined in (2) above) to the floor area available in your unit to determine the weaner / finisher carrying capacity of the unit. To do this you must know the floor area requirements for the different types of pig. The Teagasc guideline requirements are shown in Table 4 below.

Table 4: **Guideline Stocking Rates for Weaner and Finishers**

Type of Pig	*Weight (kg)*	*Floor Area Required (ft^2)*
Stage I Weaner	20	2.15
Stage II Weaner	30	3.2
	35	3.5
	40	3.8
Stage I Finisher	60 – 65	6.0
Stage 2 Finisher	100	8.0
	> 110	10.8

These guidelines take account of the EU Welfare Regulations, 2003.

You then compare the accommodation required with the accommodation available to identify any imbalances. The Teagasc "Housing Accommodation Calculator" will automatically highlight these for you.

You are now in a position to determine the optimum herd size for the housing capacity of your unit.

Shortage of Finisher Space

The most common imbalance that occurs is a shortage of available finisher space. This situation generally results in other overstocking (with associated problems) or the selling of light pigs.

In this situation you have two options:

(i). Reduce sow numbers and increase sale weight

Appendix I shows a Budget Comparison based on reducing the sow numbers and increasing the sale weight. The "existing" situation in the Budget Comparison is based on 300 sows producing 21.8 pigs / sow / year and selling finishers at 93 live weight. The proposal is to reduce the herd size to 270 sows and increase the sale weight to 103kg liveweight. The increase in liveweight takes account of the effects on technical efficiency, as shown in Table 5.

The overall effect of this proposal is that the unit can produce the same amount of pigmeat at a slightly lower cost / kg from 30 less sows and still maintain the same margins (see Table 6).

Table 5: **Estimated effect of a 10kg increase in live weight at sale**

Factor	*Effect*
Finisher F.C.E	+ 0.1
Kill Out %	+ 0.5
Lean Meat %	- 0.5
Finisher A.D.G (g)	+ 7

Table 6**: Summary of Effects of Reducing Sow Numbers and Increasing Finisher Sale Weight**

	300 Sows	270 Sows
Finisher Live wt. (kg)	93	103
Finisher Dead wt. (kg)	70.2	78.3
No. Pigs Produced	6,540	5,886
Finisher Live wt .Sold (kg)	608,220	606,258
Total cost per kg (cent)	120.5	119.2
Profit (€)	29,577	30,281

(ii). Construct more finisher space to match the farrowing capacity

The cost of finisher accommodation is about €250 / pig place. The annual cost of this additional finishing pig place can be broken down as follows:

	€
Interest ………………………………….	8.25
Depreciation on Structure ………………	10.00
Depreciation on Equipment …………….	<u>5.00</u>
Total Annual Cost ……………………...	23.25 / additional pig place

Therefore, construction of extra finisher accommodation would need to return at least this amount per pig place to be viable or approximately €5.80 per pig finished.

Shortage of Farrowing Pens Compared with Weaner / Finisher Space.

A less likely scenario that could occur in terms of available accommodation is a shortage of farrowing pens compared with available weaner / finisher space. In this situation the options include:

i. Increase the number of litters farrowed per pen per year. This could be achieved by reducing the turnover time between sows in the farrowing house and / or by reducing weaning age. In most cases this option will not be possible.
ii. Increase the number produced, thus reducing the number of farrowings needed to achieve the target throughput. This will require increasing born alive / litter or reducing piglet mortality. This may be difficult to achieve if performance on the unit is already good.
iii. Increase target sale weight. This will reduce the throughput capacity required. This needs to be considered in terms of existing sale weights and the scope to increase these further without incurring price penalties for overweights.
iv. Construct more farrowing accommodation to match the weaner / finisher capacity. The cost of farrowing accommodation is about €2,400/pen.

The annual cost of this additional farrowing place can be broken down as follows:

	€
Interest ……………………………………	79
Depreciation on Structure …………………	66
Depreciation on Equipment ……………….	108
Total Annual Costs ……………………	€ 253/ additional farrowing place

Assuming 10 pigs are weaned out of this additional farrowing place every 5 weeks (i.e. 104 pigs per year), then this cost is equivalent to €2.43 per pig produced, i.e. the investment would need to return at least this amount to be economically viable.

Constraints on Increasing Herd Size

While the areas dealt with above are those most likely to influence your optimum herd size there are a number of other areas which could have an impact. These include:

1. Likely Return on Investment

Rather than invest money in the pig unit, you may decide to reduce your herd size and invest money in other areas (e.g. property) that may generate a greater return on your investment.

2. Integrated Pollution and Prevention Control Licensing

The costs involved in meeting the I.P.P.C. requirements are considerable. Depending on your current situation, future plans, and existing unit size it may be more economical to reduce your herd size below the threshold required for these regulations.

Alternatively, you could consider converting your existing integrated pig unit to a breeding unit and finishing some of your pigs on another site (or contract finishing) to keep below the I.P.P.C thresholds.

3. Planning Permission

Similar to the I.P.P.C regulations the cost of getting planning permission are considerable and you need to weigh up the costs versus the benefits before making any decisions to expand or re-invest in your unit.

4. Welfare Legislation / Dry Sow Housing

The amended EU Welfare regulations, which came into force in January 2003, could have a significant impact on optimum herd size, especially in relation to the area of pregnant sow housing. These regulations require almost twice the space for a pregnant sow than what is currently being provided. Those units with tethers will have to give serious consideration to their options over the coming months (if they haven't already done so) as tethers are banned from the end of 2005. One option for such units may be the reduce sow numbers and increase finisher sale weights.

5. Labour Availability

Good staff are becoming more difficult to find and retain. As labour becomes less available many units may have to reduce their herd size to match the labour available.

Review Your Herd Size

Once you have established your optimum herd size you will need to review it continually to take account of any changes that occur on your unit (e.g. number pigs produced, farrowing rates, growth rates, labour availability) or in the weight range specifications required by your slaughter plant.

You should review this regularly with your Teagasc Advisor. Teagasc have a number of computer programmes that will enable you to consider all your options and evaluate them economically. These include the "Housing Accommodation Calculator" and several financial "Budget Comparison" programmes. Is it time you reviewed your optimum herd size?

Appendix 1 – Budget Comparison

Basic Assumptions		Existing	Proposed
No. Sows		300	270
No. Pigs Produced/Sow/Year		21.8	21.8
Ave. Weaning Age (days)		28	28
Ave. Weaning Weight (kg)		7	7
Weaner F.C.E.		1.79	1.79
Weaner Weight at Transfer (kg)		35.2	35.2
Weander A.D.G. (g)		434	434
Finisher Sale Liveweight (kg)		93	103
Kill out %		75.5	76
Finisher Sale Dead Weight (kg)		70.2	78.3
Lean Meat %		58	57.5
Finisher F.C.E.		2.73	2.83
Finisher A.D.G.		743	750
Base Finisher Price (c/kg)		117	117
Technical Summary			
No. Pigs Produced		6540	5886
Total Feed Used (tonne)		1728	1756
Total Finisher Live Weight Sold (kg)		608,220	606,258
Ave. Price per kg dead (c)		127.2	125.9
Weaning to Sale	F.C.E.	2.42	2.52
	A.D.G. (g)	602	618
	Days	143	155
Basic Annual Budget		**€**	**€**
Gross Output		567,372	565,032
Variable Costs		446,628	443,584
Gross Margin		120,744	121,448
Fixed Costs		91,167	91,167
Cash Surplus		29,577	30,281
Budget Analysis			
Feed cost per pig €		58.1	64.78
Non-feed cost per pig €		26.56	28.51
Total cost per pig €		84.66	93.29
Feed cost per kg dead (c)		82.7	82.8
Non-feed cost per kg dead (c)		37.8	36.4
Total Cost per kg Dead (c)		120.5	119.2

Bord Bia: Pigmeat Market Up-date

Jackie Hughes, An Bord Bia

(Paper to support presentations October 11th – 13th)

Following recent developments in the pigmeat industry in Ireland, the relative stability experienced throughout 2003 and 2004 will be challenged by questions relating to slaughter capacity in the light of Galtee's proposals to close Mitchelstown.

The answers to these questions lie not only in the individual throughput capacity of each slaughtering plant operating in the country, but also in the overall market situation faced by the industry as a whole, both in Ireland and on world markets.

Key aspects to consider include market demand in Ireland and in our principal export markets, production and consumption trends in major pigmeat producing countries, the expected effects of EU Enlargement, and current issues affecting different world markets.

This presentation aims to outline each of these elements, in order to facilitate a clear understanding of the current environment in which the Irish pigmeat industry must operate.

MARKET UPDATE

IRELAND

- **Herd Numbers**

The results of the June 2004 pig survey show that total Irish pig numbers decreased by 4% (67,000) head on June 2003 levels to just under 1.65 million head.

This fall-off in numbers has been seen at export approved meat plants during the first half of the year, as throughput decreased by over 8% (122,000 head) on corresponding 2003 levels to just under 1.32 million head.

Within the total, both the "breeding herd" and the "other pigs" categories showed declines. The breeding herd was some 2.5% (3,900 sows), lower than corresponding year earlier figures.

This overall fall in herd numbers can be attributed to lower productivity caused by producers exiting the industry and to live exports going North (9,000/wk).

The total number of "other pigs" was over 4% (63,000 head) lower, at 1.48 million head. Within this, pigs '80 kg and over' declined by 22% to 132,000 head, while pigs between '50kg and 80kg' declined by 1% to 369,000 head.

In 2004, we expect herd numbers to continue to decline as more producers exit the industry.

Irish Pig Numbers, June 2004 Survey ('000 Head)

(`000 head)	2003	2004	% Ch 04/03
Total Pigs	**1,713**	**1,646**	**-4.0**
Of which:			
Breeding Pigs	**176**	**170**	**-3.1**
- Gilts in Pig	19	19	3.1
- Sows in Pig	104	102	-1.9
- Other sows for breeding	31	29	-8.1
- Gilts not yet served	18	17	-7.0
- Boars	3	3	-8.1
Other pigs	**1,538**	**1,475**	**-4.1**
- 80 kg and over	169	132	-21.8
- 50 kg and under 80kg	373	369	-1.0
- 20 kg and under 50kg	466	467	0.1
- Less than 20kg	529	507	-4.2

Source: CSO

• Production

Pig production in Ireland in 2003 reached approximately 3,288,248 head, representing a 2.9% decrease on 2002 levels. Pig slaughterings at export approved meat plants for 2003 were down 6.7% on 2002 levels to 2.834 million head, while live exports to the North for 2003 reflected an increase of 30% on 2002 levels, to 453,823 head.

Up to September 4th of this year, pig slaughtering levels in Ireland were down 8.2% to 1.773 million head. Based on reduced slaughter capacity, a falling breeding herd and a further 6% increase in exports to the North, slaughter levels for 2004 as a whole are expected to be back by approximately 8% to 2.6 million head, while total pig production for the year is predicted to decline slightly by .06%, to 3.08 million head.

Irish Pig Marketings

	w/e 30.08.03	w/e 28.08.04	To Date 2003	To Date 2004	% Change
Pigs	54,533	52,169	1,870,713	1,720,299	-8.0
Sows & Boars	1,515	1,725	60,498	53,105	-12.2
Total Pigs	56,048	53,894	1,931,211	1,773,404	-8.2

Irish Pigmeat Balance 2001 – 2004 ('000 Tonnes cwe)

	2001	2002	2003	*2004
Production cwe	212	223	217	191.66

** Bord Bia prediction – 191,663 tonnes*

Pigmeat production in Ireland for 2004 is expected to fall by approximately 11% due to the following reasons:

- A 4% decline in the breeding herd, as seen in the December 2003 census, followed by a 2.5% decline in the breeding herd, as seen in the June 2003 census.
- An 8.2% decrease in slaughtering levels at export approved meat plants, as recorded year to date September 2004.
- Due to disease problems experienced in some units throughout 2003/2004, some units have depopulated. Some producers have also exited the industry.
- Live exports to the North of Ireland continue in large numbers. It is estimated that approximately 9,000 pigs are exported live to the North each week. This is reflected in the fact that for the full year 2003, pig slaughterings in the South of Ireland were 2,834,425 heads (a 6.7% decline on year earlier levels), while pig exports to the North of Ireland for the full year 2003 were 453,823 head.

  Overall exports to the North are expected to increase by 6% in 2004, to approximately 481,052 head.

- ## Consumption

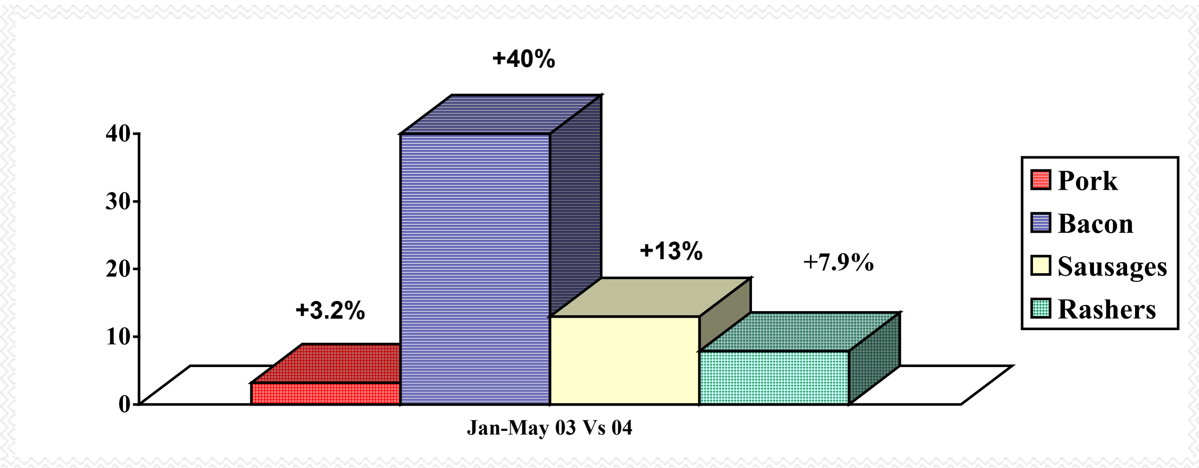
Irish Pigmeat Balance 2001 – 2004 ('000 Tonnes)

	2001	2002	*2003	*2004
Consumption cwe	151	150	151	152

** = Bord Bia predictions*

Consumption levels in Ireland were expected to remain relatively stable for the year, at approximately 150,000 tonnes cwe. However, following strong retail sales during the first half of 2004, records are likely to reflect an increase in consumption to approximately 152,000 tonnes. Over one third of consumption is accounted for by backs and loins.

% Change in Sales Volumes of Pigmeat Products at Retail Level in Ireland



Note: Overall pork and sausage sales in terms of value increased by approximately 6%, while bacon sales in terms of value increased by approximately 18%.

- ***Exports***

The UK is a major export market for Irish pigmeat processors, taking over 50% of exports. Continental EU and International markets each account for approximately one quarter of total exports.

International markets continue to grow in importance, with exports to countries such as the US, Japan and Hong Kong increasing over the past few years.

Irish Pigmeat Exports, 1999 – 2004 ('000 tonnes pw)

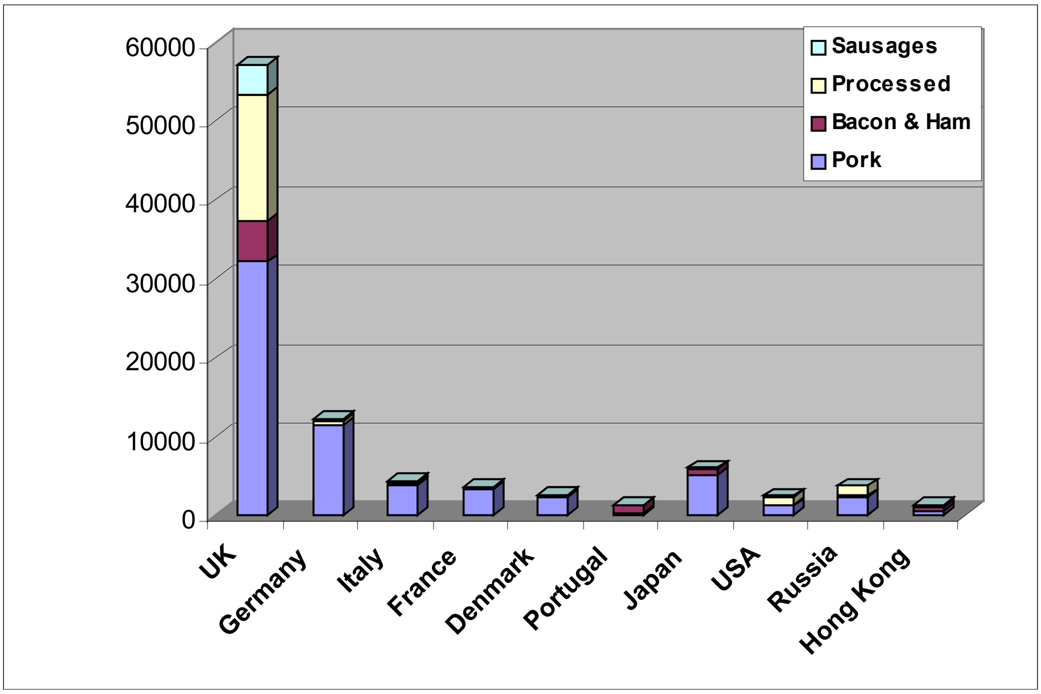
	1999	*2000*	*2001*	*2002*	*2003*	*2004*
TOTAL Of which to:	**135**	**129**	**136**	**123.09**	***120.22***	***118 (p)***
UK	**72**	**61.9**	**68**	**69.4**	***61.2***	
Continental EU	**41.7**	**40**	**55**	**33.7**	***28.5***	
- Germany	*16*	*16*	*16*	*11*	12	
- France	*10*	*5*	*14*	*6.8*	3.6	
- Italy	*10*	*4*	*8*	*5.4*	4.3	
- Other EU	*5.7*	*15*	*17*	*10.7*	8.4	
International Markets	**21.3**	**27**	**12.8**	**19.8**	***30.3***	
- Russia	*4.5*	*5.4*	*5.6*	*9.6*	7.3	
- Japan	*10*	*12.3*	*3.1*	*2.9*	6.3	
- Hong Kong	*2.7*	*2.3*	*1.8*	*1.5*	2.1	
- USA	*1.5*	*2.6*	*0.4*	*3.3*	12.3*	
- Other International	*2.6*	*4.4*	*1.9*	*2.5*	2.2	

Source: CSO and Bord Bia estimate. Note (p) = prediction.

Please note, the 2003 export figure to the USA appears to be incorrect and is estimated to be approximately 6,000 tonnes. We have asked the CSO to check the figure.

Exports for 2004 are expected to fall by approximately 1.8% to 118,000 tonnes pw due to falling pig supplies.

Irish Exports by Cut, 2003



- ***Imports***

Imports of pigmeat into Ireland for 2003 reached 47,782 tonnes pw. Imports for 2004 are likely to also show a further increase, mainly due to a continued deficit of backs and loins on the Irish market, the strong price competitiveness of imported product and the demand on higher value export markets for loins and legs.

Much of the pigmeat imported is processed and re-exported. Processed imports have increased mainly due to increased demand for non-traditional domestic product, such as Parma Ham, Serrano Ham and Charcuterie Products.

Origin of Pigmeat Imports into Ireland: 1999 – 2003 (Tonnes pw)

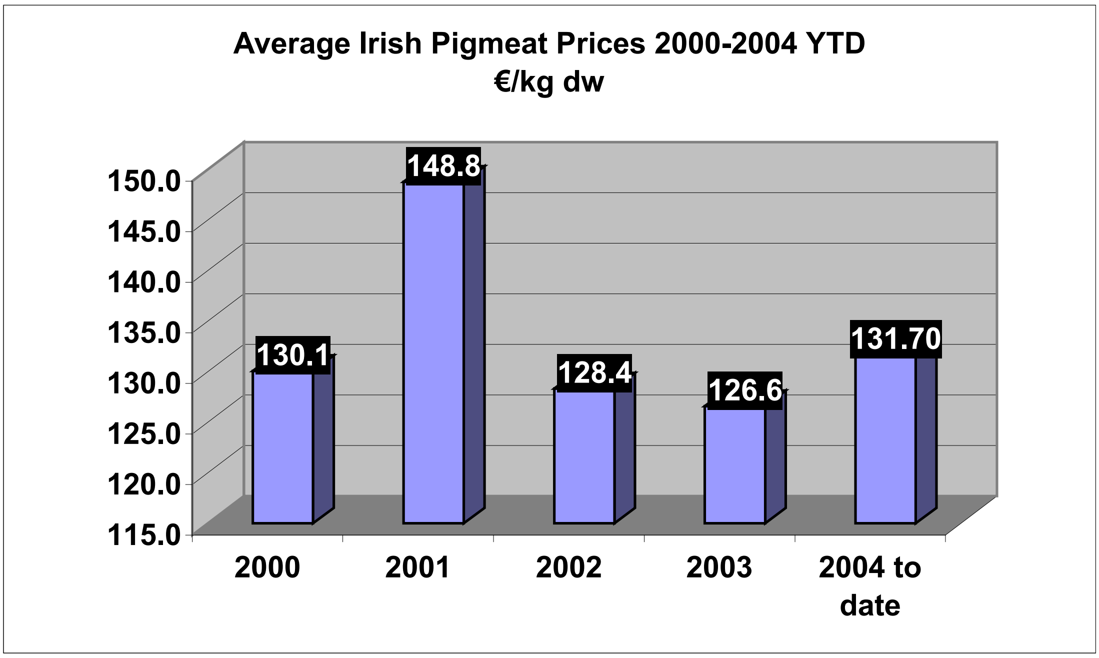
	GB	N. Irl	Holland	France	Denmark	Germany	Others	TOTAL
1999	10,308	4,997	6,622	2,329	3,902	2,419	1,931	**32,508**
2000	12,475	5,109	8,782	4,791	3,876	2,675	2,216	**39,924**
2001	14,320	2,779	7,837	4,600	5,768	4,437	1,223	**40,964**
2002	13,115	3,097	9,180	4,477	5,256	6,613	1,532	**43,270**
2003	15,944	3,923	8,174	4,183	5,764	7,965	1,829	**47,782**

- ***Prices***

The average Irish pig price for 2003 amounted to €1.27 / kg and compares to an EU average reference price for the same year of €1.26 / kg.

The year-to-date (28/08/04) average Irish pig price is currently at €1.32 / kg and compares to an EU average reference pig price for the same period of €1.34 / kg.

Overall year to date (28/08/04) Irish pig prices have increased by 8.2%, from the equivalent price of €1.22 / kg in 2003.



EU-15

- Herd Numbers

Although the pig industry in Europe was experiencing difficulties due to low prices and high feed costs at the end of 2003 and in early 2004, the outbreak of bird flu in Asia and BSE in the US led the market situation to improve considerably from February onwards.

As a result, overall EU herd numbers are expected to experience minor changes, declining slightly by approximately 0.4% to 121.5 million head. This decline will be mainly due to falls in Belgian and Dutch herd numbers, caused by environmental constraints and buy-out schemes that have encouraged some producers to exit the industry.

German and Danish herds are forecast to remain relatively unchanged.
With regards to Germany, producer confidence in the sector last year has maintained herd numbers, while in Denmark, although the April census indicated a fall in Danish herd numbers,

overall numbers are expected to remain stable as producers, with support from the banks, have been able to allow sow numbers to increase.

French, Spanish and Italian herds are all expected to show a small drop in numbers due to producers exiting the industry, while the sustained fall in UK herd numbers recorded over the past few years has begun to level off.

With regards to the New Member States, Poland and Hungary are forecast to experience a decrease in numbers as over-production in late 2003 led to a collapse in market prices, while feed costs increased considerably.
The industries in each of these two countries are expected to see significant re-structuring as smaller producers exit the industry, while larger producers invest in improved facilities and genetics.

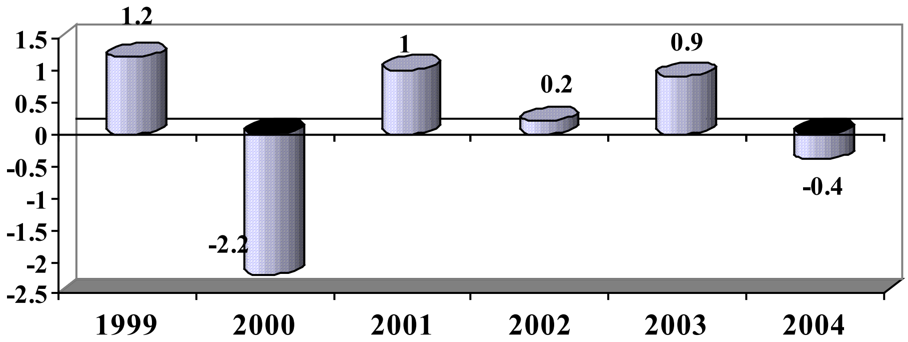
- ***Production***

EU production for 2004 is expected to fall slightly by 0.3% to 201.5 million head. Production levels remained almost static during the first half of the year, as a 5.4% increase in German slaughterings counterbalanced the impact of low sow conception rates in 2003.
The second half of the year is not expected to show any significant change in comparison with year earlier levels, as although the breeding herd is in slight decline, sow productivity recovered last autumn.
Year on year slaughterings are expected to be slightly lower in the last quarter of the year however, as pig finishings for 2003 were delayed following the hot summer, leading to an accumulation of stock for slaughtering in the fourth quarter of that year.

- Consumption

Consumption levels in the EU have remained stable over the past few years. However, if production levels remain relatively stable and exports to third countries increase, then supply levels are likely to fall. This reduced supply situation would push prices up at retail level, leading to a slight decrease in consumption of approximately 0.4%, to 16.740 million tonnes for 2004 as a whole.
A marked growth in consumption is expected in the New Member State countries, and this, coupled with a levelling off of prices between the EU-15 and AC-10 countries, will lead to an increase in intra-community trade.

% Change in Levels of Pigmeat Consumption 1999 - 2004(p)



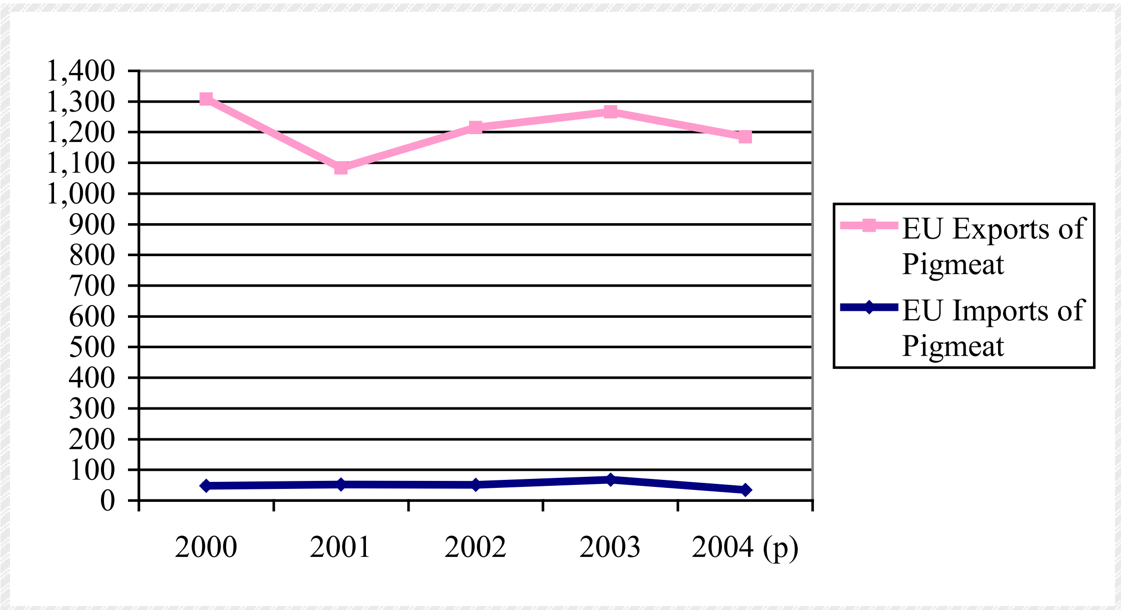
Note: (p) = prediction

- **Trade**

EU pigmeat exports increased slightly in 2003, by 2.9% to 1.19 million tonnes in comparison with 2002. Although European exports increased considerably during the first half of the year, overall forecasts for 2004 are for a decrease of 4%, mainly due to the integration of Eastern European countries into the EU market, the implementation of the safeguard clause to Japan in August, and the introduction of Russian import quotas.

Imports for 2003 amounted to 68,311 tonnes cwe, reflecting a 34% increase on 2002 import levels. Import levels for 2004 however, are expected to drop considerably, by almost 50%, mainly due to the integration of Hungary and Poland – two of the EU's primary suppliers – into the EU.

EU Imports & Exports 2000 – 2004 (p)
'000 Tonnes



• Prices

Pig prices in 2004 experienced a strong recovery following the short-lived crisis at the end of 2003. This was mainly due to the slight reduction in pig supplies coupled with an increase in exports to third country markets, and in particular Asian markets, following the outbreak of bird flu in Asia and BSE in the US.

Prices are expected to weaken in the third and fourth quarters of the year however, partly due to seasonal trends and reduced exports to Asia following the introduction of the Japanese Safeguard clause, before picking up again in early 2005.

In general, prices for the year are expected to be approximately 5% higher than in 2003, at 1.33€/kg.

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

	1999	2000	2001	2002	2003	2004	2005
1st Quarter	0.98	1.22	1.74	1.39	1.26	1.26	1.31(p)
2nd Quarter	1.10	1.42	1.81	1.38	1.24	1.35	
3rd Quarter	1.26	1.49	1.66	1.38	1.36	1.42(p)	
4th Quarter	1.15	1.53	1.45	1.27	1.21	1.29(p)	
Year	1.12	1.42	1.67	1.36	1.27	1.33(p)	

(Source: EU Commission)

Note: (p) = prediction

• Summary

Predictions for 2004

	Herd Numbers	*Production*	*Average Pig Price for 2004 (to 28/08/04)*
Ireland	*↓4% to 1.65 million head*	*↓8% to 191,663 tonnes cwe*	*€1.32 / kg*
UK	*↓2.1 % to 5.22 million head*	*+ 0.4% to 718,000 tonnes cwe*	*€1.56 / kg*
Denmark	*+ 1.2% to 13.03 million head*	*+ 1.3% to 1.78 million tonnes cwe*	*€1.17 / kg*
Holland	*↓4.0% to 10.7 million head*	*↓0.2% to 1.250 million tonnes cwe*	*€1.27 / kg*
Spain	*↓1.0% to 23.52 million head*	*↓1.9% to 3.130 million tonnes cwe*	*€1.42 / kg*
Germany	*+ 0.5% to 26.38 million head*	*+ 1.5% to 4.300 million tonnes cwe*	*€1.39 / kg*

EU ENLARGEMENT

The ten new member states added an additional 30 million pigs (25%) to the EU herd, bringing it to 150 million head. Following an overall increase in EU-15 production of 4% and an increase in New Member State production of 15%, overall EU production will have increased by 18%, to approximately 21.8 million tonnes by 2010.

In the short-term, EU Enlargement is expected to have a very limited impact on overall EU trade. This is mainly due to the fact that cross-border trade was already in place before enlargement and prices had already begun to converge for same-quality produce.
Pig prices in the Accession Countries were originally below the EU average by approximately 30 cents/kg. However, they have increased significantly since March 2004, and prices in Poland and Hungary are now on par with the EU average of €1.48/kg.
This has impacted on trade to these countries, creating strong incentives for Polish processors to import product from the EU-15, particularly manufacturing meat for processed pigmeat products.
Exports from the New Member States into the EU-15 states however are expected to be hindered somewhat in the short term by food safety standards controls.

In the medium to long-term, Poland, Hungary and the Czech Republic are expected to become major players in the European pigmeat industry, as they become increasingly efficient and as production standards increase to meet EU regulations. These countries are already restructuring and smaller, less efficient farmers are being forced to exit the industry. Furthermore, inward investment from countries such as Denmark and the US has already begun, with companies such as Smithfield Foods (which has merged with Morliny) and Danish Crown (which has merged with Sokolow) entering the market.

With regards to consumption trends, pigmeat is the number one meat in the Accession States, representing over 50% of total meat consumption, while average per capita consumption of pigmeat ranges from 39.7kg to 41 kg – only two kilograms less than the EU average of 43.8kg/capita.

Of the ten new states, Poland is the most significant pigmeat producer, accounting for almost 60% of total New Member State pig output. Poland is followed by Hungary and the Czech Republic, which account for 15% and 11%, respectively.

EU-25 Pig Herd, December Survey 2003

(`000 head)	EU-15	AC-10	% Increase on EU Herd
Total Pigs	**121,513**	**30,871**	**25%**
Of which:			
Breeding Pigs	12,167	2,946	24%
Other Pigs	109,346	26,930	25%

(Source: EU Commission)

- ## Poland

Polish pig numbers for 2003 were over 8.5% higher than the previous year, at approximately 19 million head. This number is expected to fall in 2004 however, due to the impact of a pig crisis in the country. Oversupply of pork during the first half of 2003 (leading to a 6.1% increase in production to 1.74 million tonnes), coupled with an increase in feed prices led to a severe fall in profits for producers.

Consequently, forecasts for pig numbers in 2004 are for 18.4 million head, representing a 3.2% decrease on year earlier levels, while production is expected to fall by 4.6%, to 1.66 million tonnes.

Polish Pig Numbers, December 2003 Survey (‘000 Head)

(`000 head)	2002	2003	2004	% Ch 04/03
Total Pigs	**17,500**	**19,000**	**18,400**	**-3.2**
Of which:				
Sows	**1,750**	**1,700**	**1,600**	**-5.9**
Other Pigs	**15,750**	**17,300**	**16,800**	**-2.8**

(Source: EU Commission)

Following EU accession, many Polish slaughterhouses will be forced out of business, due to their inability to meet EU standards. Only the largest and most efficient processors are expected to survive, many of which are owned by foreign investors, such as Smithfield Foods or Danish Crown.

Pigmeat consumption in Poland is forecast to decrease slightly, mainly due to an increase in prices, following tighter production levels and supplies. Overall, per capita consumption is expected to be in the region of 41.9kg.

Pigmeat imports into Poland are expected to increase by almost 25% in 2004, particularly from Denmark and Holland. The Polish pigmeat trade balance is forecast to be negative however,

due to weak exports in 2004 following a sharp fall in trade to Russia, which will contribute to an overall decrease of 13% in exports to approximately 98,500 tonnes.
Exports to the EU following integration are not expected to show any significant increase in the short-term.

- ## Hungary

Pig numbers in Hungary increased in 2002 due to favourable pig and feed price conditions, before falling at the end of that year due to the difficult financial situation of many pig producers. Consequently, 2003 numbers showed a 2.2% decrease, and are expected to fall further in 2004, to approximately 5.05 million head.
A significant number of processing plants are likely to exit the industry following EU Accession, due to their inability to meet EU standards, and this will lead to an even greater decrease in herd numbers.
As a result of reduced raw meat availability, pigmeat processing is forecast to decline in 2004.

Imports into Hungary from EU states are expected to increase by up to 17.9% to 33,000 tonnes in 2004, as Hungarian pig prices have come on par with EU prices. The main suppliers to Hungary are Germany, Denmark and Holland.
Hungarian meat exports are forecast to increase by 17.4% to 108,000 tonnes, mainly to the EU and Asia, while exports to Croatia and Romania (Hungary's primary export markets) will suffer from import restrictions in those countries.

Hungarian Pig Numbers, December 2003 Survey ('000 Head)

(`000 head)	2002	2003	2004	% Ch 04/03
Total Pigs	**5,255**	**5,138**	**5,050**	**-1.7**
Of which:				
Sows	**382**	**361**	**345**	**-4.4**
Other Pigs	**4,873**	**4,777**	**4,705**	**-1.5**

(Source: EU Commission)

- ## Czech Republic

Following a drive to increase pig productivity and product quality in recent years, standards in the Czech Republic have improved considerably. However, profitability has remained low and this has been reflected in the slight decrease in pig numbers in 2003. Numbers are expected to fall again slightly in 2004, to 3.3 million head.
In keeping with a fall in pig numbers, pig production is expected to drop, mainly due to a sustained fall in pig prices.

With regards to consumer trends, stiff competition from poultry and beef coupled with increasing prices has led to a fall in pigmeat consumption.

Imports into the Czech Republic originate mainly from Germany, France, Belgium and Denmark and are expected to decrease in the medium term. Exports have been hindered by oversupply in neighbouring countries, and are expected to fall by approximately 10%, to 9,000 tonnes in 2004.

Czech Republic Pig Numbers, December 2003 Survey ('000 Head)

(`000 head)	2002	2003	2004	% Ch 04/03
Total Pigs	**3,440**	**3,362**	**3,330**	**-1.0**
Of which:				
Sows	**289**	**282**	**280**	**-0.7**
Other Pigs	**3,151**	**3,080**	**3,050**	**-0.9**

(Source: EU Commission)

WORLD MARKETS

• Japan

The Japanese pig herd reached 9.7 million head in 2003, reflecting a 1.2% increase on year earlier levels. The introduction of strict environmental controls in the country is expected to cause some producers to exit the industry, thereby leading to a decrease in herd numbers to 9.6 million head in 2004. Pigmeat production is expected to increase by just under 2%, to 1.259 million tones cwe for 2003.

During the first quarter of 2004, Japanese pork imports were approximately 18% ahead of 2003 levels, at 172,000 tonnes. This increased trade reflects the impact of Avian Flu and the suspension of US and Canadian beef imports into the Japanese market.

The US continues to be the largest supplier of pigmeat to the region, accounting for 31% (54,000 tonnes) of Japanese imports during this year's first quarter.

Denmark increased its exports to almost 50,000 tonnes (+37%) in January-March 2004, while Canadian pigmeat exports to the Japanese market were 19% higher, at 39,000 tonnes.

Shipments from Ireland were 45% higher than year earlier levels, at 1,800 tonnes.

As a result of this increase in imports, the Japanese government reinstated the Safeguard Clause on August 1st of this year, imposing tariffs of approximately 25% on imports. These tariffs are expected to remain in place until 31st March 2005.

- **Russia**

The Russian pig herd increased by 8% in 2003 to 17.3 million head, following heavy investment in production efficiency throughout the year. 2004 is expected to bring a decline in pig numbers of 1.5 million head due to high slaughter rates.

This is mainly attributed to the increase in the import quota volume, from 337,500 tonnes to 450,000 tonnes in 2004, which has led to a decrease in pigmeat availability within the Russian market. As a result, many domestic producers and processing plants have increased activity in an attempt to meet market demand. This situation will be alleviated over the coming two years as domestic pigmeat production increases following a recovery in pig numbers.

During the second quarter of the year, uncertainties regarding EU Veterinary Certificate and Market Access issues caused traders to import larger quantities of product. However, following an EU-Russian agreement on September 3rd, no break in trade is expected for the remainder of the year, and the EU member states are likely to have market access through to the next deadline for the signing of certificates, on January 1st 2005.

For 2004 year to date, prices for imported pork have risen by approximately 20% to €2.61/kg, while the price for Russian pork has increased by 13% to €2.50/kg. This increase in prices is a direct result of the import quotas and is expected to lead to a slight decrease in consumption in the medium term, although 2004 predictions are for stable levels at 16.6 kg/capita.

- **USA**

The US market represents approximately 10% of total world pigmeat production. Herd numbers for 2004 are expected to decrease slightly, by 1.1%, to 58.83 million head, while sow numbers are also predicted to fall by 1.2%, to 5.9 million head.

Due to strong consumption levels (which have increased steadily over the past few years, reaching 8.8 million tonnes cwe in 2004 – 30.2kg/per capita), pig and pork prices remain profitable. However, industry experts are unsure if the demand spurred by high-protein diets in America is just a fad or if this trend will support the meat markets permanently.

Approximately 40 million Americans have taken on high-protein diets, such as the Atkins and South Beach diets. As prices continue to increase however, consumers are likely to reassess their spend on meat and this may lead to a decline in consumption in coming years.

US exports increased by 3.2% in 2003, to 758,000 tonnes cwe and are expected to increase further in 2004, to approximately 769,000 tonnes cwe. Primary markets include Japan, Mexico and Canada, which account for up to 79% of total pork exports.

- **Canada**

The Canadian pig herd was recorded at 14.66 million head in 2003, reflecting a 2.1% increase on year earlier levels. This growth was attributed to an increase in the level of farrowings due to good profits and a positive market outlook. Herd numbers are expected to fall by 3.7% to

14.13 million head in 2004 however, due to very high export levels (which are up by 22% on year earlier levels). Production for 2004 is forecast to increase by 2.5% to 1.9 million tonnes cwe.

Canada has a strong dependency on exports, with up to 45% of total production being exported to over 90 countries. Almost two thirds of this goes to the US market and US imports of live hogs from Canada increased for the year-to-date 27th March 2004 by 49.4%, reaching 2.2 million head. This trend is expected to continue in 2004, due to pig prices driving strong pig finishing demand in the US and limited marketing alternatives in Canada.

- **Brazil**

Brazilian pork production is forecast to decline by 1.2% in 2004 to 2.5 million tonnes cwe. Over the past few years, Brazil has exported 23% of its domestic pork production, with more than 65% destined to Russia. Under the 2004 Russian quota system however, Brazilian pork has been forced to compete for a share of the 179,500-ton quota reserved for "other countries". Although Brazilian pork is expected to remain very competitive in the Russian market, this quota is considerably lower than the 300,000 tons (pwe) Brazil shipped in 2003.

To compensate, Brazil is expected to look to other markets, building upon its recent successes in Singapore, South Africa, the Netherlands, and Argentina. Domestic pork consumption remains notoriously low, with 10.9 kg/capita forecast for 2004.

BORD BIA ACTIVITIES FOR 2004

- **Promotions and Market Development**
  - *Quality Assurance Scheme*: Management and auditing of the Pigmeat Quality Assurance Scheme. This scheme is currently being upgraded to meet with the EN45011 standards. Approval has also been obtained from the EU Commission to change the existing logo to "Quality Assured: Origin Ireland".
  - *Retail:* Promotional Campaigns to increase consumer awareness of pork, to promote pork as a tasty, versatile and nutritious meat, and to promote quality assured pork and bacon products through the Feile Bia programme.
  - *Origin Ireland Logo:* Launch of the new Origin Ireland Quality Assurance Logo in the first week of October 2004. The aim of this logo is to facilitate greater transparency as to the origin of the product.
  - *Education:* Pork Competition 2004 in conjunction with the IFA, the IAPP and the Panel of Chefs of Ireland, aimed at encouraging the chefs of the future to use more pork on menus, while educating students on how pigs are reared and pigmeat is processed. A 2nd Pork Competition is planned for 2005.

- *Trade Fairs:* Participation at international trade fairs including SIAL in Paris and World Food Moscow in Russia. Bord Bia will also run a Steak Bar at the National Ploughing Championships.
- *Media:* Press releases and enquiries; Organisation of international journalist visits.
- *Business Development:*
    - Assisting in re-opening key international markets;
    - Generating new business for Irish processors in existing markets (such as the UK) and targeting new markets (including the Chinese market to which a Trade Mission was organised in August 2004);
    - Providing local market knowledge to Irish exporters through compilation of reports, presentations to buyers, inward buyer visits and weekly market reports.

- **Information**
    - *Market Monitoring:* Weekly publication of the Market Monitor. Bord Bia monitor prices and developments in all markets and provide regular updates to the industry.
    - *Seminars:* Annual meat seminar held in January for meat processors. Bord Bia also attended the World Pork Congress in the US.
    - *Reports:* Regular market reports monitoring developments in the marketplace.
        - Quarterly Producer Newsletter updating producers on market trends and Bord Bia activities.
        - Fortnightly Processor Newsletter updating processors on current news issues in world pigmeat markets.
    - *Enquiries:* Dealing with general enquiries.
    - *Study Tours:* Pigmeat study tour to Spain to review the Spanish pigmeat industry. We are currently reviewing possible markets for a study tour in 2005.
    - *Consumer Research:* Monitoring consumer trends, attitudes to eating pork etc.

Options for Housing Loose Sows

Pat Tuite, Teagasc, Drogheda

Two important dates are looming which will affect the way dry sows are housed in future. They are January 1st 2005 and January 1st 2013.

In about 14 months time all sow tethers will be banned in the EU. Units with tethers have a number of options: (a) convert to stalls, where possible; (b) convert to loose housing; (c) convert to finishing or (d) exit pig production.

By January 1st 2013 all pregnant sows and gilts must be group housed from 4 weeks after service until 1 week prior to farrowing. This is now a requirement for any new drysow housing. This means that about 70% dry sows must be loose housed.

This paper examines several loose housing options available to pig producers. The main point to bear in mind is that the space requirement varies with group size (Table 1).

Table 1. Unobstructed floor area per sow in a group.

Group Size	*Unobstructed Floor Area*	
5 sows or less	2.5m^2	26.9ft^2
6-39 sows	2.25m^2	24.2ft^2
40 sows or more	2.025m^2	21.8ft^2

Source: S.I. No. 48 of 2003

Option 1: Long Trough Layout

This is normally used for groups of 10 to 20 sows, which are wet-fed in a stainless steel trough. The trough is best placed on the floor with an 18" feeding space per sow. Two troughs per pen appear to work better than a single trough.

It is normal to have a solid lying area with a two-trough system. The water to meal ratio is kept to about 3.5:1 to avoid wet, slippery pens.

Uneven sow conditions are a problem with this system. The removal of repeats and thin sows can result in irregular stock numbers per pen. It is normal to leave one or two free feeding spaces per pen.

It can be used in units from 250 sows up to 1,000 sows.

Option 2. Welfare Stalls

These have either 4 or 6 sows per pen. The latter require 10% less floor area per sow than the former ($24.2ft^2$ vs $26.9ft^2$). It is not recommended to design a loose pen for 5 sows because it is only $11ft^2$ smaller than a pen for 6 sows. The feed trough is excluded from the unobstructed floor area, although the rest of the area within the stall is allowed.

With 4 sows per pen an 8ft gate may be used as a pen division and also for closing the sows into the stalls. With 6 sows per pen two 6ft gates are used for this purpose.

Some producers use the welfare stalls from after service and close the sows in for the first 4 weeks – a few producers like to close the gates while sows are feeding. This routine is unnecessary and not practical, except on small units.

Typical pen sizes are $14^1/_2$ft x 8ft for 4 sows and 13ft x 12ft for 6 sows. The layout may involve a common 4ft feeding and access passage or a 4ft-access passage plus a 3ft feeding passage.

Welfare stalls perform well on units from 100 sows upwards. They are easy for producers to adjust to coming from a stall or tether system.

Option 3. Conversion from stalls/tethers to loose

This basically involves removing all tethers and baskets and reducing the number of sows in the group to comply with the minimum floor area per sow – see Table 2. Some stalls can be removed so that each sow has one feeding stall.

The size of the group will be dictated by the layout of the building. The aim should be to have groups which are multiples of the number of sows served each week.

Table 2. Conversion from stalls or tethers to loose

Current Position			*New Loose*	
No. Rows	*Sows/Row*	*Span (ft)*	*No. Sows*	*% Loss**
2	8	16’9”	11	31
2	8	15’3”	10	38
2	5	14’6”	6	40
3	5	24’	10	33

**No provision is made for access passages*

Most conversions will involve moving some stalls to create the necessary space and to provide for access. One normally finishes with about half the number of loose sows as were previously in stalls or tethers.

Conversions can take place on any size of unit provided that the floor area requirements are met and the resultant sow movements are simple.

Option 4. Dump Feeding in Small Groups

The example shown has pens designed for 6 sows. The pens are 8ft by 18ft in a 40ft wide house. The solid floor for feeding and lying is about 8ft x 8ft. Sows are fed once per day from an Asza feeder and each pen has two bite action drinkers.

It is important to match sows for size when filling each pen 4 weeks after service. This system could suit units with about 300 sows. A unit with 150 sows could use just one pen per week, which will not allow sows to be matched for size when stocking.

Option 5: Dump Feeding in Large Groups

This system is generally designed for groups of 15 to 25 sows, which would suit herds of 350 to 600 sows. More than half of floor area is solid for floor feeding. The feed is delivered once per day from a number of dispensers in each pen. Competition at feeding can be intense, leading to uneven sow condition. Facilities must be available for housing individual sows that are bullied or are in poor condition.

Limited experience of this system would lead us to be slow to recommend it.

Option 6: Electronic Sow Feeding

This system has not been popular in Ireland. It normally involves groups of over 40 sows. In this case the floor area per sow can be reduced by 10% to 21.8ft^2.

Where straw is available a lower standard of building can be used. Straw-based systems tend to be easier managed, with sows more content and fewer leg problems. In the absence of straw a high standard of insulation and ventilation control is required because of the low stocking rate. This is especially true with 2-yard systems where the stocking density can be over 44 ft^2 per sow. This system demands operating skills which are unusual on Irish pig units.

References

SI No. 48 of 2003. European Communities (Welfare of Calves and Pigs) Regulations, 2003.

Pig Welfare Requirements, 2003. Department of Agriculture and Food.

Feeding the high producing sow for maximum output

Dr Bruce Mullan, Animal Research and Development, Department of Agriculture, South Perth, Western Australia

1. Introduction

In the majority of cases the breeding sow does not achieve its potential for milk production, and hence weight and viability of piglets at weaning, nor for the number of pigs it produces in a lifetime. There will always be a need for pig producers to become more efficient, and this improvement starts with the breeding sow. The purpose of this paper is to examine the impact that the sow has on overall farm productivity and profitability, and consider from a nutritional point what we need to do to optimise performance.

2. Challenges of modern pig production

There is more pigmeat consumed in the world than any other meat and world demand for pork is likely to increase, especially with the improved standard of living in many developing countries. However, competition for these markets will be high, and the industry is driven by a need to improve efficiency, lower the cost of production and to produce a product that meets the expectations of the consumer.

While there is little pig farmers can do to influence the price that they receive for their product, there are many avenues available to reduce the cost of production and increase the volume of product produced per unit of capital invested. Perhaps the greatest challenges facing the industry are the impact of the industry on the environment, the increased attention being placed on animal welfare and the concern of society to limit the use of antimicrobial growth promoters in livestock feed. Each of these will have an impact on how we feed the high producing sow in the future.

2.1 Environmental impact

In regards to the impact of pig production on the environment, a relatively high proportion of many of the nutrients we feed our animals are not utilised and hence end up in effluent. In many cases we are still uncertain about the exact requirements of the modern genotype and hence will feed more than that often recommended to be certain of not limiting performance.

It is possible to reduce the flow of nutrients into the effluent by using ingredients of higher availability to the animal, using enzymes to improve digestibility of ingredients, supplying as close as possible to the animal's requirements or treating the effluent to remove and recycle major nutrients. However, all of this comes at a cost and the greatest opportunities exist where we can supply a nutrient that has higher bioavailability and at the same time get an improvement in performance. There are several good examples where this has been possible through the use of organic trace minerals and there is growing interest in using these as partial replacement of minerals in the inorganic form (Close, 2003).

2.2 Animal welfare

As far as pig production and animal welfare is concerned, greatest attention is focussed on the housing of sows in stalls, in particular during gestation. As a consequence, an increasing proportion of sows are now group-housed for some or all of gestation. The challenge is then to have a feeding program that allows the body condition of individual animals to be regulated. If we are unable to control body condition of sows during gestation, then this in itself becomes a welfare issue with sows that are either too light or too heavy at farrowing.

2.3 Antibiotics

The majority of the problems arising from antibiotic resistance in humans is due to the over-use of antibiotics in people and sub optimal infection control and hygiene practices that enable these bacteria to spread easily from person to person (Collignon, 2003). Antibiotic use in animals is a potential problem for human medicine because antibiotic resistant bacteria can pass through the food chain to people (JETACAR, 1999). Some consumers may also be choosing alternative products because they have been lead to believe that the pig industry routinely uses antibiotics as growth promotants.

Improving the immune status of the piglet is a priority area because of the potential for high mortalities both pre- and post-weaning, and some of these options involve what we feed the sow. Many producers are also starting to re-consider the age at which piglets are weaned, and there is a general move for the length of lactation to be increased towards four weeks in many countries.

3. What is the modern sow capable of?

Assuming a gestation length of 114 days, a period of lactation of 21 days and 5 days between weaning and mating then the sow is capable of having 2.4 litters per sow per year. We know that many of our sows are able to produce and rear 12 piglets per litter, making an output close to 29 piglets weaned/sow/year theoretically achievable. Close and Turnley (2004) have suggested a more realistic performance target of 24 to 25 piglets weaned/sow/year. However, in many commercial herds the average output per sow is much closer to 20 piglets weaned/sow/year (Smits, 2003). Perhaps of greater concern has been the apparent lack of progress that has been made over the last decade despite the conduct of high quality research and development in many countries. A large proportion of overheads is attributed to the breeding herd, hence increasing the number and viability of piglets weaned per sow has a large impact on overall herd productivity and profitability.

4. Priority areas for attention

There are a number of priority areas that must be given attention if we are to optimise output from the breeding sow. These include making certain the gilt is properly prepared prior to first mating, maximising milk production, optimising health status of the sow and litter and reducing the number of days in which the sow is non-productive. All of these are influenced by the feeding program and types of diets that we feed the sow, and ultimately by attention to detail by management.

4.1 Non-productive days

An indication that we often don't pay enough attention to these priority areas is the large number of empty or non-productive days that is typical of many commercial piggeries. Non-productive or empty days includes all the days when sows are not pregnant or lactating, and allows for a period of 7 days between weaning and re-mating. In a herd with a 21-day lactation and having 2.4 litters/sow/year, the number of empty days would be 24/sow/year (parity of 142 days; 114d gestation + 21d lactation + 7d wean-mating). Close and Turnley (2004) have calculated the cost of each empty day to be €2. Therefore, even in a very productive herd the cost of empty days would still be €48/sow/year, and that for herds producing 2.0 litters/sow/year the cost in lost revenue is more like €162/sow/year.

4.2 Culling rates

The other most noticeable area where it is clear that our management of the breeding sow is sub-optimal is in the high replacement rates of sows. Apart from wanting to improve genetic gain, there is no other reason why we would not want sows to remain in the breeding herd until they have had at least 4 litters, since this is when they are at their most productive such as in the number of piglets born alive/litter (Figure 1). A number of studies have been conducted to document the reasons why replacement rates in commercial herds may be as high as 60% and the average parity at culling as low as 3 (Smits, 2003; Stalder *et al*, 2004). The major cause of sow turnover is due to reproductive failure (46%), of which post-weaning anoestrus and a failure to conceive were primary factors (Smits, 2003).

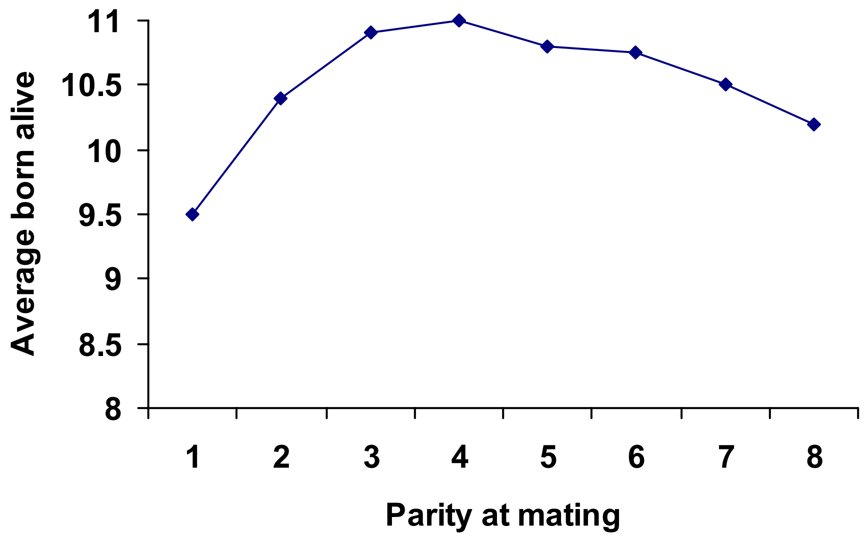


Figure 1. Average born alive for commercial sows of different parities weaned at 25 days (Smits, 2003)

5. Steps to be taken in feeding the high-producing sow

5.1 Set achievable targets

In order to make improvements to productivity it is obviously important to know what your current level of productivity and cost of production is, and to then compare these against some achievable targets. For example, it is unrealistic to have a target of 30 pigs weaned/sow/year when you are currently only producing 20. In a typical commercial piggery it is often difficult to decide what areas to give priority and just how the problem can best be corrected.

Close and Turnley (2004) describe how the Premier Pig Program^{TM} has been developed to provide independent technical information and support to the pig industry world-wide. An important aspect of this program is to encourage producers to set target objectives for performance (Table 1) and to then identify actions and solutions that can be taken on-farm to enhance performance. In this way productivity and economic efficiency can be improved. Feedback from participants would suggest that part of the cause for lack of improvement in technology is a lack of technical information in a format that is easy to adopt.

Table 1. Key targets and suggested intervention levels for sow productivity (Close and Turnley, 2004)

Parameter	Target	Intervention
Culling rate, %	35	> 42
Sow parity at culling	6 – 7	< 3, > 8
Average parity	5	< 3, > 8
Sow mortality, %	< 5	> 5
Farrowing rate, %	90	< 83
Litters/sow/year	2.4	< 2.2
Empty days/sow/year	12	> 20
Total piglets born/litter	12.0	< 11.0
Piglets born alive/litter	11.3	< 10.5
Pre-weaning mortality, %	< 10	> 13
Piglets weaned/litter	10.2	< 9.5
Piglets weaned/sow/year	24.5	< 21
Piglet weaning weight, kg (day 23)	7.0	< 6.0
Feed/sow/year, tonne	1.2	< 1.0, > 1.5

5.2 Gilt preparation

A feeding program for the breeding sow must start when we first select the gilt for breeding. Close and Turnley (2003) have suggested that the breeding gilt should be selected as early as possible (approx. 60 kg body weight) and raised on a special gilt diet to achieve the following target body criteria (Table 2). Reducing the feed intake of gilts for the 3 weeks post-mating is important to optimise embryo survival, but thereafter feeding level should be adjusted to achieve a condition score at farrowing of 3.5. In too many cases gilts are not given sufficient time to acclimatise and build up body reserves prior to having their first litter, and it is little wonder that many of these animals then fail to perform satisfactorily and are subsequently culled prematurely.

Table 2. Suggested target conditions at first mating (Close and Turnley, 2004).

Age	220-230 days of age
Body weight	130 – 140 kg
Backfat thickness (P2)	16 – 20 mm
Mating	2nd or 3rd oestrus

5.3 Diet composition

5.3.1 Energy and protein supply

Milk production in the sow is largely a factor of stage of lactation and litter size, reaching a maximum during the 3rd to 4th week of lactation and increasing linearly with litter size (Auldist and King, 1995). Heavier piglets are also able to remove more milk from the mammary glands of lactating sows (King *et al*, 1997). Allowing for maintenance and milk production, the requirement for digestible energy (DE) and amino acids, the building blocks of protein, can be calculated. For example, a sow with a body weight of 200 kg and rearing 12 piglets would require an average intake of 100 MJ DE and 60 g lysine per day during a 21-day lactation. Because the energy requirements are so high, it is thus important that the lactation diet contains at least 14 MJ DE/kg and 0.9% lysine, which would equate to an average intake of over 7 kg/day.

Many sows fail to eat sufficient to meet the demands of lactation. Fortunately they are able to mobilise their own body reserves to supply the nutrients required for milk production, rather than conserving these reserves to ensure a prompt start to the next reproductive cycle (Mullan and Williams, 1989). Williams (1995) suggests that gilts have a ceiling to milk output and, if reached, do not respond further to nutrition whereas sows show a linear response of milk output to feed intake during lactation.

In some commercial herds it is standard practice to skip-mate, especially with first-litter sows, as a way of replenishing body reserves prior to the commencement of the next reproductive cycle. While this is a very effective way to improve reproductive performance, in particular litter size, it should not be seen as a reason for not doing everything possible to maximise nutrient intake during lactation. It is also expensive from a nutritional perspective to have to replenish the sows condition during gestation as compared to minimising the loss during the previous lactation. Therefore, we must do all that we can to maximise nutrient intake of the sow during lactation, which will include feeding several times per day, ensuring feed is fresh and that there is ample water supply.

5.3.2 Role of minerals

The mineral requirements in the modern sow may well be higher than is currently recommended. For example, in an experiment in which sows which had completed three parities were compared with non-pregnant animals of similar age, those that had reared piglets had lower body mineral content (Mahan and Newton, 1995) (Figure 2). In addition, the higher the mean litter weight at weaning, the greater the loss of minerals from the body. It is therefore not surprising that a relatively high proportion of sows are culled prematurely from the herd, many due to a decline in skeletal structure. It is also not only the amount of minerals in the diet that is important, because several studies have shown the benefit to sow performance when sows are fed minerals in the organic form rather than the less expensive, but less bioavailable inorganic form.

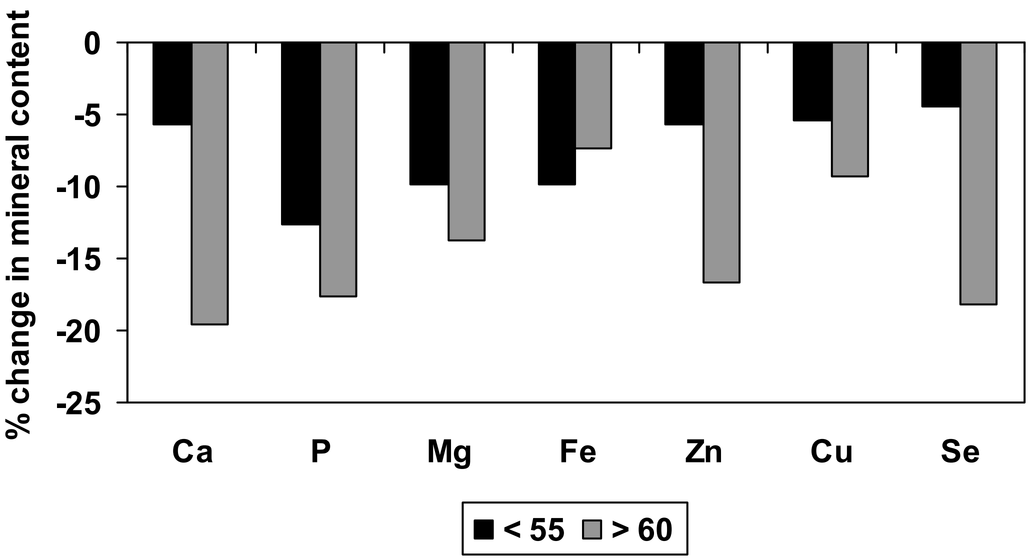


Figure 2. Change in the mineral content of sows after three parities, with litter weights of either less than 55 kg or greater than 60 kg (Mahan and Newton, 1995)

One example of how the role of trace minerals in sow nutrition is being examined relates to iron. Iron plays an important role in oxygen transport as a component of haemoglobin, and is an important constituent of several metabolic enzymes. In a number of studies conducted in different countries, summarised by Close (1999), sows were fed some 2-3 weeks before farrowing and throughout lactation a diet supplemented with organic iron (Bioplex™, Alltech Inc.). This resulted in a reduction in pre-weaning mortality and an increase in weaning weight of the piglets. There was also a reduction in the proportion of small piglets and an increase in the proportion of large piglets at weaning, which has important commercial ramifications. The blood haemoglobin and the serum iron levels were also higher in the sow and piglets at farrowing. The suggestion is that when iron was provided to the sow in the organic form it was absorbed into the blood in a form that is more readily transferred across the placenta, leading to an improvement in the iron status of the piglet at birth. The stronger piglet consumes more milk leading to an increase in food intake by the sow. While this practice does not negate the need to give piglets iron injections at birth, it has helped improve piglet performance through what we feed the sow.

Table 3. The effects of supplementing organic (Bioplex™) iron on sow and piglet performance (from Close, 1999).

Study / Country	Sow feed intake (kg/day)	Piglet weaning weight (kg)	Piglet mortality (%)	% small piglets	% heavy piglets
Ireland	4.69 → 4.84	7.86 → 8.15	-	-	-
UK (1)	-	-	11.0 → 9.5	13 → 5	55 → 65
UK (2)	-	6.47 → 7.04	-	-	-

Australia	-	6.24 → 6.51	-	21 → 6	34 → 41
Vietnam	4.76 → 4.86	4.72 → 4.93	13.0 → 8.4	-	-
Chile	(90 ppm)	5.84 → 6.06	9.6 → 5.0	24 → 17	46 → 50
	(150 ppm)	5.84 → 6.49	9.6 → 4.4	24 → 9	46 → 65
USA	4.59 → 4.66	6.22 - 6.22	23.1→13.4*	-	-

*includes stillborn piglets
Studies provided 90 mg Fe/kg from Bioplex™ Fe All piglets given iron after birth

5.3.3 Sow immunity

When it comes to optimising the health of the sow and her litter, there is no substitute for proper cleaning and resting of the farrowing crate and facilities. However, given the pressure that many herds are under to maximise output, farrowing facilities are rarely rested sufficiently, although the move to all-in all-out compared to continuous flow systems has certainly helped. There is hence interest in improving the immune status of the sow and piglet to reduce the need for antibiotics.

Funderburke (2002) conducted a study to evaluate the use of Bio-Mos, a mannan oligosaccharides product derived from the cell wall of yeast, fed during the last 3 weeks of gestation and during a 21-day lactation. Litters from sows receiving Bio-Mos were significantly heavier at birth and at weaning, and there was a reduction in pre-weaning mortality rate (Table 4). Much of the improvement in piglet performance was attributed to a significant improvement in the immunoglobulin concentration in sow colostrum. The impact on performance of such products will no doubt vary according to the disease challenge on particular farms, but their use might be a strategy that could be cost effective in some circumstances. If products such as these are to be evaluated on farm, then it is essential that they are assessed over a sufficient period of time and with variables such as cross-fostering controlled.

Table 4. Effect of Bio-Mos on sow and piglet performance in a commercial piggery in North Carolina (Funderburke, 2002)

	Control	Bio-Mos	P =
No. of sows	517	509	
No. of piglets born alive	9.96	9.78	NS
Average birth weight, kg	1.66	1.69	< 0.05
Pre-weaning mortality, %	11.27	9.09	< 0.01
No. of piglets weaned	8.84	8.89	NS
Piglet growth rate, g/d	177	195	< 0.05
Piglet weaning weight, kg	5.47	5.80	< 0.05
Wean-oestrus interval, d	7.27	5.20	< 0.05

5.3.4 Water

We often make the assumption that water is not a limiting factor, yet even when the sow is housed in an individual stall unless the flow rate of nipple drinkers is above 2 L/min then water consumption may be sub-optimal. This is especially the case in warm or hot environments and it can have a major impact on performance by reducing milk yield.

5.3.5 Ingredient quality

For the majority of producers, decisions on what ingredients are used in sow diets are made by feed manufacturers. However, since feed is by far the major cost of operating a piggery, there will always be pressure on to reduce feed costs by using cheap ingredients or by-products. Unfortunately some ingredients, and hence feed, can contain moulds or mycotoxins and the breeding herd is particular sensitive.

While there are tests for many mycotoxins, there are many others that have not been identified and for which there is no reliable test. In addition, it may be a combination of mycotoxins that has a combined impact. Fortunately there are binders that can be added to pig feeds to reduce absorption of mycotoxins by the animal, but there is a large range in specificity and effectiveness and it is important to compare various options before making a decision.

5.4 Feeding strategy

The requirements of the sow vary depending upon the stage of the reproductive cycle, hence it is important that feeding level and diet is adjusted accordingly. Close (personal communication) has suggested the following feeding program for gilts (Figure 3). The actual feeding levels will depend on the energy content of the diet, but the important aspects are that feeding level is increased in the two weeks pre-mating to stimulate ovulation rate, reduced immediately after mating to enhance embryo survival, increased in the last trimester of gestation when most foetal growth occurs, and then increased gradually but to as high a level as possible during lactation.

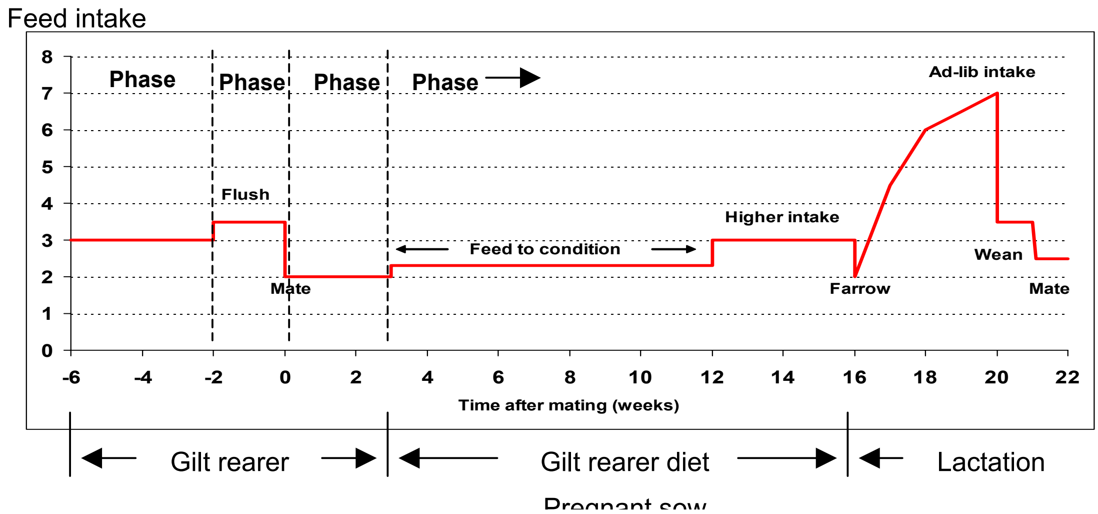


Figure 3. Feeding program for gilts (Close, personal communication)

5.5 Housing and environment

The nutrient requirements of the modern sow will be influenced by housing system and environment. For example, there has been interest in providing very low energy diets to sows during gestation, sufficiently low that the sows can be fed *ad libitum* without gaining excessive body weight during gestation. If this was successful then sows could be fed from a self-feeder throughout gestation, thus reducing the need for individual feeding stalls and reduce the behavioural problems associated with restrict feeding. Whittaker *et al* (2000) used sugar beet pulp as a diluent in the gestation diet, and while sows fed the low energy diet *ad libitum* gained more weight during gestation, they subsequently lost more during lactation. There was no significant impact on sow performance, but the authors considered that the average intake of 4.1 kg/d for sows fed *ad libitum* during gestation was too high to make this commercially viable.

The other major factor that influences the nutrient requirements of the lactating sow is ambient temperature. The ideal temperature for lactating sows is approximately 20ºC, whereas that for piglets is closer to 30 ºC. Numerous studies have been conducted to examine the response of the sow to high ambient temperatures, and the primary response is a decline in feed intake during lactation, an increase in the loss of body reserves as the sow attempts to maintain milk production, and eventually a reduction in piglet growth rates (e.g. Black *et al*, 1993).

5.6 Supplementary feeding of the litter

A growth rate of between 180 and 240 g/d is fairly typical for piglets feeding from the sow, but this is far less than their potential for growth. When piglets were removed from the sow and fed cow's milk *ad libitum*, Hodge (1974) recorded growth rates of 576 g/d from 10 to 30 days of age. As this is not commercially viable, there has been a lot of interest in feeding piglets supplementary feed prior to weaning to gain at least some of this growth potential.

Most commercial herds would supplement milk production by providing piglets at 10 to 14 days of age with a creep or starter diet based on highly digestible cereals and various sources of animal and plant proteins. It is assumed that piglets that consume more dry feed during lactation will be heavier at weaning and be better able to cope with the changes to diet at weaning. Pluske *et al* (1995) have reviewed the results of 10 different experiments and calculated that the contribution of creep to daily energy intake was extremely variable, ranging between 1 and 17%. The intake of creep food ranged between 3 and 77 g/d. Furthermore, growth rate in the immediate period following weaning is often poorly related to pre-weaning creep food intake (Fraser *et al*, 1994). Nevertheless, providing creep feed to piglets is still generally recommended, especially given the move to increasing the length of lactation to 4 weeks and the relatively small contribution to total feed costs for a farrow-to-finish piggery.

Supplementing piglets with liquid diets has been shown to give benefits to the growth of piglets pre- and post-weaning. For example, Dunshea *et al* (1997) fed piglets liquid milk replacer both prior to weaning and in the first week after weaning. Pigs that received milk before and after weaning were 10% heavier at 120 days of age compared to those that suckled the sow and were weaned onto dry starter feed. Even when supplementary milk is available *ad libitum* to the piglet pre-weaning, piglets still remove a similar amount of milk from the sow and Williams (1995) suggested that the cues that arise from sow-piglet interaction still override the potential nutritional response. While providing piglets with supplementary liquid diets will increase weight at weaning and possibly lead to improved performance thereafter, it is a difficult practice to implement on a commercial scale and so is rarely done.

5.7 Optimise output from the boar

While this paper is concerned with management of the breeding sow, we must also consider what can be done to improve the performance of the breeding boar. From a nutritional viewpoint, a number of studies have been done in recent years to look at the role of a range of feed additives in optimising semen quality. For example, Marin-Guzman *et al* (1997) evaluated the effects of dietary selenium and vitamin E on semen quality and its subsequent fertilization rate in mature gilts. Boars fed low selenium diets produced a higher percentage of abnormal sperm. There is also interest in feeding boars diets supplemented with a range of other trace minerals, vitamins and oils.

5.8 Management

One of the biggest constraints to efficient pig production in many countries is a lack of skilled and dedicated staff. It is often difficult to attract and retain young people, partly because the industry has a poor image and there are better career opportunities elsewhere. The lack of a well-trained and committed workforce can have a major bearing on whether a unit will reach its potential.

Studies by Flowers (1992) (Tables 5 and 6) demonstrates the influence of staff on farrowing rate, number of pigs born alive and on total pigs born. The difference in total pigs born alive between the best and worst staff member when using natural matings was approximately 500 pigs or 26%, whereas when artificial insemination was used then the difference was even greater (1,000 pigs or 55%). In another study, staff supervised the mating of 40 sows in one continuous work session. While the average farrowing rate for the first 20 sows mated was 85%, this declined to 73% for the second 20 sows mated demonstrating the effect of fatigue over a long period.

Some staff are clearly better than others at managing the breeding herd. This may be because they are more experienced, are more dedicated to their role and/or are better trained.

Table 5. Influence of staff who supervise natural matings on farrowing rate and litter size (Flowers, 1992)

Staff	Farrowing rate (%)	No. born alive	Total pigs
1	87.6	11.0	2400
2	84.7	11.3	2325
3	83.0	10.8	2210
4	78.6	10.3	2000
5	81.2	9.6	1950
6	79.1	9.6	1899

Table 6. Influence of staff who artificially inseminate sows on farrowing rate and litter size (Flowers, 1992)

Staff	Farrowing rate (%)	No. born alive	Total pigs
1	91.3	11.5	2413
2	89.6	11.4	2346
3	86.1	11.7	2310
4	84.6	11.2	2153
5	80.0	10.2	1870
6	75.1	8.0	1377

6.0 Summary

The modern sow has enormous potential for milk production and producing piglets. However, for this to happen we need to closely examine diet composition, how we are feeding the sow and the conditions in which the sow and progeny are housed. Finally, and probably most importantly, our capacity to achieve target levels of production relies on management and staff implementing work practices and new technologies.

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Keeping piglets in large litters alive

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Introduction

The pig industry has put a lot of effort into increasing litter size. However, more than 1 pig out of each litter born alive still dies before weaning. This figure is even higher when you consider that, on some units, a large proportion of pigs recorded as born dead were alive at farrowing. Perhaps we should concentrate more on keeping live born pigs alive and less on increasing litter size, which is often associated with an increased incidence of light, low viability pigs.

This paper looks at industry statistics and individual on farm factors related to pre-weaning mortality. It looks at how pre-weaning mortality is related to litter size, gives recommendations on how to increase piglet viability and describes how large litters should be managed so as to minimise piglet mortality.

What the industry statistics say

The trend in average litter size and pre-weaning mortality over the last 10 years is shown in Table 1. It can be seen that total born has increased by 0.3 of a pig. Number born alive per litter was increased by 0.2 of a pig over this period. Not a huge increase! In the same period pre-weaning mortality increased by 0.5%.

Table 1. Trend in litter size and pre-weaning mortality for the national herd

	‘94	‘95	‘96	‘97	‘98	‘99	‘00	‘01	‘02	‘03
No. born alive per litter	10.8	10.8	10.8	10.9	10.8	10.9	10.9	10.8	11.0	11.0
No. born dead per litter	0.70	0.75	0.74	0.76	0.74	0.76	0.76	0.75	0.76	0.78
Pre-weaning mortality (%)	8.9	9.1	8.8	8.8	8.6	8.7	9.0	9.1	9.0	9.4

In 2003 average pre-weaning mortality in Ireland was 9.4%. The top 25% of producers recorded a pre-weaning mortality of 7%, while pre-weaning mortality for the bottom 25% of producers was recorded at 12.4% (Martin, 2004).

Table 2 demonstrates the savings that can be achieved per 100 sows by reducing pre-weaning mortality to levels currently being achieved by the top 25% of producers. This should be the target for every serious producer. Industry average figures take into account “the good, the bad and the ugly” and as such should never be used as a target by a serious progressive producer.

Table 2. Cost per 100 sows as mortality levels increase (€/100 sows)

	Top 25%	*Average*	*Bottom 25%*
No. born per 100 sows	2500	2500	2500
Pre-weaning mortality (%)[1]	7.0	9.4	12.4
No. pre-weaning deaths	175	235	310
Cost of dead pig (€)[2]	45	45	45
Loss associated with dead pigs (€)	€7,875	€10,575	€13,950
Difference[3]	€2,700		
Difference[4]	€6,075		

1, Martin (2004)

2, Calculated by subtracting predicted cost of feed to slaughter (€48) from the predicted sale price of the pig (€93).

3, Comparison between Top 25% and Average.

4, Comparison between Top 25% and Bottom 25%

Looking deeper at individual farm data

From the National Industry statistics (Martin, 2004) we know the average pre-weaning mortality figures. We also know that large differences in pre-weaning mortality exist between individual farms and that we need to set our targets at the best levels being achieved by our peers (Top 25% of producers).

This information is useless unless producers have their own records and as importantly that they use this information to make management decisions. For the purpose of this paper Pig Champ data was taken and summarised for the past 5 years from a 2000 sow herd (Appendix 1). What does this data say?

1. Average pre-weaning mortality was 8.9% over 5 years but has increased to 9.4% in the past year.
2. 55% of this mortality occurs in the first 48 hours after birth.
3. The main recorded reasons for pre-weaning mortality were Runt/unviable (47%) and Injury/Trauma (43%).
4. Pre-weaning mortality was highest for parity 2 sows and sows on their 7th or greater parity. Injury/Trauma as a cause of death increased markedly for sows on their 7th or greater parity.
5. Pre-weaning mortality was positively correlated with litter size.

Examining the records from any farm would probably reveal very similar findings to those in appendix 1. However, the recorded cause of death relies on subjective appraisal and it is often only the terminal factor that is recorded. There may have been one or more predisposing influences leading up to death. Overlying, pig size and starvation are usually the principle causes (Varley, 1995). Appendix 1 shows that 90% of pre-weaning mortality on our 2000 sow herd was recorded under these labels. Table 3 indicates that large variations exist between farms /surveys, in the proportions of specific causes of death.

Table 3. Causes of death in pre-weaned pigs (after Varley, 1995)

	% of total pre-weaning mortality					
Reference	Overlying, Savaged	Small, weak, malnourished	Infection	Genetic abnormality	No Cause	Other
Fahmy and Bernard (1971)	19	27	18	14	16	6
Spicer *et al.* (1986)	32	9	27	5	3	24
Dyck and Swierstra (1987)	39	42	1	1	17	0
Prime *et al.* (1987)	45	14	7	-	-	-

Problems with large litters

As might be expected, Appendix 1 reveals that pre-weaning mortality is highest in sows that have a high litter size. This increase in mortality is largely attributed to increased within litter variation in piglet birth weight (Marchant *et al.,* 2000). As a consequence, some piglets out-compete their littermates causing them to starve or become crushed (Lay *et al.,* 2001).

As litter size increases there is also an increase in the length of the parturition process. Piglets are more likely to be subjected to a state of hypoxia (lack of oxygen). This is associated with an increased incidence of stillbirths. Even live born pigs may have a reduced viability as a consequence. Such pigs are more likely to starve, be crushed or become diseased (Lay *et al.,* 2001).

Management interventions

The following is a list of management interventions that may prove worthwhile in reducing the level of mortality from large litters.

1. Increase size / viability of pigs

Large litters have a high proportion of light pigs. Piglets weighing <800g at birth have only a 32% survival rate compared with 97% for piglets weighing 2kg or more (Gardner et al., 1989). Wolter et al. (2002) found that pre-weaning mortality increased from 5.2% to 9.4% for pigs that weighed 1.33kg and 1.83 kg, respectively at birth. Any means that can increase piglet birth weight is likely to increase piglet survivability.

Table 4. Relationship between birth weight and survival (Speer, 1970)

Weight range (kg)	Weight distribution of population (%)	Survival (%)
<0.9	6	42
0.9-1.1	13	68
1.1-1.3	24	75
1.4-1.5	28	82
1.6-1.8	19	86
>1.8	10	88

1.1. Breeding

Number born alive and piglet birth weight can vary greatly between breeds. Pig size at birth can vary with breed. Meishan sows have large litters of lightweight pigs. However these pigs are very vigorous. The fat content in the colostrum of the Meishan sow is higher than of the European breeds and that can provide her piglets with the energy needed to maintain body temperature (Le Dividich et al., 1991)

1.2. Parity

Litter size is usually smallest on gilt litters and rises to a maximum between the third and fifth litter and then remains constant or declines slightly with older parities. The incidence of stillbirths is usually highest in the fifth or greater parities. Average herd parity should be between 2.5 and 3.0, with over 45% of sows in parities 3 to 6 being the optimum for overall productivity (Aherne, 2002)

1.3. Gestation feeding

In late gestation the demands on the developing litter for energy and nutrients increase dramatically. Sixty per cent of foetal growth occurs in the last 30 days of gestation (Noblet *et al.,* 1990). Cromwell et al (1989) increased sow feed intake by 1.36 kg per day between day 90 of gestation and farrowing. This increased average born alive by 3%, pigs weaned per litter by 3% and pig birth weight by 3%.

Aherne (1997) and Young (2003) recommended feeding an extra kg per day from day 100 of gestation until farrowing. Tokach, *et al*. (1999) recommended feeding 1 to 2kg extra feed per day in this critical period. This extra feed has been shown to prevent backfat loss in late gestation and it does not effect sow feed intake during lactation.

2. Farrowing crate

The farrowing crate has been a major success when it comes to reducing pre-weaning deaths due to crushing (one of the main causes of pre-weaning mortality) (Lay et al. 2001).

3. Supervised Farrowings

3.1. Over-supervision

Supervision of farrowings can help greatly to lower pre-weaning mortality. However excessive disturbance by the stock person can stress the sow thus prolonging the farrowing process. This prolonged farrowing can increase pre-weaning mortality. It doubles for litters whose farrowing process takes more than 6 hours (Lay et al., 2001).

3.2. Induction

Induction of sows can be a very useful technology in that it allows all farrowings to be supervised. It gives the opportunity to carry out earlier fosterings and it reduces weekend work. However, records must be perfect if it is to be carried out or else an increased incidence of abortions will occur. It also results in reduced birth weight piglets and colostrum quality is likely to be compromised as a result of its use (Teagasc, 2003). Both of these consequences are of particular concern where piglet weight is small/variable (ie. with large litters).

Sows can be induced to farrow by injecting with a prostaglandin analogue. Injected sows usually farrow about 27 hours after injection. Induce on Thursday morning of day 114 or later to farrow on Friday. This procedure is best restricted to overdue sows since litters induced to farrow prematurely usually have reduced viability. Inducing overdue sows facilitates fostering of piglets.

3.3. Thermoregulation

Temperature regulation in the farrowing house is a play off between the sow and the piglets' temperature requirement; too high a temperature and the sows' intake drops and too low a temperature and the piglet suffer from hypothermia. It is important to remember that birth for the piglet results in a rapid 15-20^{0}C drop in temperature between the uterine environment and the ambient temperature of the farrowing house.

The low birth weight pig is at particular risk of hypothermia, with a greater body surface to volume ratio and reduced energy stores (English and Morrison, 1984). Furthermore, newly born pigs do not increase (unlike older pigs) but rather decrease their intake of colostrum during cold exposure, exacerbating the likelihood of starvation (Le Dividich and Noblet, 1981).

The general recommendation is to turn on the heating in advance of farrowing so that piglets are born into a warm, dry, draught-free pen. An infra-red lamp and/or shredded paper should be positioned at the rear of the farrowing pen and the slatted area under the lamp should be covered with a paper bag or mat to prevent draughts from below. The house temperature should be increased to 24°C before the first piglet is born.

3.3. Supervision of the farrowing process

Pre-weaning mortality can be greatly reduced (18% improvement) and stillbirths halved due to good supervision and timely intervention around farrowing (English, 1993). This is particularly important when litter size is high as farrowing duration is usually longer and there is a greater number of small pigs.

If the interval between piglets being born exceeds 30 minutes the sow should be checked and handled, if necessary. The sow should complete farrowing within 5 hours. A suitable lubricant gel, but not soap, should be used to cover the hand and arm when handling the sows or wear an arm length disposable plastic glove.

The farrowing process may be accelerated, especially in older sows, by injecting the sow in the vulva with Oxytocin. However the sow should first be checked so that there are no blockages. Individual doses should not exceed 5 i.u. (0.5 ml). The injection may be repeated after 30 minutes provided piglets are being born.

Newborn piglets with low viability should be assisted immediately to suckle the sow to ensure that they receive colostrum and/or be given an energy booster by oral doser

4. Post-farrowing supervision

Pigs must get their allocation of colostrum as early in life as possible. Colostrum is an excellent energy source for the newborn pig. However the newborn pig also depends on early transfer of maternal antibodies from colostrum for immune protection. Colostral IgG levels drop by 50% within 6 hours of the first suckling (Lay et al., 2002).

4.1. Cross Fostering

Cross fostering has been shown to reduce pre-weaning mortality by 40% (English *et al.,* 1982). However cross fostering should be carried out as soon as possible after birth, because continuous cross-fosterings later in the suckling period can decrease overall growth (Straw *et al.,* 1998). Small herds don't have the same opportunities to cross foster as larger herds, however moving to batch farrowing may prove advantageous in this regard.

Standardise litter size within the first 24 hours when two or more sows farrow together, by transferring piglets between sows, ensuring that the piglets on each sow are of similar weight. Piglets which do not have a settled teat are the most obvious candidates for fostering. Smaller piglets where possible should be fostered on to gilts or on to sows with long slender teats. All piglets must get colostrum immediately or, at latest, within 6 – 12 hours of being born.

Ensure that the number of piglets on a sow does not exceed her rearing capacity i.e. the number of exposed functional teats when suckling. Limit the number of piglets suckling first litter sows to 10 where possible.

4.2. Where fostering is not an option

Cross fostering may not be an option in some cases (e.g. on small herds or with large litters born on the weekend). In such instances few litters are born at the same time making it impossible to cross foster. The following options are available

- Split suckling – This involves enclosing the heavier pigs in the creep area, injecting the sow with 5iu of oxytocin and assisting the smaller pigs to suckle. This ensures that all pigs in a large litter get adequate colostrum.
- Piglets can be given sow colostrum or colostrum replacer by oral dosing or stomach tube 3 – 4 times daily until there is a possibility to foster.
- Forward fostering – After all piglets have had their ration of colostrum forward fostering could be practised. Forward fostering is where the largest piglets in the litter are fostered onto a docile good milking sow which has farrowed one week previously. In turn the one-week-old piglets from this sow can be fostered onto a docile good milking sow weaned at the normal stage.
- Supplemental milk – Large litters left suckling the sow should be supplemented with a suitable milk replacer. It is essential that each piglet has received colostrum before this practice starts. Pigs should be fed on a little and often basis and strict hygiene is essential to prevent milk going off to reduce the incidence of enteric infection.

4.3. Minimise crushing

Regardless of temperature or heat sources within the pen (infra-red lamps, heat pads etc.) piglets prefer to huddle close to the sow and littermates during the first 3 days of life (Hrupka *et al.,* 1998). For this reason, it is advisable, over this critical period to enclose the litter in the creep area each time before feeding the sow. When the sow has been fed, and within 1 hour of locking them in, the litter must be released (Teagasc, 2004).

5. Sows' milking ability

Adequate and prompt intake of colostrum is crucial for the survival of the newly born piglet as its energy reserves at birth are low (half that of lambs and calves) (Lay *et al.,* 2001). This can particularly be a problem with large litters where colostrum demand may exceed its supply. In addition herds with high born alive figures will need increased milk supply during lactation to ensure that as many as possible survive.

5.1. Gestation feeding

The importance of gestation feeding cannot be over emphasised. Having sows "fit but not fat" at farrowing is not only critical for lactation feed intake and subsequent return to oestrus but also to ensure the adequate milking ability of the sows mammary gland. Gilts with a back fat depth of 36mm at farrowing had a 60% lower milk yield than gilts with a back fat depth of 25mm (Pluske et al., 1995).

Adding fat to the sows' diet in late gestation and during lactation can increase the milk yield and fat content in colostrum. This will increase the survival (+17%) of low birth weight pigs (<1kg) much more than larger littermates (Pettigrew, 1981). Feeding medium chained triglycerides in the sows' diet is particularly beneficial in increasing the survival of pigs weighing <900g at birth.

5.2. Lactation feeing

Sow feed intake during lactation is widely known to influence milk yield and associated nutritional status of suckling pigs as well as re-breeding performance (Lay et al., 2001). For this reason promoting high sow feed intake must be a major priority in the farrowing house. Some practical tips that will increase sow feed intake in lactation include:

- Environmental temperature should be kept as low as possible to promote sow feed intake. Reduce the farrowing house temperature to 20°C when the youngest piglets are over 2 days old. This is likely to provide a suitable compromise between the high temperature requirements of the piglets and the low temperature requirements of the sow. Warmer farrowing houses will result in reduced sow feed intakes (Teagasc, 2004). .

- Wet fed sows will eat more than dry fed sows
- If feeding dry then pelleted feed will give higher intakes than meal.
- Use a high energy lactation sow feed.
- Feed sows 3 times daily and get sows up to feed.
- Ensure that an adequate supply of clean water is available (nipple drinker plus leaver valve or hose)
- An effective health control programme should prevent disease stressors that can contribute to depressed feed intake.

6. Genetics

There are indications that through decades of breeding we have unwittingly selected poor mothering characteristics in sows that contribute to crushing (Lay et al., 2001). Because farrowing crates were so successful selection pressure was put on characteristics like litter size and growth rate at the expense of the maternal traits. This should be reversed and in future breeding programmes, maternal traits and mothering ability should be selected for.

A positive effect of heterosis on piglet survival is known to exist even though it also increases litter size. An improvement of 5 to 6% in survival is found in crossbred compared with pure bred piglets (Blasco *et al.,* 1995)

7. Selection/culling

The basic selection criteria for gilts are that they are a good weight for age, have good sound legs and have a minimum of 14 functional, evenly spaced teats (English et al., 1982). This should minimise overlying and ensure that there is sufficient teat access for large litters.

Sows that cannot rear 10 pigs or have a history of overlying should be marked for culling.

Summary

The bulk of pre-weaning piglet deaths occur in the first 48 hours after birth. Therefore close supervision and providing optimum environmental conditions at this time can be very rewarding. Birth weight has a major influence on piglet survival and this can be maximised by optimising parity profile and increasing feed levels to sows in late gestation. Overlying and crushing are major contributors to pre-weaning mortality. Closing piglets into the creep area for an hour each time the sow is fed in the first 2 days of life can help. Where the rearing capacity of the sow cannot cope with excessively large litters cross fostering where possible should be carried out. Quality colostrum and a high sows' milk yield are essential for piglet survival. Sow feeding during gestation and in lactation can influence the yield and quality of sows' milk.

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Appendix 1

Table 1. Trend in littersize and pre-weaning mortality (5 years data from a 2000 sow herd)

	’99-‘00	’00-‘01	’01–‘02	’02–‘03	’03–‘04	**’99–‘04**
No. born alive per litter	11.0	11.3	11.5	11.5	11.2	**11.3**
No. born dead per litter	1.2	1.1	1.1	1.1	1.2	**1.1**
Pre-weaning mortality (%)	9.2	8.4	8.9	9.0	9.4	**8.9**

Table 2. Timing and recorded cause of pre-weaning mortality (% of deaths) on a 2000 sow herd (5 years data).

Cause	Time post-partum (days)				
	0-2	3-6	7-14	15+	Total
Runt/ Unviable (%)	39	61	50	55	47
Injury/Trauma (%)	53	26	36	33	43
Congenital (%)	4	6	0	1	4
Scour (%)	0	5	8	2	3
Other disease (%)	1	0	5	7	2
Other (%)	4	2	1	2	1
Total recorded deaths (%)	55	21	16	8	100

Table 3. Percent of pig deaths by parity (5 years data from a 2000 sow herd)

	1	2	3-6	7+	Total
% of farrowings	20.7	19.2	51.4	8.7	100
Pre-weaning mortality	9.0	9.8	8.4	9.7	8.9
Cause					
Runt/ Unviable (%)	53	52	43	27	47
Injury/trauma (%)	36	39	48	62	43
Congenital (%)	3	4	4	5	4
Scour (%)	4	2	2	2	3
Other disease (%)	3	2	2	3	2
Other (%)	1	1	1	1	1
Total	30	21	44	5	100

Table 4. Break down of mortality (% of total deaths) by Total Born (5 years data from a 2000 sow herd)

Total Born	<8	9	10	11	12	13	14	>15
% of Total Deaths	8.2	4.9	7.6	10.5	12.6	14.2	13.5	28.7

Response of growing-finishing pigs to lysine in the diet

Karen O'Connell, Teagasc, Moorepark

Introduction

In order to grow, pigs need a combination of protein for maintenance and muscle growth, and energy to break down the consumed protein to its constituent parts (amino acids) that are used for these functions. The amount of protein and energy required by the pig changes as the pig matures because the relative amounts used for maintenance and growth are altered.

Pigs generally eat to meet their energy requirement. However, if the protein content of the diet is low, they will increase consumption in order to consume the protein that they require. This in turn leads to an increase in energy consumption, which results in fatter pigs with poorer feed conversion ratios and poorer carcass grading. Therefore, getting the balance right between the energy and protein content of the diet in order to optimise pig growth and feed efficiency is very important.

The protein deposition rate of growing pigs increases rapidly initially and then declines to zero at maturity. Oversupplying protein to the pigs can disimprove feed conversion ratio because the excess protein has to be deaminated (at an energy cost to the pig) and excreted, increasing nitrogen output. The ratio between protein (amino acids) and energy should be continually adjusted according to stage of growth, so that the diet matches as closely as possible the pigs' changing requirements. It is not always practical to continuously adjust this ratio, but it is useful to know the pigs' requirements at different stages of growth.

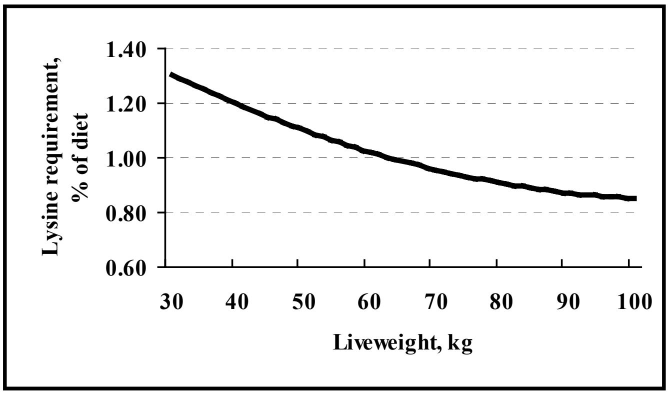


Figure 1. Predicted lysine requirement of pigs from 30-100 kg (adapted from Gill 1998)

Protein for pigs may be described in terms of 'ideal protein'. This is simply protein that has the correct balance of amino acids that are required by the pig. In barley, wheat and soyabean meal based pig diets, lysine is generally the 'first limiting' amino acid. This means that, if lysine is deficient, regardless of the content of the other amino acids, the growth of the pigs will be determined by the content of lysine. This paper summarises the results from a series of trials conducted to determine the optimum digestible lysine to digestible energy ratio in the diet of pigs at various stages of growth.

Trial work

A series of trials were carried out in Moorepark with pigs at different stages of growth. Seventy-two pairs of pigs were studied from 40-60 kg (grower pigs), 90 pairs from 60-90 kg (early finishers) and 72 pairs from 80-100 kg (late finishers). The general format of the trials was that pairs were divided into groups of six, and one of six diets was fed to each pair within those groups (or blocks), for four weeks, or until slaughter at either 90 or 100 kg. All diets were composed of barley, wheat and soyabean meal, with added vitamins, minerals and synthetic amino acids, where required. All diets had similar energy content (13.8 MJ/kg) but differed in protein and amino acid content. Digestible lysine was kept at between 5.0-5.5 % of the protein content, and the ratio of methionine, methionine plus cystine, threonine and tryptophan to lysine were maintained at 0.33, 0.60, 0.67 and 0.20 for all diets. This ensured that the diets differed only in protein (lysine) to energy ratio. The crude protein and lysine content, and the digestible lysine to digestible energy ratios of each diet during each stage are presented in Table 1.

Table 1. Specification of the diets

Weight range	Diet number					
40-60 kg	1	2	3	4	5	6
Crude protein g/kg	149	163	182	204	208	230
Total lysine g/kg	8.3	9.1	10.1	11.1	12.0	13.4
Dig. lysine g/kg	7.0	7.7	8.6	9.4	10.2	11.5
Dig. lys: DE g/MJ	0.51	0.56	0.62	0.68	0.74	0.83
60-90 kg						
Crude protein g/kg	141	153	168	183	199	214
Total lysine g/kg	7.4	8.5	9.4	10.4	11.2	12.4
Dig. lysine g/kg	6.3	7.2	8.0	8.8	9.5	10.5
Dig. lys: DE g/MJ	0.46	0.52	0.58	0.64	0.69	0.76
80-100 kg						
Crude protein g/kg	122	135	151	162	183	198
Total lysine g/kg	6.6	7.4	8.2	9.1	10.3	11.1
Dig. lysine g/kg	5.7	6.3	7.0	7.7	8.8	9.4
Dig. lys: DE g/MJ	0.41	0.46	0.51	0.56	0.64	0.68

Digestible energy content was 13.8 MJ per kg for all diets

Results

Weight range: 40 to 60 kg

Table 2 shows the performance results from pigs from 40 to 60 kg. Growth rate of pigs reached 968 g/d at a lysine content of 12.0 g/kg (1.2% lysine) and feed conversion ratio improved with each increase in lysine in the diet. There was no difference between male and female pigs in growth rate, feed intake or feed conversion ratio regardless of the lysine level fed during the 40-60 kg growth stage. This indicates that in this weight range the requirement for lysine of the pigs was not affected by sex and was between 12.0 and 13.4 g/kg.

Table 2. Performance of pigs from 40-60 kg

	Total Lysine, g/kg					
	8.3	**9.1**	**10.1**	**11.1**	**12.0**	**13.4**
Daily gain g/d	902	939	917	938	***968***	947
Daily feed intake, g/d	2026	1966	1918	1897	1964	1900
Feed conversion ratio kg/kg	2.25	2.10	2.10	2.04	2.04	***2.01***

Weight range: 60 to 90 kg

Table 3 shows the performance and some carcass results for pigs from 60 to 90 kg. Growth rate of pigs was affected by the lysine content of the diet. Growth rate was lowest for pigs fed the diet containing 7.4 g lysine per kg and highest for those fed the diet containing 10.4 g of lysine per kg. Feed intakes were relatively similar for all pigs and feed conversion ratio was poorest for pigs fed the 7.4 g of lysine per kg diet and best for those fed 11.2 g/kg.

Diet had no effect on kill-out proportion, muscle depth or carcass lean content of pigs. However, pigs fed the 8.5 g/kg diet had the most fat and those fed the 11.2 g/kg diet had the least fat. Carcass growth rate was highest at 10.4 g/kg and carcass feed conversion ratio was best at 11.2 g/kg. These results indicate that a lysine content of 10.4 to 11.2 g/MJ optimised pig performance between 60 and 90 kg.

Table 3. Performance and carcass characteristics of pigs from 60-90 kg

	Total Lysine, g/kg					
	7.4	**8.5**	**9.4**	**10.4**	**11.2**	**12.4**
Daily gain g/d	851	915	932	***977***	939	955
Daily feed intake, g/d	2351	2416	2346	2422	2288	2417
Feed conversion ratio kg/kg	2.78	2.67	2.54	2.51	***2.46***	2.55
Carcass						
Lean content g/kg	592	591	592	595	598	593
Daily carcass gain g/d	729	810	793	***832***	764	821
Carcass feed conversion ratio kg/kg	3.17	2.99	2.92	2.91	***2.90***	2.95

The figures below show the effect of diet on the carcass growth rate and carcass feed conversion ratio of male and female pigs. Both sexes responded similarly to lysine in terms of carcass growth rate, although males showed higher growth rates regardless of diet. The improvement in carcass feed conversion ratio with the increase in lysine declines at a lower lysine content for females compared to males. This indicates that male pigs have a positive response and female pigs a negative response to higher lysine in the diet, offering an advantage in feeding separate diets to male and female pigs during this growth period. Entire males have a higher capacity for growth than females and they achieve this growth more efficiently than females at higher lysine to energy ratios. Supplying male and female pigs with the same diet at this stage of growth can affect overall pig unit performance. Either the lysine content would be too low for males, who would not achieve their potential growth rates, or be too high for females, leading to a depression in growth rate. In both scenarios, feed conversion ratios would be adversely affected.

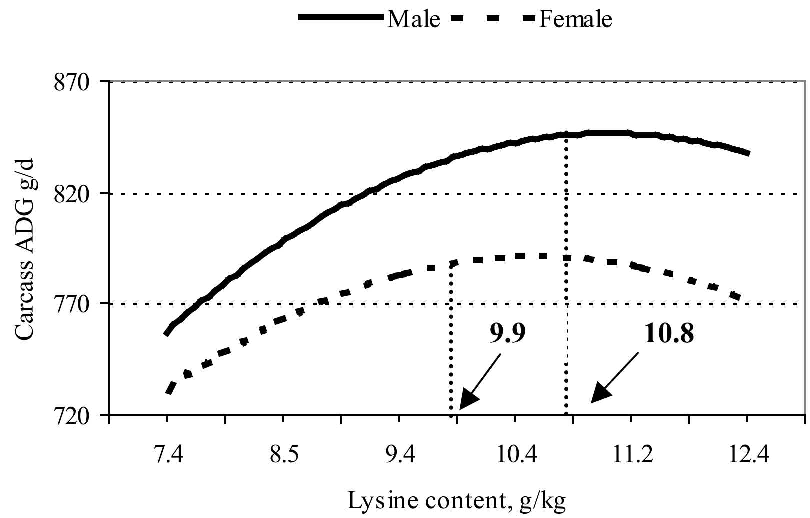


Figure 2. Graph of carcass average daily gain of male and female pigs from 60-90 kg.

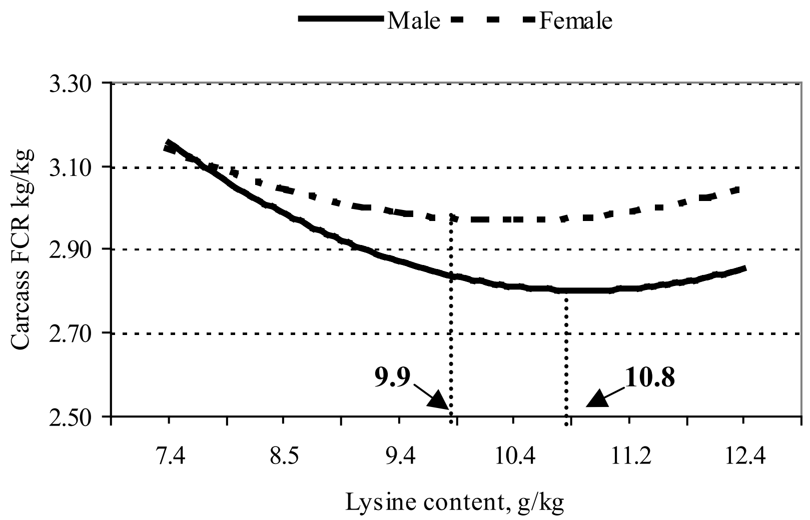


Figure 3. Graph of carcass feed conversion ratio of male and female pigs from 60-90 kg

Weight range: 80 to 100 kg

Table 4 shows the performance and some carcass results for pigs from 80 to 100 kg. The highest daily gain and best feed conversion ratio were achieved by pigs consuming the diet with 8.2 g of lysine per kg, while those consuming the diet containing 6.6 g/kg had the lowest growth rate and the poorest feed conversion ratio.

Pigs eating the diet containing 10.3 g of lysine per kg had the leanest carcasses, with the least fat. Pigs eating the 6.6 g/kg diet had the poorest carcass lean content and were fattest. Kill-out proportion was similar across diets. Carcass growth rate and carcass feed conversion ratio were best for pigs on the 8.2 g/kg diet and poorest for those on the 6.6 g/kg diet. These figures indicate that 8.2 g lysine/kg results in the best overall pigs performance during this stage.

Table 4. Performance and carcass characteristics of pigs from 80-100 kg

	Total Lysine, g/kg					
	6.6	**7.4**	**8.2**	**9.1**	**10.3**	**11.1**
Daily gain g/d	816	919	***975***	873	918	952
Daily feed intake, g/d	2476	2415	2562	2382	2482	2562
Feed conversion ratio kg/kg	3.09	2.77	***2.64***	2.76	2.74	2.72
Carcass						
Lean content g/kg	586	592	597	599	600	596
Daily carcass gain g/d	739	751	***822***	745	790	791
Carcass feed conversion ratio kg/kg	3.46	3.22	***3.12***	3.27	3.17	3.26

The figures below indicate the effect of diet on the carcass daily growth rate and feed conversion ratio of male and female pigs between 80-100 kg. Figure 4 indicates that the carcass growth rate of male pigs increased with each increase in lysine content. Because the line does not show a downward curve, it is impossible to say if maximum carcass growth rate was achieved at the highest lysine level used here. The highest carcass growth rate of male pigs was observed at 11.1 g of lysine per kg. The carcass growth rate of the female pigs shows a clear increase up to about 8.7 g/kg and declines thereafter. This graph indicates that the optimum lysine content in the diet for maximising carcass growth rate in female pigs from 80-100 kg is at 8.7 g/kg.

There is an interaction between sex of pigs and diet in carcass feed conversion ratio as seen in Figure 5. The carcass feed conversion ratio seems to be at the lowest for female pigs up to around 7.9 g/kg and increases thereafter, indicating that when fed to female pigs the higher lysine contents are inefficient. The carcass feed conversion ratio of male pigs shows a progressive improvement with a lysine content up to about 9.5 g/kg and disimproved thereafter.

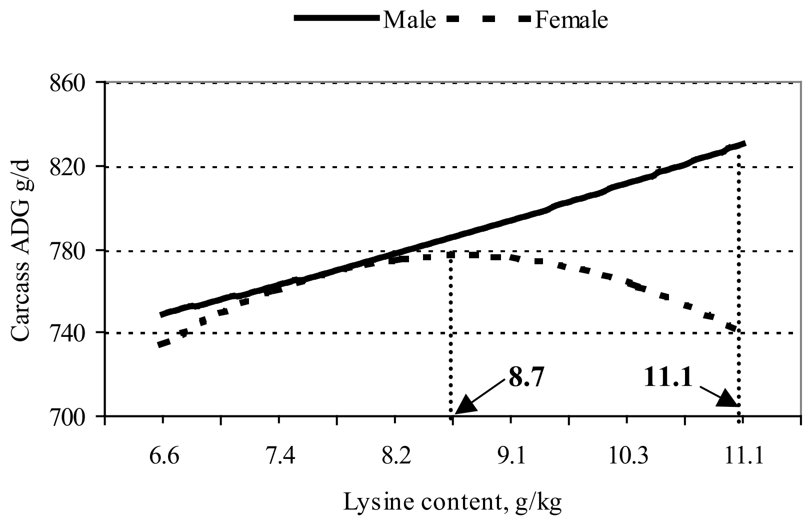


Figure 4. Graph of carcass average daily gain of male and female pigs from 80-100 kg.

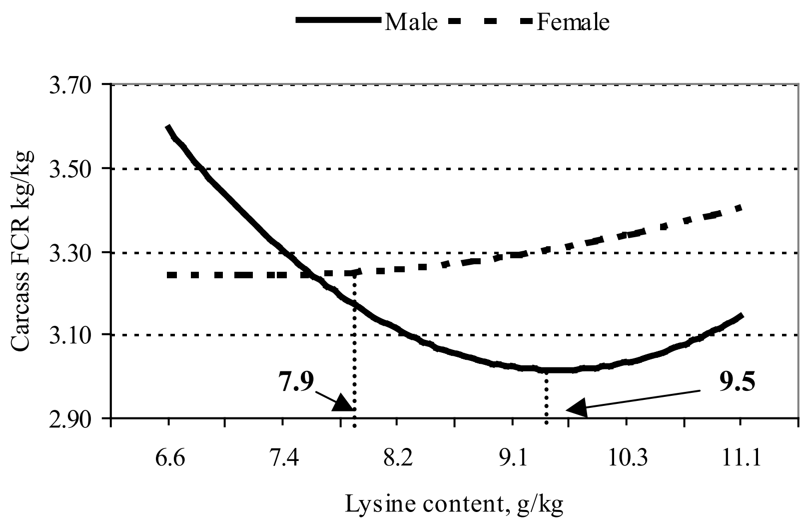


Figure 5. Graph of carcass feed conversion ratio for male and female pigs from 80-100 kg.

Summary

From 40 to 60 kg

- The requirement for lysine for male and female pigs was similar
- The lysine content that maximised daily gain was **12.0 g/kg**
- Feed conversion ratio was best when the diet contained **13.4 g of lysine per kg**

If males and females are fed the **same** diet from 60 to 90 kg

- The lysine content that maximised daily gain was **10.4 g/kg**
- Feed conversion ratio was best when the diet contained **11.2 g of lysine per kg**

For **separately** fed males and females from 60 to 90 kg

- Carcass daily gain was highest and carcass feed conversion ratio of females was best at **9.9 g of lysine per kg**
- Carcass daily gain was highest and carcass feed conversion ratio of males was best at **10.8 g of lysine per kg**

If males and females are fed the **same** diet from 80 to 100 kg

- Maximum daily gain was achieved at **8.2 g of lysine per kg**
- Feed conversion ratio was best at **8.2 g of lysine per kg**

For **separately** fed males and females from 80 to 100 kg

- Carcass daily gain of females was highest at **8.7 g of lysine per kg** and carcass feed conversion ratio of females was best at **7.9 g of lysine per kg**
- Carcass daily gain of males was highest at **11.1 g of lysine per kg** and carcass feed conversion ratio of males was best at **9.5 g of lysine per kg**

Conclusions

- The optimum lysine content of the diet declines with stage of growth for both male and female pigs
- After about 60 kg, the requirement of males and females are different (with males having a higher requirement)
- The lysine content provided for optimum performance depends on whether sexes are mixed or not

Pig Group Size - What is the Optimum?

Jim Finn, Teagasc, Moorepark

Introduction

Traditionally pigs in Ireland were penned in groups of 10-30 animals. In recent times the concept of larger groups has become more common particularly in weaners. Performance and economic implications all play a part in determining the 'Optimum'group size for each farm. This paper will examine some of the critical issues to be dealt with in order to decide the optimum group size.

Claimed Advantages for Large Groups

Economic

- Reduced building costs per pig place (less penning, increased stocking rate?)
- Reduced washing time due to fewer obstructions from gates and partitions.

Management

- Large groups in Stage I weaner provide an opportunity to draw off pigs into a number of smaller, uniform groups in Stage II weaner with little or no aggression.

Animal Welfare

- Greater choice (microclimate, eating, drinking places)
- Reduced aggression during resting
- Greater tolerance if over crowding occurs in the short term.

Disadvantages of Large group Sizes

Handling

- More difficult to catch individual pigs for treatment e.g. vaccinations or tagging.
- Safety of staff could be an issue when handling large groups of finisher pigs.
- Higher level of stockmanship required.

Age and Health

- Likelihood of greater problems with larger group when weaning age is young or health status is poor. Disease spread can be more rapid in absence of pen divisions as greater interaction occurs in the larger group.

Emptying Pens of Slaughter Pigs

- May be more difficult to empty out larger pens

Animal Performance

This is the key issue in deciding the most suitable group size. Any deterioration in pig performance can very quickly offset savings made in building costs and labour. The important traits are:

- Growth performance
- Feed conversion efficiency
- Variation in weight within a group

Group Behaviour

It is important to understand the animal behaviour characteristics of young piglets. This will have a large bearing on the success of the system. When any group of pigs is re-mixed into a new social group there is very intense activity within the group as a new dominance hierarchy or pecking order is established. This goes on for around 48 hours until every pig recognises every other pig and it's social position, then the abnormal behaviours such as fighting and competition subside.

The smaller the group the easier this is and the intense behaviour at mixing is much less. As the group size increases the ability of pigs to recognise and remember every individual in the group diminishes. The social hierarchy begins to fail and this can lead to errors in communication and may result in increased fighting and stress. This can lead to great disruption in the medium sized groups of 25 to 60 pigs, because of the constant competition at feed troughs, water supply and lying areas. The dominant hierarchies are never stable. They are constantly altering as pigs strive to work their way up the table. Growth is reduced because feed energy is diverted significantly into the competitive activities and less time is available for feeding.

Figure 1 below illustrates the dominance hierarchies in pig groups.

Figure 1. **Dominance Hierarchies in Pig Groups**

Linear Hierarchy (Small Group 8-10 Pigs)

A Top Pig
B
C
D
E
F
G
H ***Bottom Pig***

Complex Hierarchy (Large Group 25+ Pigs)

A Top Pig

J

Sub-Group Interaction

P

X
Z Bottom Pig

What does the research work tell us about the impact of group size on pig performance?

Turner et al. (2003) did a review of the implications of housing pigs in large social groups for performance and other economic traits. Their review came from 20 independent studies using almost 22,000 animals. The results of their findings are as follows;

Weaners

Feed Intake

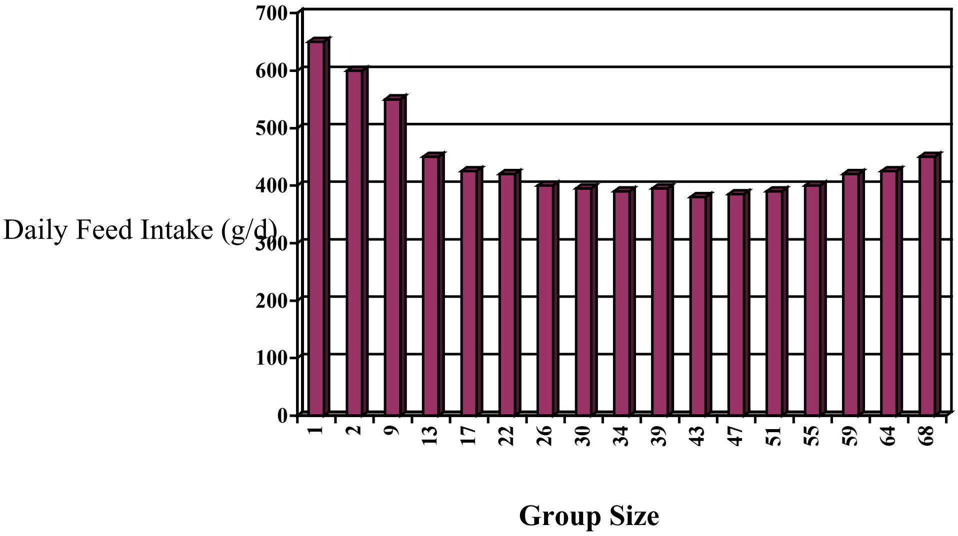
A significant depression in average daily feed intake (ADFI) with increases in group size was detected during the weaner stage (Table 1).

Table 1: Impact of Group Size on ADFI during Weaner Stage

Performance Change Per Additional Pig (g/pig/day)	Group Size Range	No. of Studies	No. of Animals
-0.51	3-120	8	9,543

The depression in ADFI during the weaner stage may suggest that younger pigs are more susceptible to disturbance in their feeding behaviour. Regardless of group size feeder space per pig will have an overriding effect on feed intake, growth rate and F.C.E whatever the system in place. As group size increases it is vitally important that feeding space, watering facilities and other essential facilities are increased proportionally. This will ensure that each pig in the group has ample opportunity to obtain it's feed and water requirements and to carry out all other essential activities Fig 2 is a graphical illustration of the effect of group size on daily feed intake done by Varley (2001) in the first 20 days after weaning.

Fig 2: **Effect of Group Size on Daily Feed Intake.**



Growth Rate

Table 2 illustrates the effect of each additional pig on A.D.G. in the group size 3-120 for weaners. A significant depression in A.D.G. occurred with increasing group size during the weaner growth stage. It equated to 3.6 grams per per day less for each 10 additional pigs in the group. One possible explanation for this is that group-housed pigs tend to be more active than isolated individuals (Chapple,1993) and this pattern seems to become more apparent as group size is further increased. For example, Pedersen (1990) reported that the duration of the day occupied by resting fell from 77.0% for groups of 16 pigs to 70.9% for groups of 48 pigs. Similarly groups of 36 pigs were found to be more active than groups of 6 or 18 pigs (Petheric et al.,1989). Other studies challenge these findings.

Table 2: *Impact of group size on ADG during weaner stage*

Performance Change per Additional Pig (g/pig/day)	*Group Size Range*	*No. of Studies*	*No. of Animals*
-0.36	3-120	7	7,623

Feed Efficiency

In their analysis of the 8 different studies, increasing group size had no significant effect on FCE.

Finishers/Growers

Feed Intake

The study showed no significant effect of increasing group size in the finisher/grower stage (Table 3).

Table 3: **Impact of group size on ADFI during weaner stage**

	Performance Change per Additional Pig (g/pig/day)	Group Size Range	No. of Studies	No. of Animals
Grower	- 0.05	3-100	10	4,922
Finisher	+ 0.033	3-100	9	9,014

Growth Rate

A significant depression in growth rate was observed in the grower stage (20-56 kg) The depression observed in the finisher stage was not significant (Table 4). Pigs of 68 kg or less appear to be more susceptible to a group size related depression in ADG than older animals.

Table 4: Impact of Group Size on ADG during Grower and Finisher Stage

	Performance Change per Additional Pig (g/pig/day)	*Group Size Range*	*No. of Studies*	*No. of Animals*
Grower	-0.48	3-100	11	7,682
Finisher	-0.09	3-100	10	9,854

Greater opportunities for exploration as well as greater freedom of movement may be factors in the poorer growth rates in the larger groups in the grower stage.

Feed Efficiency

The finisher stage was not associated with any significant change in FCE with increasing group size. However, there was a significant difference in the grower stage. This is probably related to the depression in growth rate mentioned above.

Weaning to Sale Trial in the Netherlands

In a study at the Research Institute for Pig Production forming large groups of piglets at weaning has proved to be beneficial when combined with splitting up the large group at the time of reallocation to the finishing house (Vermeer & Hoofs, 1994). During the nursery period, piglets reared in groups of 45 or 90 had 5% and 8% less growth, respectively, than piglets reared in a group of 10 piglets. On average the depression in weaned pig performance amounted to 22 cents per piglet. Performance in the piglets in the groups of 10 & 90 was subsequently monitored in the finishing period, where all the pigs were finished in groups of 8 (Table 6). The eight pigs were either mixed from several pens of 10 piglets or split up from a pen of 90 piglets according to body weight.

Table 6**: Performance of fattening pigs reared either in a small group (ten piglets per pen) or in a large group (90 piglets per pen) (Adapted from Vermeer & Hoofs, 1994).**

	Small Group	*Large Group*
Number of pens	31	31
Number of slaughtered pigs	239	242
Age at slaughter (days)	182	182
Bodyweight at slaughter (kg)	110.9	111.6
Growth (g day-1)	760	776
Food intake (kg day –1)	2.24	2.23
Food conversion ratio	2.96	2.87
Lean (%)	54.2	54.8

(Source: Varley-The Weaned Pig)

Finishing pigs reared in a group of 90 as weaners had not only higher growth but also a higher lean meat % than pigs reared in a group of 10 as weaners. Feed intake was similar but F.C.E. was numerically improved for the finishing pigs reared in a group of 90 piglets. Altogether the economic performance in the finishing period was improved by €1.48 per pig.

Commercial Farms Trial in Netherlands

The implications of keeping larger groups of finishers for labour requirements were studied on 8 commercial farms between September 2001 and June 2002. The farms had pigs in groups of 35 to 130. The main conclusions are:

1. Larger group sizes require less pen cleaning when the pigs are sold
2. Removal of group requires at least 2 people
3. Having daily inspections are more difficult
4. Safety of the stock person remains an issue

Variation Within Groups

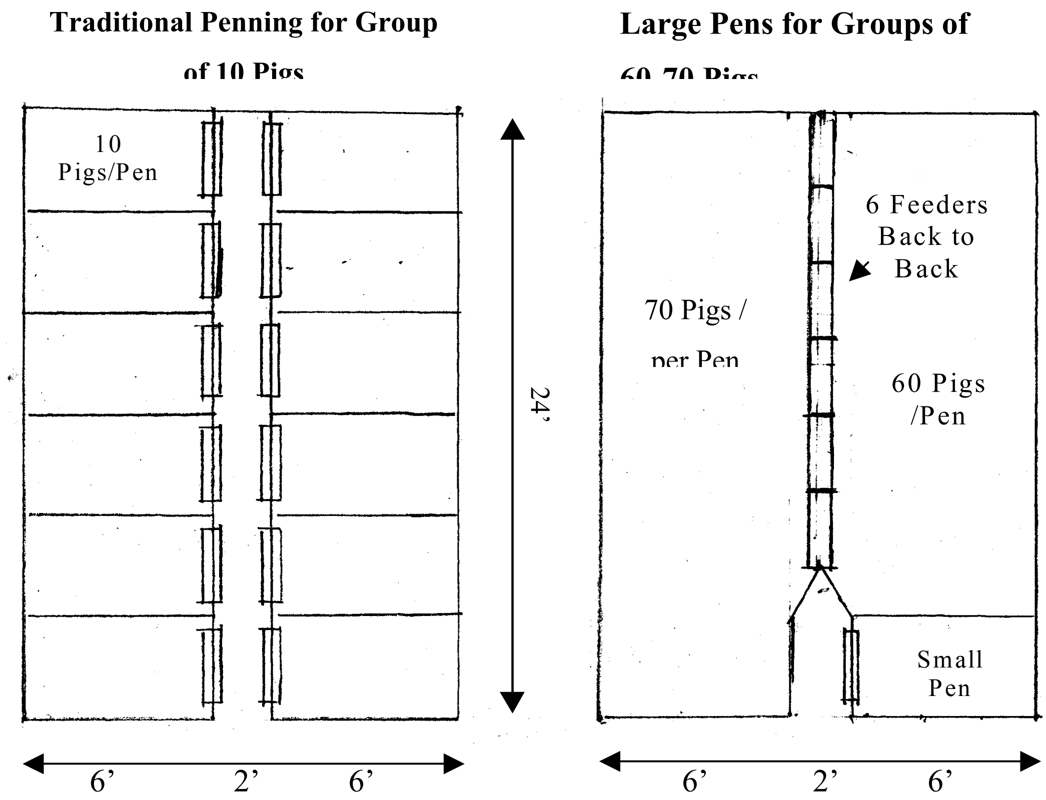
In recent years, there have been many attempts at reducing the amount of variability in a group of pigs. Most have failed. Recent studies completed at the Prairie Swine Centre found that sorting failed to reduce variability. These findings were later confirmed by experiments at Kansas State University. Other research at the Prairie Swine Centre has found that only severe restriction of access to feed will increase variability. Changing group size or crowding pigs was also found to have no effect. The Centre also looked at the impact of nutritional status of the diet and found that only when amino acids, for example, are severely limiting is variability increased.

Some critical points to be considered when making a decision to change group size.

1. Area(s) likely to give the greatest return e.g. Weaner 1, Weaner 2 or Finishing
2. Adaptability of existing penning system
3. Impact on ventilation, e.g. draughts
4. Impact on dunging pattern e.g. part slatted pens
5. Feeder space per pig and positioning of feeders
6. Positioning and number of water drinkers or nipples
7. Pig movement, inspection and handling
8. Stockpersons safety
9. Impact on health status of unit
10. Stocking density – can larger pens be stocked at a higher level than smaller ones without affecting performance? Welfare requirements must be met at all times.

Any changes should be done on a gradual basis and performance should be monitored closely. An example of Stage I weaner pen adjustments from small groups to large group sizes for a 300 sow unit producing 22 pig per sow per year is shown in Figure 2 below. There is a saving of 54 ft of pen divisions costing around €700/room. An additional 40 sq. ft of floor space becomes available for pigs. This could be used to provide more space per pig or carry an additional 18-20 pigs at 2.15 ft^2 per pig. Each room should have at least one small pen as shown on diagram in Figure 2 to cater for 'fall backs' and sick pigs

Figure 2: **Penning Arrangements for Different Group Sizes**



Conclusions

The optimum group size is not that easily defined. It differs from one unit to another. Large group sizes will depress growth rate in weaners and growers. However some of this loss in growth may be recovered in the finishers. There is a saving in penning costs and there are also less passages. Washing time is reduced. The stockperson's safety may be at risk in the finisher area. Where there are serious health problems such as PRRS or PMWS smaller group sizes may be more desirable.

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Sow longevity

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Ensuring that the incoming gilt has a long productive life is important for a number of reasons:

- the financial cost of the gilt (purchase, culls, feed and housing to mating)
- lower productivity of young sows
- disruption to even weekly production
- biosecurity risks of introducing animals
- welfare of animals required to be culled

Since the parities of maximum productivity are 3 to 5 there is a significant loss of potential herd output (pigs per sow per year) as well as a the direct financial cost of replacing a sow with a gilt. Stalder *et al.* (2003) estimated that a gilt must produce 3 or 4 litters to pay for the cost of her replacing an older sow.

The average sow replacement rate in herds recorded under the Teagasc PIGSYS system in 2003 was 46% (not including mortality of 6%). This means that the average number of parities produced by the average sow is about 4.4. This looks good but includes a percentage of very old sows which serve to mask the loss of very young sows.

Sows leave a herd through death or culling. There is a need to examine sow records to identify cullings which are preventable and cullings which are unlikely to advance the desired objective (usually improved herd productivity).

The culling programme should aim to reduce the numbers culled in early parities, maximise the numbers culled at around parity six or seven and minimise retention of old sows past their prime.

Culling strategies for pig herds have previously been discussed at this conference in 1999 by Ciaran Carroll. He proposed the following optimum parity distribution (Table 1).

Table 1. Optimum sow parity distribution

Parity	1	2	3	4	5	6	7	8
% of sows	17	16	15	14	13	11	10	4

In 1996 Laura Boyle carried out a survey of sow replacements in 24 Irish herds (Boyle, 1996). These herds ranged in size from 90 to 2,000 sows (mean herd size was 319 sows) and had a mean replacement rate of 43% (weighted for herd size).

Forty six percent of removals were parity 3 or less (Table 2). While 42% were parity 6 or over, half these were well beyond their prime at parity 8 or over. A high proportion of old sows in the cull (undesirable in itself) will raise mean culling parity but may mask the loss of young sows which is the major loss.

Table 2. Distribution of sow removals by parity[1]

Parity	*% of sows*
0	4
1	16
2	15
3	11
4	6
5	6
6	9
7	11
8	13
9	7
10 or over	2
Total	**100**

[1] *Excluding 7% of unknown or unrecorded parity*

Source: (Boyle 1996)

Recorded reasons for culling are shown in Table 3.

Reasons for removal were not evenly spread across parities (Table 4). Sows in parity 1 and 2 (approximately 20% and 18% of sows) accounted for a disproportionately high proportion of removals for reproductive problems, locomotor problems and deaths. In the US mortality rates seem to be higher in large herds, though the reasons are unclear (Crenshaw, 2003).

Table 3. Reasons for sow removal/culling and average parity for 2057 sows from 24 herds

Reason	*% of sows*	*Average parity*
Old age	31	7.9
Reproductive failure	30	2.8
Locomotor problems	11	3.9
Poor performance	11	4.0
Death	6.6	3.1
Disease / illness	5.9	3.1
Other	4.0	4.0
Total	**100**	**4.6**

Source: (Boyle 1996)

Table 4. Percentages of removals from each cause which were from parity 1 and 2

Reason	*Parity 0 or 1*	*Parity 2*
Reproductive failure	36	22
Locomotor problems	35	20
Poor performance	2	28
Death	30	17
Disease / illness	27	24

Source: (Boyle 1996)

Dean (2004) classified cullings into "successful" and "unsuccessful". An example of a successful culling is a culling on age since the animal has reached the end of it's useful working life and should be replaced.

He instanced removal for reproductive failure as the least likely to be "successful". Based on farm records, he found that litter size in parities 1 and 2 was a poor predictor of next litter size. Sows with under 8 pigs in parity 1 had an 18% chance of having under less than 8 in parity 2 while sows with over 8 had a 14% chance of a second litter under 8.

Dean also maintained that in a herd of low fertility it is difficult to reliably identify problem animals whose removal will be worthwhile. He estimated that in a herd with a low farrowing rate (around 70%) up to 40% of sows might end up being culled in a year for having two or more returns to oestrus without the culling doing anything to remedy the underlying fertility problem.

Gilt supply

Gilt supply is often one of a "feast or a famine". Having a continuous and adequate supply of gilts is essential for making the best culling decisions. A shortage of mature gilts ready to be mated is often a reason for retaining old sows and for rushing the first mating of young gilts. Where gilts are purchased there should be regular deliveries and/or gilts of a range in ages should be delivered each time.

For multiplier herds, the premium over slaughter pig price for breeding gilts may encourage selection and sale of gilts of marginal quality. Gilts of doubtful conformation at around six months of age have a lower life expectancy (Jorgensen, 2000).

The following factors will have an impact on sow longevity:

- Genotype
- Rearing system (growth rate; diet; flooring)
- Age and weight at first mating
- Housing system
- Pregnancy feeding
- Lactation feeding

Rearing for longevity

Effect of genotype

There is a lot of evidence that the genotype of sows affects their longevity. In the US six lines of crossbred gilts (about 550 per line) were compared side by side in two 1,600 sow units. Seventy percent of one line finished parity 4 compared with 48%, 50%, 50%, 52% and 52% of the other five lines (Moeller et al, 2004).

Pre-pubertal feeding, liveweight and backfat at first mating.

Rapid growth rate is sometimes associated with an increase in the incidence of leg problems e.g. Jorgensen et al. (1998).

According to Hughes and Varley (2003) the bulk of the evidence would suggest that sows with low fat reserves at first breeding have a shorter breeding life than those with greater reserves though there are many studies that do not agree. Table 5 shows one such study. Whether fat reserves or protein reserves are most important is not agreed.

Table 5. Relationship between P_2 backfat at selection and sow longevity (Gaughan et al., 1995)

	< 14mm	14 to 16	>16mm
No. gilts	161	466	466
Lifetime litters per sow	2.81	3.47	3.75

Similar data from Canada examined survival to parity 4 of Landrace (n = 19,031) and Large White gilts (n = 17,414) varying in backfat at 100kg (Table 6).

Table 6. Relationship between backfat at 100kg and percentage of sows completing parity 4 (Brisbane and Chesnais, 1996)

Breed	*< 12mm*	*13 to 16*	*>16mm*
Landrace	24	40	50
Large White	27	36	47

Having good fat reserves at first mating may be more an insurance than an absolute requirement. Foxcroft et al. (2004) suggested that where weight and condition loss in lactation are minimised body reserves at first mating are not important.

Many gilts especially those home-reared will be fed a typical growing pig diet (or diets) designed to maximise growth rate and carcass lean. This is probably not the best strategy for a long breeding life. The MLC has published interim results of a trial examining high (1.0 to 1.2%) and low (0.5 to 0.6%) lysine diets from 30kg to mating, combined with high (0.75%) or low (0.5%) lysine diets in pregnancy and high (1.0%) or low (0.7%) lysine diets in lactation giving in total 8 treatments (Edge et al., 2003).

Gilts fed the high lysine diet in the rearing period were heavier and had less body fat at mating. Pigs weaned up to parity six (calculated per gilt mated at the beginning of the trial) was highest (40.9 pigs) on the Low-High-High lysine sequence and lowest (31.4 pigs) on the High-Low-Low sequence. Sows reared on the high protein diet were twice as likely to be culled for leg problems as those reared on the low protein diet.

Many pig units now feed finisher diets of low phosphorus content. This results in some reduction in bone strength and these diets may not be suitable for future breeding stock.

Age and weight at first mating

There is a lot of evidence that gilts mated at an early age produce fewer litters (Table 7). This data is from a survey of breeding herds in France practicing early, normal or late breeding strategies. The effect is complicated by the fact that gilts first mated at very high ages may contain a higher proportion of inherently infertile animals.

Table 7. Imposed gilt mating age and sow longevity (Le Cozler et al., 1998)

	Early	Normal	Late
No. herds	250	514	212
Mean age at first mating (days)	221	240	255
Mean parity at culling	4.85	4.99	4.95

Mating at the second or third oestrus may increase first litter size but there is little evidence that it will improve lifetime performance (Hughes and Varley, 2003).

Foxcroft et al. (2004) recommended that puberty be induced at an early age by boar stimulation on the basis that early responders have better lifetime fertility. It is important to remember that these early responders are not necessarily bred at an early age or at a light weight.

Sow feeding

Most of our knowledge of sow feeding has come from trials conducted in the 1960s and 1970s when sows were fatter, productivity was lower and management systems were very different to present day conditions. Feeding these high producing sows has been discussed by Bruce Mullan in another paper at this conference.

Body condition

Thin sows have a reduced life expectancy, being more prone to cold and less fertile while the poor condition may indicate an underlying health problem. Hughes (2001) compared return to oestrus, wastage (failure to conceive, anoestrus, abortion, not in pig) and next litter size of heavy and light, thin and fat sows (parity 3 to parity 7) as shown in Table 8.

Table 8. Relationship between body condition at weaning and sow performance

	Liveweight at weaning		P_2 backfat at weaning	
	Heavy	Light	High	Low
Weaning to oestrus, d	6.2	8.2	5.8	8.1
Wastage[1] %	11	37	9	39
Next litter size (liveborn)	10.9	8.8	11.4	8.9

[1] failure to conceive, anoestrus, abortion, not in pig

Assessing backfat depth by condition score using a reference scorecard is a simple exercise but of limited value. Hughes and Smits (cited by Hughes and Varley, 2003) found that while most sows assigned a condition score of 3 on visual inspection were between 12 and 18mm in backfat depth, a small number of sows on score 3 were under 10 or over 20mm.

Lameness

Lameness and foot/leg problems are important causes of culling young sows. Keeping sows in stalls without exercise results in poorer muscle tone, weaker bones and thinner cartilage all of which can lead to lameness and inability or difficulty in walking and changing posture (Orth, 2003).

In Australia, a survey identified the following risk factors for lameness in sows (Cargill, 2001).

- Conformation at selection
- Flooring
- Overstocking
- Infections

Cargill suggested a simple protocol for assessing lameness. Make all sows stand e.g. after feeding. If over 30% lie down in the next 40 minutes examine the first 20 or 30 who lie for:

- Leg and toe lesions
- Swollen joints
- Shifting weight from one leg to the other more than 4 times in a minute
- Percentage time weight is borne on one leg.

The "downer sow "syndrome is caused by breaks in bones (especially in the pelvic area) weakened by poor mineral or vitamin nutrition. These breaks and lameness often occur after weaning but may happen in the farrowing house. In rare cases, lameness or complete rear leg paralysis is caused by injuries received in delivery of extremely large pigs. This lame condition may be short-term, but sometimes the sow will not recover. Many of the sows may not recover sufficiently to salvage any market value.

Osteochondrosis is one of a number of conditions of the cartilage in the joints where damage results in lameness. It appears to be very common in pigs and several contributory factors have been identified though there is little agreement on nutritional or management strategies to prevent or cure it (Nakano and Aherne, 1993; Nakano et al., 1993).

Flooring contributes to lameness and paralysis. Fighting is an important reason for foot damage in group-housed sows and loss of dewclaws is common A study conducted at Moorepark showed that covering the slatted floor with mats at mixing reduces the risk of sows being injured at mixing (Boyle and Lynch, 2003).

Lameness generally results in poor lactation performance, reduced litter size and weight and possibly culling of the affected sow. Rough flooring can damage foot pads or cause cuts and scrapes. Any of these injuries can be infection sites for lameness-causing bacteria. Slippery flooring causes injuries and may discourage sows from attempting to get up, eat and move about.

Diet and skeletal development

The recommended calcium and phosphorus concentrations in diets for growing replacement stock and for mature breeding stock are higher than those for slaughter pigs (Close and Cole, 2000). This means that a diet suitable for finishers may not be correct for gilts. However, daily feed intake will complicate any assessment of requirement.

There is still uncertainty over the optimum calcium and phosphorus levels in diets for breeding animals. Bone mineralisation is sometimes used as an indicator of bone strength but Crenshaw (2003) questioned whether maximum bone mineralisation is desirable and he suggested that over-supplementation of calcium and phosphorus might in fact contribute to lameness in later life. He also speculated that feeding a high level of dietary calcium in late pregnancy might precipitate hypocalcaemia or milk fever at parturition which could be a factor in a high stillbirth rate.

NRC (1998) suggested feeding a diet with about 0.1% more calcium and 0.1% more phosphorus than that fed to finishing pigs.

When sows are fed inadequate amounts of calcium and phosphorus the skeletal reserves may be used to maintain foetal growth and for milk production. This can contribute to the "downer sow syndrome" in which sows are unable to stand (OSU, 1998).

Staff

Staff supply and staff retention are concerns in the pig industry. The quality of stockmanship affects sow productivity and it seems reasonable to assume that the same holds true for sow longevity, culling and mortality. Attention to individual sows, prompt care for ill or injured animals will reduce culling and mortality. Having an adequate number of properly trained staff is important. In the USA Loula (2002) claimed that an inexperienced labour force with poor training was a common feature of units with poor sow longevity.

Bonus payments to staff have the potential to distort an effective culling/replacement programme e.g. breeding targets may be met by retaining unsuitable sows which are later culled or farrow in an unfit condition.

An example of how stockmanship can have an impact on later skeletal quality and how easy it is to cause such damage was shown in a trial where young pigs (29kg) were dropped from waist height or placed gently into a cart. Those dropped had a higher incidence of osteochondrosis at 90kg than those placed gently (Nakano and Aherne, 1988).

Sow deaths

There is a perception that sow mortality rates have increased and this may be due to more strict criteria for sows at slaughter resulting in more on-farm deaths or euthanasia.

In the USA sow mortality is higher in summer, higher in the first three weeks after farrowing and is higher in low parity and high parity animals (Deen and Xue, 1999). This survey used 3.6 million sow parity records. Interestingly, they found that where the gilt pool was too small at the time of mating there was an increased risk of sow death in that pregnancy. This was most likely due to sows being retained too long in the absence of a suitable replacement.

Abiven (1997) in a survey of 100 herds in France reported a higher risk of sow deaths where there was high incidence of urinary tract infection, metritis or lameness. There was a lower risk where pregnant sows were fed three times daily rather than twice and where sows had feed intake increased rapidly after farrowing.

There is no information on causes of sow mortality in Ireland. In the USA, the principal causes of sow deaths vary from farm to farm according to Geiger et al. (1999). They conducted post-mortem examination of dead or euthanased sows on six farms and found a high proportion of very thin sows on one farm, a high proportion of very fat sows on another. They found musculo-skeletal conditions as the most common cause of death of sows (38%) but this varied from 15% to 55% of deaths on different farms.

On some farms lesions of the gastro intestinal tract e.g. stomach ulcers were important reasons for mortality. Overall they found that only 28% of sow stomachs had "normal" epithelium with the others showing mild to severe keratinisation, erosion, ulcers or strictures.

Culling to sale

Sows are very inefficient converters of feed to weight gain. Feeding of sows to improve body condition prior to sale is seldom justified with a feed efficiency ratio as poor as 7:1. Holding these non-producing sows increases sow stock number and depresses the calculated output per sow per year. Watch the timing of injections and vaccinations to avoid long retention of sows marked for culling.

Conclusions

The following recommendations are made to improve longevity:

1. Gilt rearing
    a. Use only dam line animals
    b. Feed a special gilt rearer diet
    c. Allow adequate space on good floors (at least $1.0m^2$)
    d. Have an adequate stock of maiden gilts (about 12 to 14% of herd size)
2. Gilt selection
    a. Cull suspect animals on legs and conformation
    b. Induce puberty early
    c. Cull slow responders (over 260 days of age)
    d. Gilts at least 130kg at first mating
    e. Avoid overfatness or excessive weights
3. Flooring
    a. Part solid floors are better
    b. Keep slats in good condition
    c. Mix sows on solid flooring or cover slats with mats
4. Body condition
    a. Maintain sows in "firm but not fat" condition

   b. Avoid excessive fat gain and loss
5. Supervision
   a. Check every sow at least once daily after feeding
   b. Check for body condition, injuries, lameness
   c. Have adequate staff
   d. Ensure staff are trained
6. Records
   a. Keep good records

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Teagasc Services to the Pig Industry

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DD = Direct Dial; S = Switchboard; M = Mobile.				

Notes