Pig Farmers' Conferences 2005

Conference Proceedings

Longford, 17th October, 2005
Kilkenny, 18th October, 2005
Fermoy, 19th October, 2005

ISBN 1 84170 435 0

Published by Teagasc, Oak Park, Carlow.

What top producers do

(What top producers do that the rest of us wish we had done or could do!)

Seamas Clarke, Ballyhaise

Introduction

- Who are they?
- What makes them different?
- What do they do that *we* can't do ourselves?

They are people who are *continually focused* on profit and performance!

They:

- **Plan ahead**:pig sales outlets, feed purchase, manure clientele, major repairs, renewals
- **Make changes** to effect output in terms of genetics, management, health
- **Regularly review** position in terms of production targets, major costs, returns
- **Correct mistakes quickly** in terms of sale weight scatter, dietary effects, breeding policy

For us:

As it was in the beginning, is now and ever shall be!

Sow Productivity

Top producers at the scale of 500 sows:

- sell 1,100 pigs per annum more than us, 20 per week
- farrow an extra 802 piglets per annum more than us, 15 per week
- lose 172 pigs less than the rest of us!

Table 1: Average & Top 25% herds selected on No. Pigs Produced per Sow per Year

	Average	Top 25%
No Pigs per Year	21.9	24.1
Litters per Year	2.28	2.36
Piglets born alive	11.2	11.5
Total Mortality %	14.1	12

Source: Teagasc Pigsys 2004

Table 2: Two 500 Sow Herds Compared

	Average	*Top 25%*	*Difference*
No Pigs per Year	10950	12050	+1100
Litters per Year	1140	1180	+40
Piglets born alive	12768	13570	+802
Total Mortality	1800	1628	-172

Table 3. Breakdown of Pig Mortality

	Average	*Top 25%*
Piglet %	9.1	8.1
Weaner %	3.2	2
Finisher %	2.4	2.3

Note: 66% of deaths occur in the farrowing house, mostly within the first 24 hours of life! This must be an area worth looking at?

Table 4: Weekly performance of Average and Top 25% herds

Weekly performance	*Average herd*	*Top 25%*
Piglets born alive	246	261
Piglet deaths	22.3	19.1
Weaner deaths	7.1	4.8
Finisher deaths	5.1	5.4
Total deaths	35	31
Pigs produced / sold	211	232

What's more they are not 'necessarily' the biggest producers!

Herds in the 200 – 500 sow range, with an average of 300 sows produce more pigs per sow per year than the >500 or <200 sow range

Table 5: Herd size and productive performance

Herd size	*>500*	*200 – 500*	*<200*
No pigs produced per sow per year	21.8	22.4	20.8
Born alive per litter	11.2	11.2	10.9
Litters per sow per year	2.29	2.30	2.21

Source: Teagasc Pigsys 2004

Growing pig performance [Weaning to sale]

Table 6 Average & Top 25% Herds selected on FCE Weaning to Sale

	Average	*Top 25%*
Feed Conversion Efficiency	2.46	2.25
Average Daily Gain g	597	620
Daily Feed Intake g	1,452	1,386
Sale Weight Live kg	96.5	95.7

Source :Pigsys 2004

Top herds

- grow their pigs at 620 grams per day versus our growth rate of 597 grammes ~ 3.9% faster than our pigs
    - ~ 145 days versus 150 days to 96.5 kg
    - ~ 165 pigs less on the farm at similar performance levels
    - ~ €16500 in their pocket not in stock
- sell more pig meat
    - ~ 1533 kg more sold per week weekly (8% more)
- ~ factory return of €2040 extra weekly at common price of 133c per kg

- use feed more efficiently
    - ~ 18.7 kg feed less fed per pig sold
    - ~ 205 tonne less bought at similar levels of production
    - ~ savings of €887 per week or €46,125 per year

Daily Gain:

They:

- Give adequate space to weaners & finishers to grow efficiently to selected weights
- Provide good supply of feed and water for efficient growth
- Select top genetics for intake and efficiency
- Provide hospital space for damaged and failing pigs
- Provide health insurance by way of bio-security, vaccines and strategic medication
- Control internal and external parasites

We:

- Fit them in!

Feed Efficiency:

They:

- Provide adequacy of space and economy of diet to yield best economic return!

We:

- Carry on with our old routine, never adjusting to changing circumstances!
- Overcrowd pens, picking off the tops as they come fit
- Over feed creep & link, pampering the entire room, not the few poor ones
- Dump the remains of creep / link down the slats at weaner transfer
- Leave feeders unadjusted for long periods
- Fail to repair or replace damaged feeders
- Send our pigs to the factory full of dear feed
- Leave the non-thriver too long in the pen
- Leave nipples unchecked for flow rates until tail biting has started

Feed prices:

Table 7: Purchase price of feed on recorded herds

Herd Size	>500	200 – 500	<200
Sow	200	201	212
Creep	711	671	716
Link	439	441	493
Weaner	251	257	269
Finisher	198	203	210
Composite	222	224	233

Source: Teagasc Pigsys 2004

At national standard usage and production figures the savings per pig due to lower feed costs are as follows:

Table 8 : Effect of Feed price on Feed Cost per Pig

Feed	*Kg per Pig*	*Price Difference /t*	*Saving per Pig c*
Sow	55.3	11	60.8
Creep	4.6	45	20.7
Link	7.2	52	37.4
Weaner	40.6	12	48.7
Finisher	170.5	7	119.4
Total	278.2		287.0

The saving of €2.87 per pig is 3.9c per kg or €31426 on a 500 sow unit with average output per sow.

Factors affecting feed price:

- Meal versus pellets
- Load size
- Buying strength Scale / Credit requirements
- By-product usage
- Herd health

They:

- Know the price they fixed for their feeds
- Compare with Teagasc national figures regularly
- Check for any mistakes on invoices
- Check the costs of in feed additives
- Review via their records the value for money of the feeds

Us:

- Look for maximum discount
- Discuss the match / the neighbours
- Post date the cheque

Market return:

Factors affecting carcass value

- Weight
- No of pigs
- Lean meat yield
- Condemnations
- Under-weights
- Over-weights

Table 9 Overall Result:

	Top producer	*The Rest*	
Total feed usage per pg Kg	*253*	*276*	*8.3% less*
Total feed purchase Tonnes	*3,050*	*3,022*	*1% more*
Composite price per tonne €	*224*	*233*	*5% less*
Pig numbers sold	*12,050*	*10,950*	*10% more*
Total carcass sold Kg	*870,612*	*797,707*	*9% more*
Carcass return c / kg	*142.6*	*137.2*	*4% more*
Margin over feed €	*558,293*	*390,328*	*43% more*

<u>Get it right for the future</u>.

What are the areas you can exploit in reducing your costs and increasing your income?

Like the top 25%, you need to *'focus'* on profit and production *continually!*

<u>Exploitable areas in input costs</u>:

	% total costs
Feed	68
Labour	11
Medicines / Vaccines / Health care	4
Manure / Environment	2
Repairs / Maintenance	2
Breeding cost	2
Recording/ Accounts / Insurance	1

<u>Key areas with direct effect on income</u>

- No. pigs sold per sow
- Weight of carcass
- Quality of carcass
- Price per kg
- Price per tonne of feed
- Quantity of feed used

<u>The Eddie Hobbs Approach:</u>

Pay attention to the '<u>big</u>' costs and your pig price per kg.

Reducing aggression in group housed sows

Laura Boyle, Moorepark

Note to the reader: Throughout this paper we refer to the findings of a survey of the welfare of sows in groups with free-access or welfare stalls conducted in 2002/2003. Seven farms were visited with an average herd size of 497 sows. 2060 sows were inspected for lameness, skin damage, and other injuries. Contact the author for further details.

Introduction

From 2013 all sows and gilts must be housed in groups during a period starting 4 weeks after service until 1 week before the expected time of farrowing (EU Directive 2001/88/EC). Housing sows in groups eliminates problems of social deprivation and lack of exercise associated with individual housing. Nevertheless, social living is also associated with welfare problems primarily because of aggression.

Is aggression normal?

Aggression is a normal part of the behaviour of all social species. Pigs, being highly social animals, are no different. However, the level of aggression occurring when pigs are mixed on farms is much higher than that observed when unfamiliar pigs encounter each other under more natural conditions. Feral and wild female pigs are relatively tolerant of the gradual integration of new group members. Whatever the reason for this difference, intense aggression is inevitable when unfamiliar sows are abruptly mixed on farms and this poses a major welfare concern. Problems for sows include fear, stress, injury and lameness resulting in involuntary culling, a reduction in farrowing rate and litter size and even death.

What is its purpose?

In group-housed sows, the purpose of aggressive interactions at mixing is to establish a dominance hierarchy. Aggression is reduced and the dominance hierarchy becomes relatively stable after one week of mixing in most groups. In theory, a stable dominance hierarchy reduces the need for overt aggression to settle future disputes. In practice, this is influenced by the degree of competition for access to resources such as water, preferred lying areas, manipulable substrates and most importantly food. So agonistic interactions at mixing are not only inevitable, they are also vitally important. The challenge is to reduce the level of aggression wherever possible and failing this, to limit its consequences.

Sow factors affecting aggression

The position a sow holds in the dominance hierarchy is one of the most important sow factors affecting aggression and the degree to which sow welfare is affected. Weight, age and parity are positively correlated with social ranking. The oldest and heaviest sows in the group inflict most of the aggression at mixing while the younger and/or lighter subordinate sows are the main recipients (Arey and Franklin, 1995). This was illustrated by the findings of our survey where only 50% of the sows inspected during the first month post-mixing were affected by skin lesions (Boyle and Lynch, 2003). Obviously, close supervision of sows at mixing is crucial in order to safeguard the welfare of the most vulnerable animals.

Once the dominance hierarchy is established, subordinate animals are most likely to suffer from aggression at feeding. This is particularly the case in competitive feeding systems where low ranking animals are interrupted during feeding as they retreat from attacks. This explains why these animals generally show poorer growth rates and higher skin lesion scores than their higher-ranking pen mates (e.g. Stewart et al., 1993). Close supervision of newly mixed groups during feeding is therefore crucial. This helps identify sows that are being bullied and facilitates intervention to ensure they acquire their full feed allowance. If the bullying is excessive or shows no signs of abating it is more humane to remove either the main perpetrator of the bullying or her victim from the group.

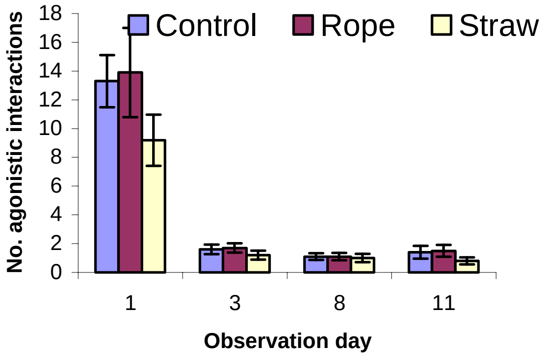
Housing factors affecting aggression

Manipulable substrates

One of the ways that aggression and harmful social behaviours can be reduced in growing pigs is by giving them access to manipulable substrates (e.g. O'Connell and Beattie, 1999). Unfortunately, preliminary results from both Moorepark and Hillsborough suggest that the same cannot be said for sows.

Free access stalls

At Moorepark, sows in groups of four with free access feeding stalls were provided with straw in a rack or with a length of natural fibre rope in each stall. The aggression that occurs at mixing in this system is severe, and its consequences often serious, owing to the fact that sows are mixed on fully slatted floors. We hoped that the enriching substrates would divert the sows attention from fighting. Although the number of aggressive interactions in the straw treatment at mixing was slightly lower, the difference was not significant and was not evident thereafter (Figure 1a). The striking reduction in aggression recorded in all treatments three days post-mixing is typical of this housing system (Figure 1). Neither form of enrichment had an effect on skin lesion scores (Figure 1b). Interestingly a reduction in sham chewing and pen directed exploratory behaviour was recorded in both enriching treatments which is often interpreted as a welfare improvement. In an older study at Hillsborough with a similar housing system, spent mushroom compost presented in racks reduced aggression and injuries in sows after mixing (Durrell et al., 1997). This may be a more attractive substrate to sows but there are problems with availability and environmental concerns associated with its use, making it an impractical option.



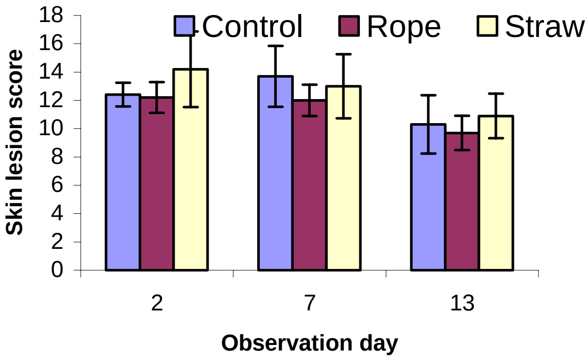


Figure 1. Effect of providing sows with straw in racks or lengths of natural fibre rope on number of agonistic interactions (a) and skin lesion scores (b) (Boyle and Gauthier, 2004).

Split-yard system with ESF

More recent research at Hillsborough focused on sows in a large dynamic group operated as a split yard system with an ESF. In two studies, sows were provided with racks of straw or silage in both yards. Skin lesion scores recorded one week after sub-groups of sows were introduced to the main group suggest that there was no effect of either treatment on aggression at mixing (Stewart and O'Connell, *personal communications)*. In contrast to the study at Moorepark, the straw had no effect on sham chewing, which was probably because the racks were too short for all sows to gain access to them. However, the silage was successful in reducing this behaviour. Nonetheless, the silage created very dirty, unhygienic conditions in the pens making it an unlikely option.

Providing sows with straw in racks is relatively easy to implement in different housing systems and does not affect pen cleanliness. Importantly it also complies with EU legislation which states that all pigs must have access to a manipulable substrate to satisfy their behavioural need for exploration. Nevertheless, it has little or no impact on the main welfare problem for sows in small static, or large dynamic groups, namely aggression. The same results were found where straw was provided as bedding although bedding undoubtedly reduced lameness caused by fighting (e.g. Anderson and Boe, 1999).

Flooring

Straw bedded floors offer protection to sows legs while fighting but sows are likely to fight for longer on straw compared to slatted floors (Walker and Beattie, 1994). This is because bedded floors provide more secure footing than slats. Slats in turn, provide more secure footing than mats which become very slippery soon after sows are introduced to the pen. In a Moorepark study, the reluctance of sows to fight on a slippery floor was reflected in lower levels of aggression and skin lesion scores in pens where mats covered the slats (Boyle and Llamas Moya, 2003). Mats might also have a role to play in protecting claws from damage during fighting at mixing but must be removed after 24hours.

Table 1 shows the maximum concrete slat openings and minimum widths for use with sows and gilts under the new legislation. From our experience 80mm is too narrow causing serious problems for sows in terms of claw damage. Fortunately slat widths ranged from 100 to 140mm on most farms visited as part of the survey. Anecdotal evidence from producers indicated that the widest slats were the least injurious and provided the best foothold for sows while fighting. Gap openings on all farms were approximately 15mm.

Table 1. Maximum concrete slat openings and minimum widths for sows and gilts

	Slat opening	***Slat width***
Sows and gilts	20mm	80mm

Diet

The new legislation states that all pregnant sows and gilts must be given bulky or high fibre food in addition to their high-energy diet. This is to address the problem of hunger in restricted fed sows. While this is one of the main factors influencing the performance of stereotypies it is also thought to aggravate levels of aggression particularly in competitive feeding systems. The legislation states that straw, being edible, satisfies both the requirements for a manipulable material and for a high fibre diet. However, as already seen, straw has no effect on aggression levels. It is possible that straw does not reduce sows motivation to feed (Ramonet et al., 2000) enough to influence aggression. In this respect simply feeding sows their normal high-energy diet *ad libitum* prior to, and during mixing, successfully reduces aggression at mixing (Edwards et al., 1994). Obviously this strategy cannot be adopted in the long term because sows become too fat and their reproductive performance is adversely affected. A more practical option is to increase the fibre content of the diet through addition of beet pulp, soya or oat hulls for example. This decreases the risk of vulva lesions in ESF and floor fed herds (van Putten and van de Burgwal, 1990; Whittaker et al., 1999). But in general, effects of high fibre diets on aggression depend on other interacting system components such as feed level and the presence or absence of straw.

Aggression in different loose housing systems

Systems based on small groups

Small groups have a smaller area available for movement during social encounters. This results in higher levels of aggression at mixing compared to large groups at similar stocking densities. However, because small groups tend to be static, a more distinct linear dominance hierarchy forms resulting in a more positive social environment that may prevent social stress in the individuals in the long-term (Pedersen et al., 1993).

Free-access feeding/welfare stalls, voluntary cubicles

Voluntary cubicle, free-access or 'welfare' stall systems where the cubicle/stall is used for lying and feeding, and a fully slatted area behind is used for exercise and dunging are a popular choice for producers converting to loose housing. Groups of four sows are common and they must have 2.5m^2 each under the legislation. Where the system is operated with six sows the space allowance required for each sow is lower at 2.25 m^2/sow. Mixing sows in such a small area results in severe aggression. The feed stalls can be used as 'retreats' by sows being attacked. However, these animals are then vulnerable to bites to the rear and vulva regions by their pursuing attackers. Indeed the survey of commercial farms found that 10% of sows had injuries to the hindquarters/ano-genital region suggesting a potential role for self-closing rear gates.

The problems associated with mixing in this housing system are further compounded by the fact that all the fighting is conducted on fully slatted floors which can damage the claws. The survey revealed that 5% of the 2060 sows inspected had amputated an accessory digit (Boyle and Lynch, 2003). This probably underestimates the number of sows affected by this injury considering that most would have been culled for lameness.

One of the best features of this housing system is that levels of aggression are very low once the dominance hierarchy is established because the feeding stalls prevent competition arising over access to feed. Full-length stalls are more successful in this respect (Andersen et al., 1999) because they reduce the incidence of stall re-entry. Nevertheless, shorter stalls might be a feasible option if wet feeding. Average eating times on wet feeding are shorter and individual variation is less, so sows tend to finish meals simultaneously which reduces aggressive competition (Boe, 1996).

Levels of aggression can be further reduced by using solid rather than slatted flooring in the stalls (Boyle and Lynch, 2001). This is because sows, preferring to lie on solid rather slatted floors (Phillips et al., 1996), are encouraged to use the stalls rather than the loose area for lying. This reduces the potential for aggressive encounters between sows.

Conversions

The layout of the stalls or tethers on some farms means that they can be readily converted to group pens. Nevertheless, careful consideration of the legislation governing housing for pregnant sows and gilts is warranted before considering such a conversion. Even if the resulting pens meet the requirements on space allowance and pen side length they may cause problems with aggression owing to the layout.

A case in point is a farm we visited that had recently converted from individual stalls to loose housing. Where two rows of stalls existed, the stalls were shortened, some of the sow spaces removed and pens created for seven to 11 sows. With single rows of stalls, the stalls were left full-length and gated off to create pens for 3 to 6 sows. When compared to the seven other farms, sows in the converted unit had the highest skin lesion scores and the highest percentage of sows with vulva injuries (Table 2). Table 3 illustrates that most of the aggression problems were in the larger groups. The pen layout was more than likely responsible for these problems. Previous research at Moorepark found that two rows of feeding stalls significantly increases the amount of sow 'traffic' in the loose area which in turn increases the potential for aggressive encounters (see proceedings of 1999 Teagasc Pig Conference). This, combined with the use of short stalls, which are known to increase the incidence of stall swapping during feeding, inevitably increases aggression. Furthermore, because sows in such systems dung and urinate in the middle of the pen, instead of at one end as they would in conventional pens, the slats are dirtier and more slippery. This creates a dangerous environment for fighting. Finally, the layout of the uninterrupted space often means that the display of aggressive behaviours is inhibited or interfered with, resulting in the inability of sows to establish a stable dominance hierarchy.

Table 2. Skin lesion scores and percentage of sows affected by vulva injuries in a converted farm and on seven farms with conventional groups of four sows in pens with welfare stalls

	Converted farm	*Welfare stall farms with groups of four (n=7)*
Aggression induced lesion scores	5.9	1.4 ± 2.48
Vulva injuries (%)	4.0	2.1 - 3.4 (range)

Table 3. Skin lesion scores of sows in different group sizes on the converted farm

Group size	*Lesion score*	*No. sows*
3-6	3.5	71
7-9	6.7	138
10-11	7.4	40

Trickle/Biofix systems

Food is augered at the same controlled rate to each individual sow space. In theory this should eliminate the need for full-length partitions between the sows. Nevertheless, studies show that aggression in such systems is higher than in free-access stalls (Backus et al., 1997).

Systems based on large groups

Generally sows mixed into large groups are better able to avoid aggressive attacks owing to the large numbers of animals in the pen and the greater total amount of space (Edwards et al., 1993). In the longer term, however, levels of aggression are often higher than in small groups (e.g. Durrell et al., 2002). This is because large groups are likely to be dynamic, whereby the group is continually destabilised due to weekly removal and addition of sows. Furthermore, as wild and feral sows live in small, core groups of about four adult females, systems based on large dynamic groups are probably the furthest removed from the natural social organisation of the pig.

Electronic sow feeding (ESF) systems

One of the main advantages of ESF systems is that sows can be fed according to individual requirements. These systems also allow large groups of animals to be housed in relatively low cost, unspecialised housing. However, excellent management skills are required to ensure that aggression and its consequences are minimised. Apart from weekly introduction and removal of sows, levels of aggression will be primarily influenced by design and reliability of the feeder itself, number of feeding cycles per day and start time of the feeding cycle (Edwards et al., 1984; 1988). Specifically, the mechanism of gate control in the ESF feeder is a critical factor determining the incidence of vulva biting (Jensen et al., 1995). Donnelly and Hawe provided a good account and diagrams of the traditional and two-yard layouts commonly used in conjunction with ESF in Northern Ireland at the Teagasc pig conference in 1999.

Dump/spin feeding

Perhaps the simplest and cheapest way of feeding sows in large groups is to distribute food on the ground. Owing to the intense competition that occurs over access to food, aggression levels in these systems often remain high, long after the dominance hierarchy is established. Little can be done to alleviate such aggression and it is unlikely to be a popular choice for Irish producers.

Strategies to reduce aggression and/or its consequences

Mix at weaning, stall, and re-group after 28 days

Current legislation permits housing sows individually for 28 days after service. This means served sows are past the crucial stage of embryo implantation prior to mixing. Nevertheless, sows are still more at risk of reproductive failure if mixed when pregnant than when weaned. For this reason it might be worth considering a strategy whereby sows are mixed at weaning, moved into stalls a few days later, and re-mixed into the same groups 28 days later (Bauer and Hoy, 2003). The number of agonistic interactions in groups of sows after 28 days in stalls is much lower than the number of interactions occurring in the same groups at weaning. This is because the sows establish a stable dominance hierarchy at weaning and being able to remember one another, have less need to fight when re-introduced 28 days later.

Specialised mixing pens

On farms with small, static groups, and particularly those with fully slatted pens, using a specialised mixing pen could help reduce aggression and lameness and injury caused by aggression at mixing. The desirable but expensive or inconvenient features such as space (at least $6m^2$/sow required), bedded or non-slip floors and partial barriers can be readily provided in such pens. Ideally pens should be rectangular rather than square in shape because research shows that this lowers aggression.

Sub-group formation

This strategy works well for large, dynamic groups and involves housing small groups of sows together for perhaps one week prior to introducing them into the main group. Small groups of sows introduced together into a large group form sub-groups regardless of whether they are familiar (i.e. formed as a sub-group prior to introduction) or not. However, forming sub-groups prior to introduction to the large dynamic group strengthens sub-group behaviour during the first week in the group and also reduces aggression between sub-group members and between new and resident sows during this period (Durrell et al., 2003).

Rearing of replacement gilts

Pigs are generally reared with animals of the same size, breed, age, and sexual status, in barren environments. This impedes social learning, resulting in social stress when pigs encounter unfamiliar individuals later in life, ultimately making them more aggressive. Not surprisingly then, exposing gilts to a more complex social environment by repeated re-grouping early in life improves their social skills and reduces aggression levels when they are group housed as adults (van Putten and Bure, 1997). This in turn means that they are better able to adapt to group housing during pregnancy resulting in fewer losses due to lameness and low food intake (Houwers, 1994). Simply pre-exposing gilts to a group of sows prior to mixing could mean that they receive less aggression following mixing (Kennedy and Broom, 1994).

Conclusions

It is highly likely that strategies such as environmental enrichment and high fibre diets etc. fail to reduce aggression levels at mixing because such strategies simply tackle the symptom, aggression. They fail to deal with the cause, which is the abrupt introduction of unfamiliar animals to each other in confined spaces and the need for these individuals to establish some form of social ranking. For this reason, strategies such as sub-group formation, enriching the social environment of replacement gilts, re-mixing sows back into the groups they were housed with during the previous pregnancy and pre-exposing sows to one another prior to mixing are more likely to be successful in reducing aggression because they take account of the basic social organisation of the species.

Maximising Lactation Feed Intakes

Ciarán Carroll, Teagasc, Moorepark

Introduction

The modern sow has enormous potential for milk production and producing piglets. She has the genetic potential to produce about 30 piglets per sow per year. However, she is currently falling well short of this mark with an average figure of 21.9 produced in recorded herds in Ireland in 2004 (Teagasc PigSys Report, 2004). Nutrition is the key element that enables the modern sow achieve her genetic potential for milk production and reproduction.

While nutrition at all stages of the sow's reproductive cycle is crucial, lactation feeding is the most critical and perhaps the most difficult area to manage. The aim during this period is to maximise feed intakes, minimise weight loss and thus, optimise piglet growth and subsequent reproductive performance. Consider the following:

For each 1 kg increase in average daily feed intake (ADFI), weaning to oestrus interval was reduced by 6.3 days in first litter sows (King & Dunkin, 1986).

Litter weaning weight was increased by approximately 3kg as ADFI increased from 4 to 7kg (Koketsu et al. 1996)

For each additional 1kg increase in ADFI during lactation, an additional 0.11 pigs were born at the subsequent farrowing (Koketsu et al., 1996). No evidence of a plateau in response was observed. Therefore, additional increases in feed intake might result in continued improvements in subsequent litter size.

- Increases in ADFI reduced the probability of an occurrence of reproductive failure on commercial farms (Koketsu et al., 1996).
- For each 1kg reduction in ADFI weaning to oestrus interval was increased by 0.8 days and litter size reduced by 0.3 pigs per sow (Lynch & O'Grady, 1988)
- For every 10kg loss in body weight there can be a 0.5 piglet reduction in subsequent litter size (Charlton 2005).

Considerable debate exists as to how best achieve higher feed intakes during lactation. But firstly, let's summarise the goals of lactation feeding:

- Maximise feed intakes
- Minimise body weight and back fat losses
- Increase sow milk yield
- Increase litter growth rate and weaning weight

- Decrease piglet mortality
- Optimise subsequent reproductive performance in terms of weaning to oestrus interval, conception rate, farrowing rate and litter size.

All phases of the sow's reproductive cycle are related. Therefore, the feeding programme in one phase will have significant effects on performance in another phase. The effects of underfeeding in any one phase may not be seen for several parities.

Maximising lactation feed intakes is a universal problem that continues to prove difficult. While nutritional requirements of the modern sow have dramatically increased, voluntary feed intakes by lactating sows have not increased in proportion to these higher requirements.

Measure Feed Intakes

The first challenge is to measure feed intake. Do we really know how much our sows are eating? Sure, we get our quarterly PigSys analysis showing feed intakes of 1.2 to 1.3 tonnes/sow/year. But how is this broken down? What are our sows consuming at the various stages of their reproductive cycle? I highlight this because of recent experience. A number of units have reported difficulty in getting sows to eat in the farrowing house. On enquiring as to what sort of feed levels were fed I was invariably met with one of two replies:

- I'm not sure, or
- About 6-7 kg/day (which suspiciously coincides with the target figure we quite often hear at meetings and conferences).

Upon further investigation, I had a closer look at feed usage levels on these units. The range in average lactation feed intakes on these units was 4.2kg to 5.4kg per day. My conclusion is that quite often producers think they are giving lactating sows more feed than they actually are, a finding also reported in a recent National Hog Farmer article in the U.S.

Calculate Lactation Feed Intake

Intakes can be relatively easily calculated for any period once we know the following:

- Lactation feed delivered
- No. litters farrowed
- Number of pre-farrowing days and amount feed fed per day during this period
- Average weaning age

As an example, the following data applied to one of the units I investigated:

- Lactation feed delivered (t) = 41.9
- No. litters farrowed = 294
- Ave no. pre-farrowing Days = 4
- Pre-lactating feed levels (kg/day) = 2
- Ave weaning age = 28 Days

The lactation feed intake / day is therefore calculated as follows:

- 41.9t / 294 litters = 142.5 kg / litter
- Pre-farrowing feed (4 days * 2 kg) = 8 kg
- Lactation feed fed (142.5 kg – 8kg) = 134.5 kg
- Lactation feed fed / sow / day (134.5 / 28 days) = 4.8 kg

This is a very useful management tool which should be used routinely (monthly or quarterly) to ensure that lactation intakes are being maximised. As a general guideline the lactation feed should account for about 35% of the total sow feed purchased. Once we have identified a problem we need to search for the causes and remedies.

Causes & Remedies

The causes of poor lactation feed intakes are numerous. I will focus on the most relevant causes, highlight their effects and how best to remedy them.

1. Gestation Feeding: Do not overfeed sows during gestation. There is an inverse relationship between gestation and lactation feed intakes. As the level of feed intake during gestation increases, the level of feed intake during lactation decreases (Table 1).

Table 1. Effects of feed intake during gestation on lactation feed intake

	Gestation Feed Level	
	High	*Low*
Gestation feed level (kg/d)	3.7	1.9
Sow voluntary lactation feed intake (kg/d)	4.9	6.2
Sow weight change from Start of gestation to weaning (kg)	+ 5.6	+ 12.7

(McIntosh & Willis, 2005)

The farm referred to above had an average gestation feed intake of 2.8kg/day. This was borne out by visual assessment of the dry sows just prior to farrowing – they were over-fat. This explained the low lactation intake of 4.8kg / sow / day. Target feed intakes of 2.1kg to 2.4kg

(26-30 MJ DE) per day should be sufficient for gestating sows. Individual sows will vary and these need to be monitored and fed accordingly.

2. Temperature: High temperatures reduce feed intakes. Lynch & O'Grady (1988) showed a reduction in daily feed consumption of about 109 grams, for each 1^{O}C rise in average house temperature during lactation. Similarly, Aherne (1997) reported that a U.S. study showed a decrease in ADFI during lactation of 170 grams per degree centigrade as farrowing room temperature increased from 16 to 32^{0}C. Teagasc suggests that you reduce the farrowing house temperature to 20^{o}C when the youngest piglets are over two days old. Be careful when providing supplementary heat for piglets, e.g. keep infrared lamps away from the sow's head.

3. Ad Lib Versus Restricted Feeding in Early Lactation: current thinking in the U.S and Canada is that the lactating sow should have access to feed at all times. If a trough has been licked clean, the sow has not been offered enough feed. In Ireland (and indeed Europe) we have tended to restrict feeding in early lactation and gradually increase feed levels to reach a peak by day 8-12 of lactation. This practice has been adopted because of the belief that over-feeding sows in early lactation may cause udder congestion and hypogalactia, piglet scours, sow constipation and may lead to sows "going-off" feed in mid-to-late lactation. However, many farms are feeding ad lib soon after farrowing and show no detrimental effects. It's generally an 80:20 problem, i.e. 80% of the problems are caused by 20% of the sows. By gradually increasing feed levels in the first week of lactation we are "restrict" feeding all the sows to cater for the 20% who may have problems. The U.S. / Canadian advice is to ad lib feed all the sows as soon as possible after farrowing and then cater for the 20% of sows who may have problems as they arise.

Belstra et al. (1998) showed no benefits of restricted feed intake during early lactation. Similar findings were reported in a previous study by Koketsu et al. (1996), which recorded intakes for 20,296 sows on 30 farms in the U.S. Sows consuming a low amount of feed throughout lactation and those having low intake during week 1 of lactation had lower piglet weaning weights and were at higher risk of being culled for anoestrus. Their findings suggested that even a temporary reduction in feed intake in early or mid-lactation impairs the normal resumption of oestrus after weaning.

Belstra et al. (1998) recommends the introduction of ad lib feeding the day after farrowing as long as no problems with feed refusal, constipation or other hypogalactia symptoms (mastitis, metritis, agalactia) are noted in the herd. In their study sows fed ad lib consumed 16.4kg more feed over a three-week lactation than sows whose feed was gradually increased over the first week of lactation. Similarly, Aherne (2005) reported 10-15% higher intakes for sows fed ad lib immediately after farrowing. A suggested feeding programme (Young, 2004) is outlined in Tables 2 and 3. Sows are fed 0, 2 or 4kg feed at each of three feedings during the day. If the feeder has greater than 1 kg from the previous meal, no feed is added. The sow should be made stand and water supply checked to ensure an adequate flow rate. However, if there is only a small amount of feed in the feeder (less than 1kg), then 2 kg will be added. If the feeder is empty, 4kg will be fed. Stale or mouldy feed should be cleaned out and fresh feed added.

The only deviation from the above pattern is from day 0 to 2 after farrowing. During this time the decision is to give 0 to 2kg at each meal. It is important with the final feeding in the evening that the sow receives an adequate amount of feed, as it will be 14 to 16 hours before she receives feed again the next morning. The key with this feeding method is the stockpersons ability to judge the individual sows appetite for the previous 2 to 3 meals, thus helping to determine how long a sow has been "off-feed". This is especially important where more than one person is working in the farrowing house.

Table 2: A Suggested feeding method from Day 0 to 2 of lactation

Feed in Feeder	*Kg of Feed*	
	Morning	*Evening*
Empty	2	2
< 1kg	0	1
> 1kg	0	0

Young, 2004

Table 3: A Suggested Feeding Method from Day 3 of Lactation to Weaning

Feed in Feeder	Kg of Feed		
	Morning	**Noon**	**Evening**
Empty	4	4	4
< 1kg	2	2	4
> 1kg	0	0	2

Young, 2004

4. Water: is the forgotten nutrient. Many sows are dehydrated during lactation. At peak lactation sows may drink more than 35 litres per day. To achieve this the minimum water flow rate for lactating sows should be 2 litres/minute.

With wet feeding systems careful consideration needs to be given to water:meal ratios. Large volumes of wet feed may be difficult to consume for sows that don't have sufficient gut capacity, resulting in low feed intakes.

5. Feeder Design: This should be such that access to feed is not restricted. Sows should be able to fit their head comfortably into the trough. Quite often feeders are not large enough and this can be a problem in terms of access to feed. It can also be a problem with wet feed systems feeding a dilute mix where the trough has insufficient capacity to hold the volume fed. Large feeders with a trough capacity exceeding 15 litres are ideal.

6. Lighting: evidence suggests that sows exposed to 14-16 hours light per day (compared to 8 hours) have higher intakes, increased weaning weights and improved rebreeding performance (Patience & Thacker, 1989). Put the lights on a timer switch and leave them on!

7. Feed Two Diets: Feeding separate gestation and lactation diets makes it easier to control body condition and weight loss in different phases of the sows reproductive cycle.

8. Fibre Levels: Feed a high fibre (8%) gestation diet to increase gut capacity. This should encourage increased consumption during lactation.

9. Lactation Diet: This should be a well-balanced, high energy density diet (13.75 MJ DE per kg and 0.9% Lysine). This lysine level may need to be increased where feed intakes are low.

10. Pellets Versus Meal: Feed pellets rather than meal (applicable only for units purchasing feed and dry feeding).

11.Feed Frequency: Feed sows three times daily. Patience & Thacker (1989) reported that sows fed three times daily had higher lactation feed intakes and lower weight loss during lactation than sows fed once per day.

12. Herd Health: monitor herd health. Implement and maintain a thorough vaccination and parasite control (mange, lice & worms) programme.

13. Stockmanship: this can never be underestimated. Quiet and attentive stockpeople who are good to judge individual sow needs and quick to react to them.

Target Intakes

The lactating sow should consume 155kg feed (2131 MJ DE) over a 25-day lactation. This is equivalent to an average daily feed intake of 6.2kg (85MJ DE).

A general rule of thumb is that the average sow requires 2kg feed/day for maintenance plus 0.5kg / piglet nursed, e.g. a sow with 10 piglets should be fed 7kg feed/day. If sows in the herd are consuming less, then steps need to be taken to increase intakes.

Summary

The aim of lactation feeding is to maximise intakes, minimise weight loss and thus, optimise piglet growth and subsequent reproductive performance. Failure to do this results in increased body weight and backfat losses, with associated reductions in milk yield and piglet growth rate. It also has a detrimental effect on subsequent reproductive performance, i.e. weaning to oestrus interval, conception and farrowing rate, and subsequent litter size.

We need to know exactly how much our sows are eating at the different stages of the reproductive cycle. To do this we need to measure feed intakes regularly, especially in the farrowing house. Only then can we identify if there is a feed intake problem.

We need to be aggressive in getting lactation feed intakes up quickly. Feed sows ad lib from farrowing as long as there are no problems with feed refusal, constipation or other health problems.

References: available from the author on request.

Stockmanship & Handling of Pigs

John J. McGlone

Professor, Texas Tech University, Lubbock, TX 79409-2141

John.mcglone@ttu.edu

Introduction

Stockmanship and proper handling of pigs is every bit as important today as it was 100 years ago when educators espoused the benefits of sound husbandry. Sound stockmanship has benefits for the pigs, the stockpeople, economics of the farm, food retailers, and the consumer. Sound stockmanship equals good welfare. And retailers and consumers have an interest in good welfare.

In the USA, animal activists have failed at attempts to criticize the animal producers. Farmers have a warm spot in the hearts of Americans. They are viewed as wholesome and caring. Attacking the farmers is a bit like attacking motherhood. But being critical of food retailers has been an effective strategy that activists have used to impart change. In the USA, McDonald's, Wal-Mart, Burger King, Safeway (etc.) all have a concern about farm animal welfare. If stockmanship is good, everyone is at ease – including the pigs.

In the past few decades, the topic of stockmanship has been pioneered by two notable scientists and educators. Many of us have filled in the gaps in the science of stockmanship and its brother husbandry.

Peter English of Aberdeen Scotland and colleagues published a seminal book on stockmanship in 1992. In that book, it opens up with a picture of all of the pillars of modern livestock production, including the usual characters of nutrition, genetics, housing and the like. The forgotten and undervalued pillar of animal production is the stockperson. High productivity and good welfare are only possible with well trained stockpeople.

Paul Hemsworth of Melbourne, Australia is the other leader in the area of stockmanship. Paul Hemsworth and colleagues developed the concept that a worker's attitude caused a certain behavior among animals under their care. People with a positive attitude caused non-fearful pigs which resulted in high productivity which kept the worker's attitude positive. A person with a negative attitude toward his/her work and the animals caused fearful animals which caused low productivity which caused a continued poor attitude among the stockperson. This concept is now well accepted and is a theme in stockmanship training worldwide.

What is Stockmanship & What are its Benefits?

Stockmanship is a learned behavior that provides sound care for pigs under human control. Good stockmanship includes a sound knowledge of pigs and their requirements. Stockpeople have a basic, perhaps natural, attachment to pigs. They show empathy towards pigs. The stockperson has a keen eye – they can sense slight departures from normal pig behavior and intercede on their behalf. The stockperson is organized, has a plan and knows how to set priorities with the pigs' welfare at a high priority. The stockperson has a set of skills that are consistent with high productivity and humane treatment of pigs.

Stockmanship also includes the disciplines of nutrition, health care, facility maintenance, thermal environment, air environment (air quality/ventilation), lighting, manure management, environmental enrichment, space (floor, feeders, waterers) and record keeping. While these areas will not be highlighted in this presentation, they are none-the-less important components of stockmanship. The focus of this presentation is the areas of stockmanship other than the above disciplines.

The main trait of a good stockperson is their ability to observe normal and abnormal behaviors of pigs. To do so, the stockperson must have a good grasp, perhaps even subconsciously of normal pig behavior. When observations are outside of the template of normal pig behavior on one's mind, then action must be taken to restore behavior to something more approaching normal. That may be by adjusting the temperature, the diets or treating ill animals. The tools that may be brought to bear on a problem are innumerable.

The benefits to good stockmanship in terms of productivity include:

- Increase weight gain and improved feed efficiency
- Less time requires to get the same amount of work done
- Improved farrowing rates and litter size

People have a hard time believing that all of this is possible. We (and others) have shown the increase in pigs per sow per year (ppsy) after stockmanship training. We consistently get 1-2 ppsy improvement in the 6-month period after stockmanship training. In one effort, we surveyed the attitude of people who ran 5 breeding units each of about 500 sows. The data are presented in Figure 1.

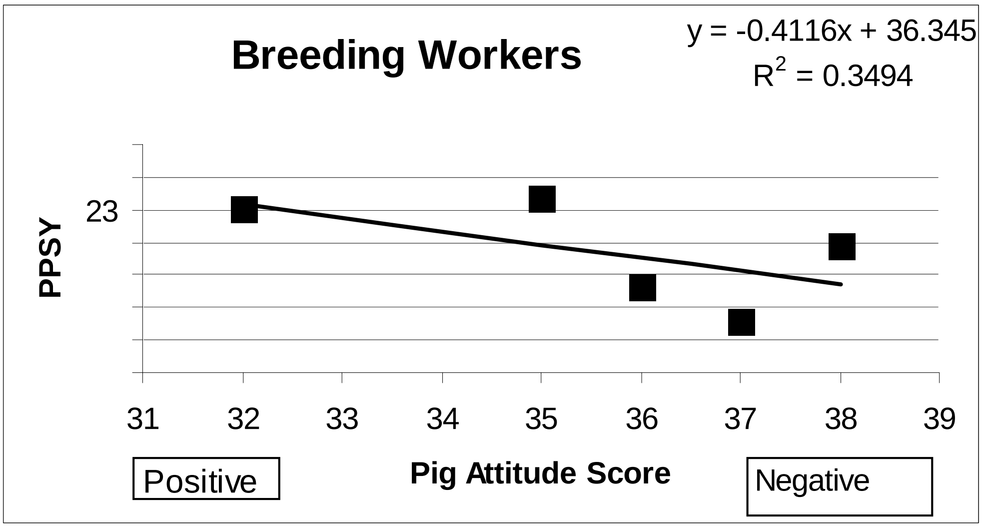


Figure 1. Effects of pig attitude on pigs per sow per year (ppsy). Note that the people with a more positive score produced more than 3 more ppsy.

The Pig Attitude Score is derived from a questionnaire that we developed. It has statements such as: "I like pigs" and you answer strongly disagree, disagree, neutral, agree or strongly agree. You would think that people who work with pigs would strongly agree that they like pigs. In fact, some people do not like working with pigs and they are the ones with lower ppsy on average.

To approach the topic from another direction, Hemsworth et al., (1987) exposed pigs to different types of human handling. Minimal handling involved not touching the pig. Unpleasant involved touching the pig with an electric prod. With pleasant handling, the pigs were gently and positively stroked. With inconsistent handling, pigs were randomly either stroked or prodded.

Pigs that were handled with unpleasantly or inconsistently had slower weight gain than pigs that were handled pleasantly. Interestingly, pigs that were handled minimally grew as fast as those that were handled pleasantly. The different between positive and negative handling was 12% in terms of ADG. Feed efficiency had the same response – pigs handled unpleasantly had an 6-8% worse feed efficiency compared with pigs handled pleasantly or minimally.

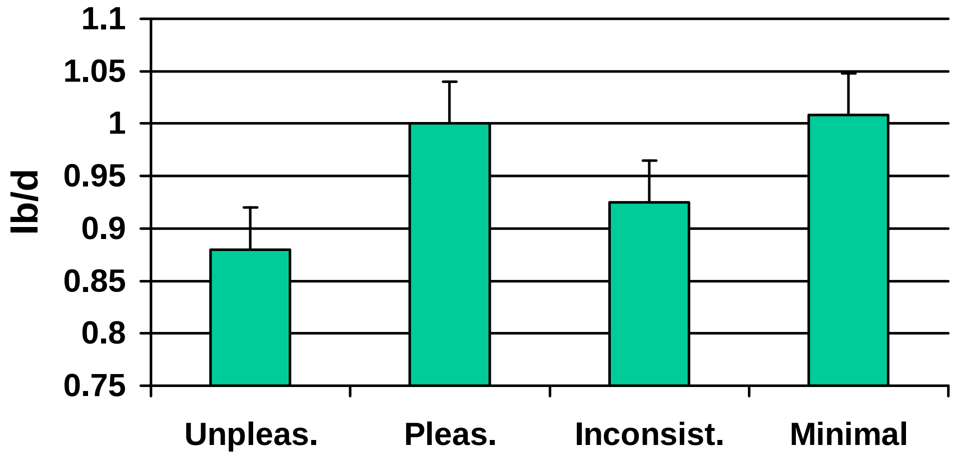


Figure 2. Effects of unpleasant, pleasant, inconsistent or minimal handling on pig average daily gain (ADG). ADG was 12% better when pigs were pleasantly handled compared with those handled unpleasantly. Adapted from Hemsworth et al., 1987.

The take-home message is that pigs should be handled as positively as possible. If problem people work on the farm, they should never handle or touch the pigs.

The Basis of Stockmanship – Pig Observation

The stockperson has a keen eye when it comes to observing pigs. The stockperson understands the nature of the pig. What is it to be a pig? What is the essence of pigness? Stockpeople know. The pig evolved in a forest and was domesticated from the European Wild Boar. The Wild Boar is a scavenger that roots and digs and spends most of its waking moments searching for food. Females travel in small matriarchal units with their piglets. A boar may visit from time to time. Older boars are often solitary. Younger boars may travel in a small band.

The domestic pig has most of the same genes as the Wild Boar. Their basic behaviors are the same. Domestication has made the pig calmer than its wild predecessor, and they were selected for eating a lot, fast growth and leanness in recent decades.

Even if they haven't thought about in this way, stockpeople understand the behaviors of pigs from piglets to adolescents to adults (Table 1 gives normal and abnormal behaviors of pigs on commercial farms). Stockpeople understand normal behavior and they can easily detect abnormal behaviors. They can understand signs of illness or pain and they know when and how to intercede on behalf of the suffering animal.

Table 1. List of normal and abnormal behaviors of pigs. See Table 2 for a list of behaviors associated with pain or distress.

Normal	*Abnormal*
Interest in surroundings	Either hyper excited or dull
Willingness to move around	Difficulty or unwillingness to move
Explorative; rooting & chewing	No rooting, chewing
Tail wagging	Tail flaccid
Non-fearful reaction to handling	Fear of people
Vocalization when feed delivered	Excessive vocalization; inappropriate vocalizations
Willingness to eat when feed is delivered	Unwillingness to eat
Normal resting patterns; more than 70% of time resting	Abnormal sleep patterns; less than 50% of time resting
Normal nursing, feeding, drinking, defecation behaviors; fewer, larger meals as they get larger	Abnormal nursing, feeding or drinking behaviors (too much or too little)
Normal non-aggressive interactions; teat order, dominance order	Excessive fighting; wounding; gilt savaging of piglets
Proper body condition	Thin or fat
Set point for oral-nasal-facial (ONF) behaviors (these are expressed at a certain level in healthy environments)	Too much of one sequence of ONF behaviors (stereotyped); excessive ONF; Tail, navel, ear or limb chewing, or sucking

To be an effective observer of pigs, one must observe them at least twice per day. The observation should include the pigs' general comfort and health, their availability of feed and water and any facility problems. The stockperson also knows what to do in case of an emergency.

The stockperson knows when pigs are in pain or distress. They also know what to do when pigs are in pain or distress. Table 2 gives signs of pain and distress in pigs as well as some action items.

If a given pig is unlikely to survive or resolve an injury in a timely manner (a few days) then the pig should be humanely euthanized. In the USA, we recommend certain methods of euthanasia. The two criteria for a method of euthanasia are that is effective (render insensible as quickly as possible) and that it is safe for people. Human safety on the farm usually precludes use of chemicals that will kill a pig (because of dangers of abuse) but these are used more often at a university setting or by a veterinarian. Preferred Euthanasia methods are given in Table 3.

Table 2. Signs of pain and distress in pigs & What to do about pain.

Signs of pain or distress:
Increased vocalization, especially when palpating a painful area (at other times pigs vocalize when not in pain) Increased aggression Guarded posture Self mutilation Intense rubbing or scratching of skin Abnormal appearance or behavior Lameness, swollen joints, broken bones, or hoof pad damage Bitten tail, ear, vulva or prolapsed rectum Physical injuries Infectious diseases Rough handling Standard agricultural practices (tail docking, castration, teeth clipping, tattooing, ear notching)
Action items when pain or distress are observed:
Relieve the causative factor, if possible; if not; Euthanize Give remedial medical treatment according to farm and veterinary policies on the farm Or use humane euthanasia Report/document Provide a description of the situation Document remedy or therapy Document how the situation was resolved

Table 3. Preferred Methods of Euthanasia for Pigs (USA recommendations)

Worker safety and humane euthanasia are important considerations

Recommendations:

- CO_2 chamber for young pigs
- Blunt trauma may be used to euthanize piglets if people are properly trained and the method is effective
- Penetrating captive bolt and exsanguination for older pigs
- Overdose of anesthetic or euthanasia solution

Proper Pig Handling

Pig Biology. To understand how to handle pigs, one first has to understand some pig biology. Pigs are well-suited for domestication because they eat a great deal, they are not too picky about what they eat, they breed in captivity and they are able to be handled and made calm. But other features of the pig are important to know when they have to be handled.

Pigs have a very good memory. They remember both good and bad experiences. Their memory lasts longer than we keep them around, so you have to be careful what you teach them. Most stock people know about the pig's memory. If you caught a sow to be bled once, the next time you try to catch her, she remembers and she tries to avoid being caught again. The catching episodes could be a year apart and it doesn't matter – the pig remembers.

Pigs develop a certain reaction to people. Their reaction could be anywhere on the continuum from fear to total ease. The way you handle them determines their reaction to other people as well. For some procedures, they generalize from one person to another. For other, more rare or more routine procedures they will not generalize. For this reason, some people who collect blood wear a unique color clothes so pigs do not develop an aversion to the regular stock people.

Pigs will follow other pigs. If they experience a new environment, one will be more brave and he/she will explore. Others will follow. When pigs are startled, they all freeze. The dominant pig moves first and then the others move.

Pigs will explore as they move along to new environments (or in their environment). They will explore unique, lighting, smells, surfaces, sounds or other animals. If any novel feature is in their environment, they are likely to explore it.

Pig Stress. Pigs are stressed by events in their lives (like transportation) they we consider necessary. Birth is the first stressful event in the pig's life. Weaning is the next stress we impose on them. Any time pigs are handled in a novel way, it is stressful. Routine handling is not as stressful.

Transportation is a necessary stressor for pigs. They must be moved and often transported several times in their life. The last transport – to harvest – is a novel experience and thus it is stressful.

Pigs handle and move differently when stressed. They have to be moved slower and as calmly as possible. Screaming, hitting, waving objects and general intensity add to the stress of being moved through a novel environment.

Negative Effects of Poor Handling. All stress including some forms of handling will cause a stress response. The stress response begins with the realization that the environment the pig is in is unfamiliar, which induces a fear and excitement that we call stress. The heart rate increases, breathing becomes more rapid, and stress hormones are secreted. The brain initiates a cascade of hormones that course through the body of the pig. The blood and meat become acidic. Health problems will arise if the stress continues. Growth and feed efficiency will decline. Pig productivity will be reduced and it will be more variable. In all, poor handling leads to a stress response and poor welfare.

The problem caused by stress hormones is a change in metabolism. The pig enters a period of cardiac and respiratory distress. Some metabolism will become anaerobic. Muscles will cramp with lactic acid. The muscles become fatigued. Then the pig's whole body becomes fatigued and the pig goes down. When all pigs are prodded 8 times in a walk way, 25% of the pigs go down. Any pig can be induced to go down if stressed enough.

The goals during handling are to:

- Reduce stress
- Move pigs in a timely manner
- Eliminate down/fatigued pigs
- Prevent injuries to pigs or people

Pig Behavioral Responses to Inappropriate Handling.

What do pigs do when they are handled roughly? They have several internal responses that are described above. Behaviorally, they show three undesirable behaviors:

- They stop

- They turn back
- They vocalize (in a certain way).

In the USA, the rate of vocalization is recorded by auditors. When the percentage of pigs that vocalize exceeds 20%, a welfare problem is assumed to be caused by the rough handling.

Causes of pig behavioral problems other than the people.

The stock persons are not the only cause of pig behavioral problems during handling. The main issues, besides people include:

- Facilities
- Weather
- Equipment
- Handling devices or techniques

All of these are important. But it is the people that will solve the problems. If the facility is in poor repair and drafts come in through cracks in the chute (causing pigs to balk), then it is the people that can solve this problem.

Which features of the building cause pigs to pause or stop?

The main facility features that cause pigs to stop when being handling include:

- Floor surface color, pattern, texture, drains, lighting
- Solid, uniform floor surface = less time for pigs to walk
- Features of penning or walls
- Sensory distractions – odor, noise, or visual distractions
- Objects in the path
- People in the path due to poor design
- Drafts – cold wing
- Funnel shaped aisles or chutes that cause pigs to jam

How Much Handling is Enough?

First, we are certain that negative handling (slaps, hits, kicks) do no good for the pig or the person. Assuming handling is only positive, how much is enough? The answer is that any amount of positive handling is good. If pigs have any negative handling, they will be more stressed by the presence of people.

We recommend that pens we walked once or twice per day. This means getting in the pens of nursery and grow-finish pigs. The only reason not to do this is if there is an active disease or disease treatment that you will transmit from pen to pen (respiratory, enteric diseases or parasites). In this case, do not walk the pens.

As little as one positive walk-through in pens a week will improve the reaction of pigs to human exposure. But in a study we conducted (Hill et al., 1997), pigs that had enriched environments and daily human contact did not move through novel chutes/pens any quicker than pigs that were isolated or had once per week positive human contact.

If pigs must be touched, especially sows, they should be stroked and touched gently. They should not be slapped, kicked or spoken to in a loud voice. If the slap can be heard, it is probably too hard.

Moving devices.

We have a number of common devices to move pigs. The most common are the board, paddle, electric prod, and the newer flags and capes (Figure 3). The key question is, which devices are the most effective?

We conducted a number of studies to evaluate the efficacy of moving devices. We measured the time it took to move pigs through a novel course. Pigs moved with a board required less time to move than when a paddle or electric prod were used. By this measure, the board was the most effective device.

Pigs moved with a paddle vocalize and turn more often than pigs moved with a board or prod (Table 4). Pigs vocalized much more when an electric prod or paddle were used rather than a board. These results indicate that from a welfare point of view, only the board is acceptable. Pigs that are repeatedly prodded are more likely to go down. In one field study, when the percentage of pigs prodded rose from <10% to over 50%, the number of pigs going down at a processing plant likewise rose 5-fold. The rate of pigs going down from fatigue is directly proportional to the rate of pigs struck with an electric prod.

Desirable Human Behavior during Handling.

Not only should we be concerned with the less-desirable behavior (like prod use), we should be encouraging more positive behaviors. The desirable behaviors and thought process include the following:

- Quiet talking; not screaming

- Touching and stroking, not slapping, hitting or kicking
- Move steady; don't run
- Understand pigs flow like water
- Don't leave openings
- Avoid sharp turns
- Avoid stops; keep the flow steady and in one direction

Handling Pigs During Transportation.

One critical time that pigs are handled is when they must be transported. Transportation is almost always stressful to the pig. The only way transportation would not be stressful would be if the pigs were acclimated to repeated transport (which is not usually desirable or practical).

The facilities and truck must be prepared for the transportation experience. The temperature should be uniform in the building, the chute and the truck. This may require heating the chute and/or truck in the winter.

The floor area and surfaces should be uniform in color and texture. The floor should be cleaned before the transport experience (not during). The aisles and chutes and truck should be observed prior to loading for sharp objects, and they should be eliminated.

Pigs should be handled calmly taking advantage of their flight zone. The flight zone is an area around the pig that the pig carries. When you enter the pig's flight zone, it moves away from you. The key is to enter the flight zone from the rear if you want the pig to move forward. If you get too close to the pig, it may turn around which is usually counter to the objective of moving pigs forward.

The preferred device is the board. Electric prods should be avoided. If the load crew feels they need an electric prod, then the facilities and procedures should be reviewed and changed, and training should be given to prevent the cause of the perceived need for the electric prod. Finally, non-ambulatory animals should never be dragged or abused. Other pigs should not be allowed to run over down/fatigued pigs. Down/fatigued pigs can be moved by use of a sled. The sled is placed under the pig and then the sled is pulled with the pig on board. The objective is to not cause friction burns on the skin of the pig when it is moved.

Table 4. Pig reactions to boards, paddles and electric prods. Adapted from Anderson and McGlone, 2002. Within a column, items in bold are significantly different from non-bold items.

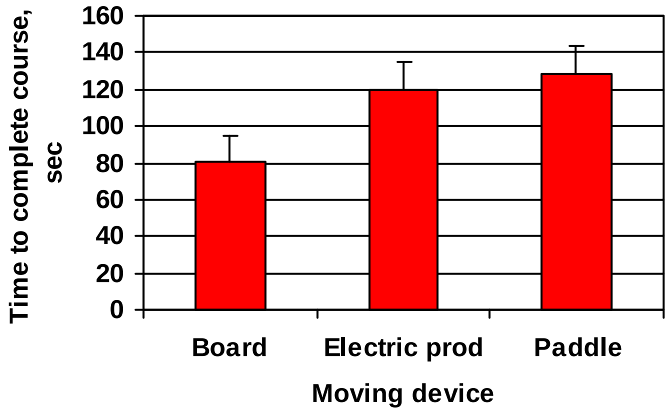
Device	*Turning*	*Vocalize*
Board	29.6%	3.7%
Electric prod	22.2%	**51.8%**
Paddle	**40.7%**	**59.2%**

Conclusions

Stockmanship is a learned behavior and anyone who likes working with pigs and has some patience can learn to be an excellent stock person. Sound pig stockmanship is good for productivity, farm profits, and the welfare of the pigs.

Figure 3. Common devices to move pigs.

Figure 4. Time to move pigs with different devices. Anderson and McGlone, 2002.



Selecting Gilts for Increased Sow Longevity

Peadar Lawlor, Teagasc, Moorepark

Introduction

In a survey of 24 Irish herds Boyle (1996) found that 32% of sows are culled before their third parity. The same survey found that 4% were removed as gilts before they were even served while 15% were lost in parity 1. Martin (2001) using data from the Pigsys data recording system found this figure to be even worse than previously estimated. He found that 13% of gilts introduced onto the unit are removed (12% culled and 1% deaths) from the herd and fail to have even one litter.

Cost

This loss of introduced gilts and early parity sows represents a major cost. These include the initial purchase cost of the gilt, the cost of rearing and acclimating the gilt. Martin (2001) estimated that the financial loss on a home reared gilt that fails to produce a litter was €51. There are further costs associated with having to introduce high numbers of maiden gilts. These include the increased risk of introducing disease, and the lower productivity of young sows. Because of this it is estimated that a gilt must survive in the herd for 3 to 4 parities in order to cover the costs associated with her replacing an old sow (Stalder *et al.*, (2003).

Cause

Boyle (1996) found that parities 0 and 1 accounted for approximately one third of all sow removals due to reproductive failure, locomotor problems, death, disease / illness and injury. In contrast parities 0 and 1 accounted for only 2% of all discretionary culling on the basis of poor performance. Reproductive failure and locomotor problems are the main causes of culling in parities 0 and 1, accounting for approximately 56% and 20%, respectively, of all removals in these parities.

Therefore, before introduction to the breeding herd, it is essential that maiden gilts should get a rigorous visual assessment for

(1) good conformation / structural soundness

(2) sound feet and legs

(3) good reproductive traits

These three assessments will be the subject of this paper. Of course many other factors such as management and nutrition will also affect longevity, however, introducing the correct raw material to your herd should be the first starting point.

'Ní déanfar capall rásaí as asal'.

1. Conformation and Structural Soundness

Desirable front and rear leg structure is shown in Figure 1, while undesirable bone conformation is shown in Figure 2.

Figure 1 shows the type of gilt that should be selected for introduction onto the unit. She has a flat top, level rump and high tail setting. As you view the animal from the side, note the front leg slope from the shoulder (M). This angle allows for the normal shock-absorbing effect at the point of the shoulder (B).

The angle displayed in the rear legs (N) of Figure 1 is smaller than that shown in Figure 2. The rear leg joints in Figure 1 are properly angled to allow the hip (E), stifle (F) and hock joints (G) to absorb pressure more equally. The pasterns (D) are sloping and long to provide a cushioning effect and the toes rest squarely on the floor surface.

Figure 2 is a representation of a gilt with undesirable front and rear leg structure. The rear leg structure shows a rump that is too steep and the tail setting is too low. The angle (N) is larger in Figure 2 than the angle shown in Figure 1. Therefore, the hip (E), stifle and hock joints lock in a straight line position with each step the animal takes. The pasterns (D) are short and straight, which offers the appearance that the animal is standing on its tiptoes. Often these animals have shorter toes with a higher tendency towards injury (cracks, tears, bruises) and uneven wear. The rear feet of these straight-legged animals may exhibit excessive sole wear with subsequent injury or swelling of the pads of the feet and, consequently, lameness.

The spine of the animal in Figure 2 is arched very high. The angle (M) is greater than 90^0, which positions the shoulder blade bone more directly over the bones of the front legs. Additional pressure may be applied at the point of the shoulder (B) and at the knee joint (C) to compensate for this straightness. As a result, the knee joints often buckle. The abnormally straight front leg posture in Figure 2 results in abrasion of the pads and toes.

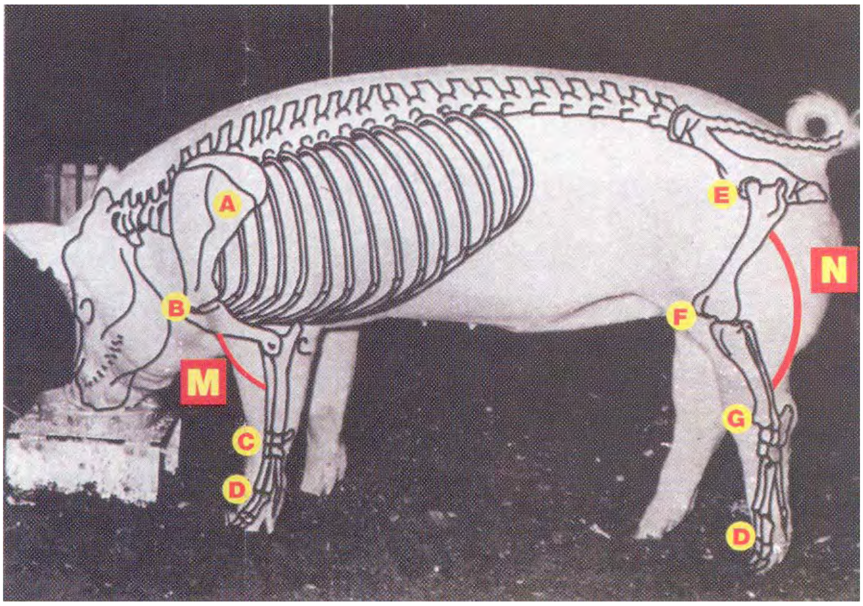


Figure 1. Desirable front and rear leg structure (Stalder and Baas, 2005a)

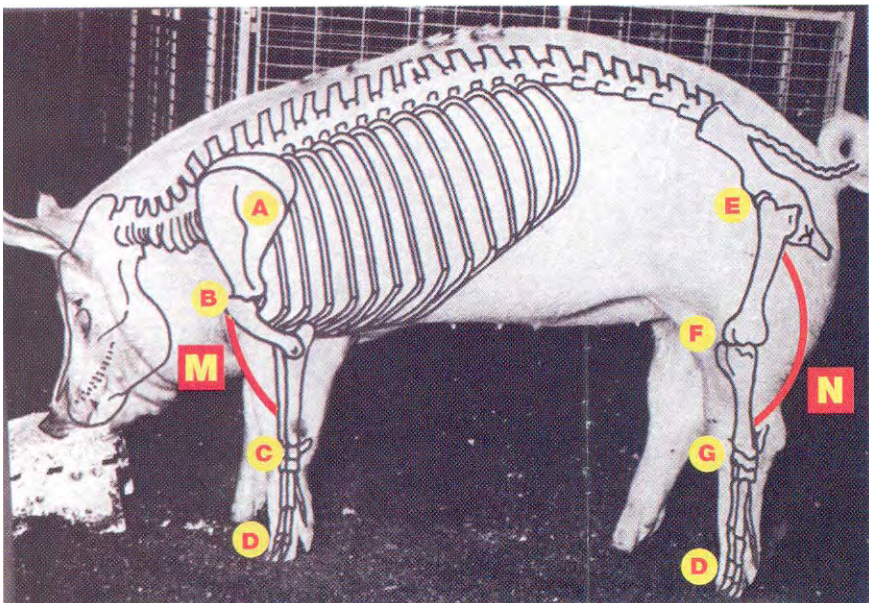


Figure 2. Undesirable front and rear leg structure (Stalder and Baas, 2005a)

2. Feet and leg soundness

Feet and leg unsoundness caused by toe size, unevenness of toe sizes, skeletal structure and/or injury to feet and legs are constant concerns that ultimately affect replacement gilt longevity. Cracked hooves, torn pads and swollen legs or joints are common causes of lameness and remain a leading cause for culling replacement gilts and sows.

The most common toe defect is small inside toes of the front and rear feet. As the gilt gets older and heavier, the legs tend to conform to the shape and size of the toes. Avoid gilts that have 12mm (½ inch) or more difference in toe size on the same foot. The larger toe is more likely to develop lesions. Small inside toes are inherited.

The ideal foot should have two fairly even toes that are big and slightly spread apart to improve ease of movement and stability. The outside toe is normally slightly wider and longer than the inside toe. It is important to select gilts with good slope and cushion in the pastern, which allows the sole of the foot to rest squarely on the floor surface.

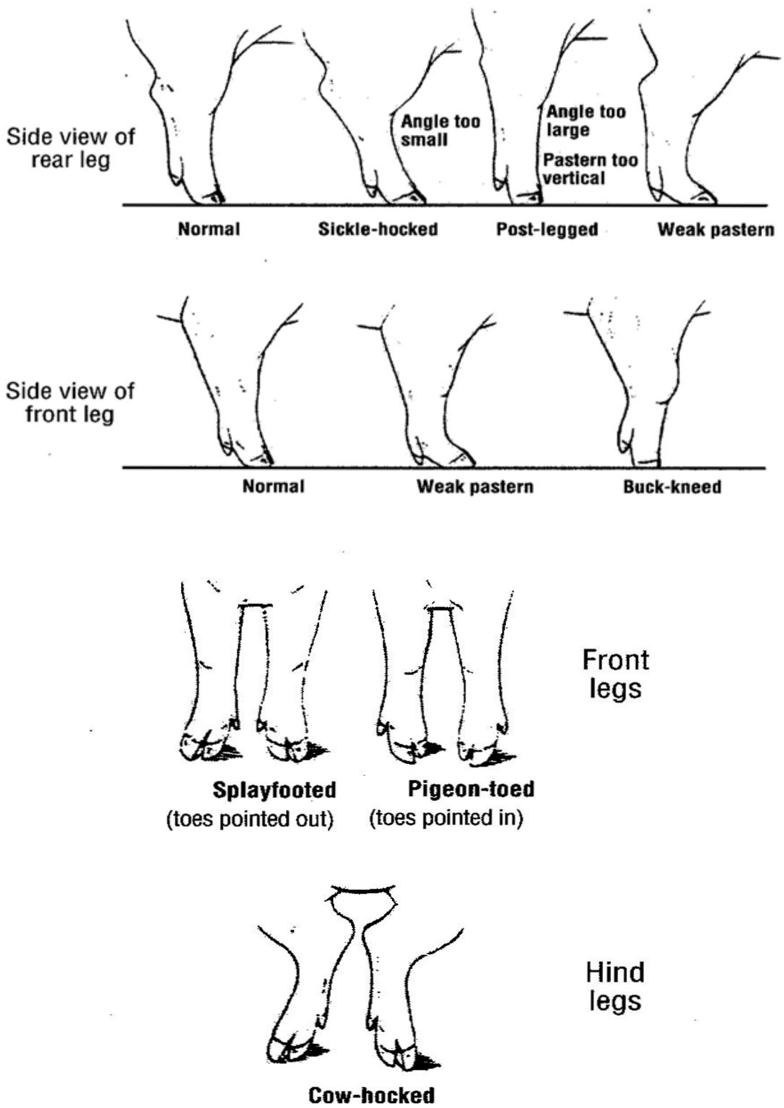


Figure 3. Illustration of leg structural deficiencies (Stalder and Baas, 2005b)

In addition to toe and foot size and leg structure, abnormalities of the bone and cartilage (osteochondrosis), disease or infectious agents causing arthritis, nutrition, genetics, floor surface and exercise can affect feet and leg soundness.

3. Reproductive Soundness

All candidate replacement gilts must clear one final hurdle before being selected - successful screening of the mammary system and female genitalia.

Beginning with the mammary system, teat number, placement and quality are the primary criteria. All teats should be functional. Avoid selecting blind or inverted teats, pin teats, damaged teats and large, coarse teats whenever possible.

Six, evenly spaced functional teats per side is the minimum requirement. Most prefer 14 functional teats. Teats should start far forward on the abdomen. Teat rows should be relatively close to the midline of the abdomen. Teat rows that are too far apart when the sow lies down puts the top row of teats out of reach of newborn piglets. Alternatively the bottom row may not be adequately exposed.

Screening for vulva size and development is another critical step in gilt selection. Avoid gilts with small or infantile vulvas. These are indications of an underdeveloped reproductive tract that may never conceive, or could present problems at farrowing. Tipped-up vulvas should also be discriminated against. In addition, an injured vulva could prevent successful breeding or cause farrowing difficulties. If severe, gilts with such conditions should be culled or at the very least breeding should be delayed until they are fully healed.

Summary

Excessive numbers of maiden gilts and young sows are being culled from Irish herds on an annual basis. This incurs a substantial cost on units since the replacement rate must be increased to maintain farrowings. The cost associated with gilt purchase, rearing and acclimating the gilt are easily estimable. However, more difficult to estimate is the increased risk of disease introduction and reduced productivity associated with an excessive replacement rate. Reproductive failure and locomotor problems account for approximately 56% and 20%, respectively, of all removals in parities 0 and 1. Therefore, it is essential that before introduction to the breeding herd maiden gilts undergo a rigorous visual assessment for good conformation / structural soundness, sound feet and legs and good reproductive traits as part of their selection (Figure 4).

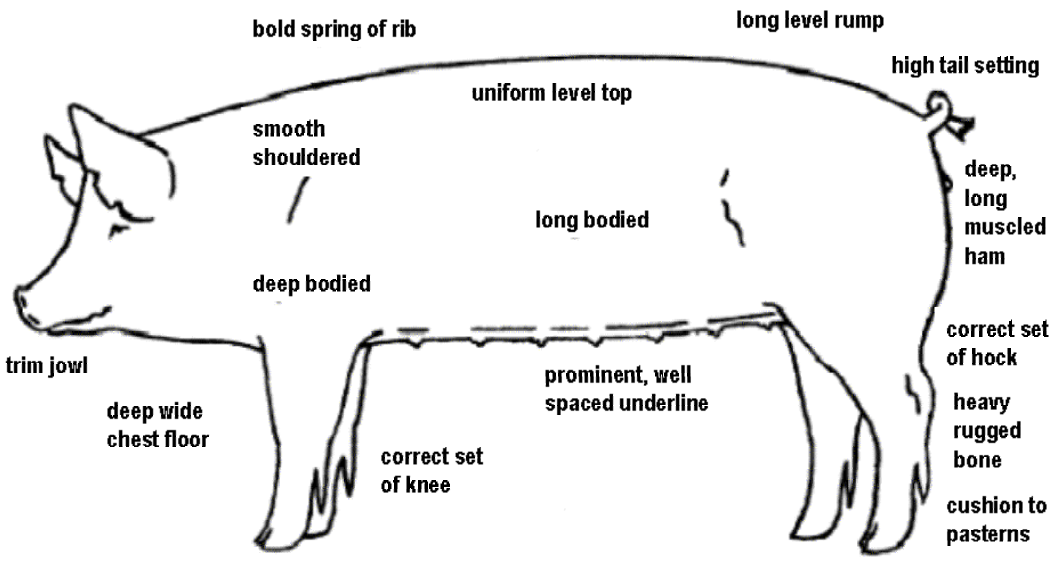


Figure 4. Selection criteria for the ideal gilt

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Designing a pig unit for the future

Michael A. Martin, Athenry

There are now significant constraints on the development of both new and existing pig production units in Ireland. There is a substantial amount of legislation that dictates what development can take place. Restrictions on the application of pig manure to farmland under the Nitrates Action Plan are a serious constraint to development. Pigmeat processors and retailers also exert a significant influence through various Quality Assurance schemes and Codes of Practice.

Legislative Framework

There are now legislative restrictions on where and how pigs will be produced. Most of this legislation derives from EU Directives. These controls include

Planning Permission required for all pig buildings (in excess of $75m^2$ total area) and mandatory Environmental Impact Statements for units in excess of 200 sows finishing progeny or equivalent.

Integrated Pollution Prevention and Control (IPPC) licence required for units of
275 sow places finishing
750 sow places breeding weaners to 30kg
2000 pig finishing places.

Comprehensive welfare requirements in relation to how pigs are housed and managed

Restrictions on the amount of pig manure / organic nitrogen that can be applied to land

Processor/Retailer Requirements

There are various Quality Assurance Schemes are in operation. These are subject to regular review and this invariably involves an increase in the standards required for approval. The revised Bord Bia scheme is based on the EN45011 standard and will involve independent auditing of participating units.
Pig slaughter weights have been increasing. This is in response to increases in the maximum carcass weight at or above which price penalties apply. Concerns still exist in relation to the risk of boar taint from entire males and to increased carcass fatness especially in gilts.

Herd Size

In Ireland, pig production is now concentrated in less than 500 commercial herds. The latest Teagasc survey of commercial pig herds (2005) shows that the national sow herd of 154,300 sows is based in 364 sow herds. The average sow herd size is 424 sows. Just two thirds of the sows are in herds of 500 sows and over and 80% of sows are in herds of 300 sows and over (Table 1).

Table 1: Percentage of National Sow Herd in different Herd Size Categories

Herd Size (Sows and Served Gilts)	*% of Sows*
<100	2
100-200	6
200-300	12
300-500	14
500-1000	30
>1000	36
Total	100

Source*: Teagasc Pig Development Unit 2005.*

This level of concentration is unusual and is not seen in the other main pig producing countries (Table 2).

Table 2: Sow Herd distribution by Herd Size in Ireland Denmark (%)

Sow Herd Size	*Ireland*	*Denmark*
<100	2	5
100-200	6	11
200-300	12	17
300-500	14	27
>500	66	40
Total	100	100

Source: *Teagasc Pig Development Unit 2005, Statistics, Danske Slagterier 2004.*

In the Netherlands (1999) 6.8% of sows were in herds of less than 100 sows while 23.2% were in herds of 100-199 sows.

The trend towards very large integrated herds is unlikely to be sustained. Planning and licensing considerations will restrict the development of such units. In addition, the problems caused by diseases such as PRRS and PMWS are likely to lead to a re-assessment of production systems. A move to multi-site production may well be necessary for some of the larger units.

Biosecurity

The impact of disease on the profitability of pig production can be devastating. When vaccines and anti-bacterials are available the impact can be reduced but at a significant cost. The newer diseases due to viruses (PRRS) or of uncertain cause (PMWS) pose a major challenge when they occur.

Effective biosecurity procedures will be a fundamental requirement for all units. Constant vigilance is required to minimise the risk of introducing disease. This starts by controlling access to the unit.

Staff Facilities

A serious shortage of staff to operate pig units in Ireland has been avoided by the employment of relatively large numbers of non-nationals. This has been done quite successfully and there is no firm evidence of any drop in herd performance. This may well reflect the quality of the staff recruited and the contribution made by the existing, experienced Irish staff.

Staff must be provided with regular training such as refresher courses if technical efficiency is to be maintained and improved. Lack of motivation and a reluctance to change routines and to adopt new technology is a recipe for a steady decline in herd performance.

To retain and motivate all staff the level of remuneration is important. However, good working conditions are also an important consideration. Too few units have good staff facilities such as showers, canteen and clean protective clothing. Pig units must provide and maintain facilities comparable to those available to employees in any other business. Good facilities are no longer a luxury but an essential element of any modern unit.

Dry Sow Housing

From January 1st 2013 sows will have to be loose housed from 4 weeks after service until 1 week before the date due to farrow. This means that 67% of dry sows and served gilts will have to be loose housed. The remainder of the dry sows and served gilts (33%) can be, legally, housed in stalls. This represents a major change from the housing in use in January 2005.

Table 3: Dry Sow Housing in Ireland (January 2005)

Type of Housing	*% of Dry sow/Served Gilt Places*
Stalls	52.1
Tethers	29.1
Loose	18.7

Source: Teagasc Pig Development Service.

For a national herd of 154,000 sows the change required by 2013 is summarised in Table 4

Table 4: Changes required in dry sow housing in Ireland (2005- 2013)

Year	2005	2013	Change
Stalls	71500	45000	-26500
Tethers	40000	0	-40000
Loose	25500	92000	+66500

Lose housing will have to be provided for at least 66,000 dry sows over the next 7 years.

Weaner / Finisher Accommodation

Pig slaughter weights have increased significantly in the last decade. Average slaughter weights in recorded herds have increased by 7.5kg dead since 1995.

Table 5: Pig Slaughter Weights in Ireland (1995-2004)

Year	Average Deadweight kg
1995	65.5
1998	67.7
2001	69.6
2004	73.0

Source : Teagasc PigSys Report 2004

Concerns in relation boar taint and carcass fatness will curtail further increases but most units should aim to take pigs to an average of 100kg liveweight (76kg deadweight).

The number of weaner and finisher places required will be determined by:

- Number pigs produced per sow per year

- Growth rate weaning to slaughter
- Average slaughter weight.

Provision has to be made also for :

- washing and disinfecting of pens between batches.
- occupancy levels

Current average growth rates from weaning to slaughter on units (597g per day) mean that pigs take 156 days to reach 100kg from weaning i.e. over 22 weeks.

Table 6: Growing Pig Accommodation required per 100 sows*

	No. Pigs Produced per Sow per Year		
Growth Rate g/d	*20*	*22*	*24*
600	892	981	1070
625	858	944	1029
650	826	909	992

**An extra 7 days accommodation is provided for washing, disinfecting and drying of pens.*

Increasing output by 1 pig per sow per year increases housing required by 40-45 pig places per 100 sows.

Increasing growth rates by 25g per day reduces housing requirements by 30-40 pig places per 100 sows.

For the present, totally slatted floors are permitted for weaners and finishers. However, from 1st January 2013 all concrete slatted floors will be required to meet the following specifications (Table 7).

Table 7: Minimum specification for concrete slatted floors

Pig	*Minimum Slat Width mm*	*Maximum Gap mm*
Weaner	50	14
Finisher	80	18

These requirements already apply to new or rebuilt houses.

Farrowing

Average weaning age in future will be at least 26-27 days. Provide accommodation for 5 weeks farrowings to allow for washing and moving sows in about 5 days before the date due to farrow.

Piglet losses are in excess of 9% of the Number Born Alive in recorded herds. This is in addition to the 0.74 pig Born Dead per litter. (Table 8)

Table 8: Born Dead and Piglet Losses in recorded herds 2004

Number Born Alive per Litter	11.16
Number Born Dead per Litter	0.74
Piglet Mortality%	9.1
Total Piglet Deaths as % Total Born	14.75

Source: Teagasc PigSys Report 2004

Good farrowing accommodation does not guarantee reduced piglet losses. However, with good management and close supervision, good farrowing facilities will contribute to fewer losses and more pigs weaned per litter.

Most piglet losses occur or are caused within the first 48 hours after farrowing.

Table 9: Piglet Mortality in recorded herds - 2004

	Average	*Top 25%**
No. Born Alive	11.16	11.25
No. Born Dead	0.74	0.66
Piglet Mortality %	9.1	6.8
Net weaned per Litter	10.14	10.49

**Selected on basis of Piglet Mortality*

The herds with the lowest Piglet Mortality also have fewer pigs Born Dead per litter.
The Total Born per litter is the same for both groups.

Attention should be focused on preventing newborn piglets being chilled by having a warm (24°C) farrowing room with supplementary heating also provided at the rear of the pen and in the creep area. Newer developments in pen flooring and crate design appear to have significant potential to reduce overlying losses.

Pig Manure

The Nitrates Action Plan requires that a minimum manure storage capacity equivalent to 26 weeks production be provided on pig units throughout the country. Increased manure transport costs are inevitable as a result of the restriction on the amount of organic nitrogen that may be applied per hectare. Minimising manure volumes will reduce storage costs but exert the biggest savings by reducing transport/handling costs. The volume of manure produced is directly related to the amount of water used or that gets into the storage facilities.

- Minimise the water to meal ratios in all wet feeding systems without compromising pig welfare.
- Use drinkers that minimise spillage.
- Eliminate leaks.
- Review washing and disinfecting procedures including use of detergents and pre-soaking.
- Use of building materials and equipment that are easily washed.
- Divert away roof and clean yard water.

On an integrated unit the volume of neat excreta, which excludes extraneous water, could be as low as $12m^3$ per sow per year with dry feeding. This manure would have about 6.3% dry matter, on average. In practice, the volumes of manure produced per sow per year are considerably in excess of this.

Energy

Energy costs have risen sharply in recent times and this trend appears set to continue.
As energy costs increase greater emphasis is required on reducing energy usage. There is considerable scope to reduce energy usage on many units. This reduction can minimise the impact of rising fuel prices on production costs.

Table 10: Energy Consumption per Pig by Production Stage

Production Stage	Typical	Good Practice
Farrowing	8	4
Weaner	9	3
Finishing	10	6
Feed System	3	1
Manure	6	2
Total	36	16

Source: *The Carbon Trust UK*

The cost of Heat, Power and Light on recorded herds in 2004 was €2.62 per pig or 3.6c per kg dead. This would suggest that usage is well over 25 KWh per pig. The use of naturally ventilated buildings on some recorded units would have helped reduce energy use. In designing units for the future, methods of conserving energy should be to the fore including heating and ventilation control.

Investment

Most pig units will be required to make substantial capital investments in the coming years if they are to continue in business and remain competitive. The total capital investment in developing a greenfield site is not less than €4000 per sow or €2m for a 500sow unit selling at 100kg. This does not include the cost of the site. The return on capital invested in new pig units compared to alternative investment opportunities has not warranted such investment in recent years. The upgrading of existing units is likely to involve a lower overall investment. This investment must provide a satisfactory return and should be carried out in compliance with the existing legislation and comply with current best practice.

Slaughter weight - How heavy can you go?

Karen O'Connell & Peadar Lawlor, Moorepark

Introduction

The recent increase in carcass weight has occurred because of associated profitability (Lawlor, 2003). Average carcass weight in Ireland is currently one of the lowest in Europe, at just 73 kg. It is clear that there is scope for a further increase. Greater profitability is due to relatively unchanged feed costs, while non-feed costs are reduced per kg carcass. Processing heavier carcasses improves factory efficiency, i.e. lower costs per kg carcass, provided meat quality and market demands are not compromised. But how heavy can you go? Increased slaughter weight has been examined recently in Moorepark (Mullane, 2004; Lawlor et al., 2005) and the aim of this paper is to illustrate the effects of increasing slaughter weight, in a responsible manner, on the production, performance and profitability of entire male and female pigs.

Pig performance as slaughter weight is increased

Lawlor et al. (2005) examined target slaughter weights of 80, 90, 100, 110 and 120 kg. The effect of increasing slaughter weight is presented in Table 1. Daily feed intake (DFI) increased with slaughter weight while feed conversion ratios (FCR) deteriorated. Increasing slaughter weight increased time to slaughter from 105.6 to 147.3 days from weaning. Kill-out percentage increased up to 110 kg but dropped off at 120 kg.

Table 1. Effect of slaughter weight on pig performance from weaning to slaughter (entire male and female pigs combined)

Slaughter weight, kg	**80**	**90**	**100**	**110**	**120**
Days	105.6	116.8	127.2	140.3	147.3
Feed/day, g	1602	1746	1810	1818	1904
Kill out, %	75.4	76.1	76.1	76.9	76.6
Carcass lean, %	57.9	58.7	58.4	58.9	**55.9**
Backfat, mm	11.1	11.9	12.9	13.8	13.1
Carcass ADG, g/d	546	568	584	573	581
Carcass FCR, kg/kg	2.92	3.10	3.11	3.18	3.29

[1] *Linear and quadratic effects; + = P<0.10; * = P<0.05; ** = P<0.01*

Lean meat

Carcass lean meat (LM) content increased up to 90kg, reached a plateau and declined after 110kg. The reduction was due to reduced lean estimates of boars, not gilts. However, studies by Mullane (2004) indicate that the Hennessy Grading Probe (HGP) consistently underestimates the actual LM content in very lean pigs, highlighting a necessity to revalidate the prediction equations used with the HGP measurements.

Despite reduced LM content at 120 kg (Figure 1a), greater carcass weight ensured a continual rise in LM yield with increasing slaughter weight (Figure 1b). The LM yield (kg) can be calculated from the data received from the slaughter plant i.e. carcass weight multiplied by the proportion of lean.

1a

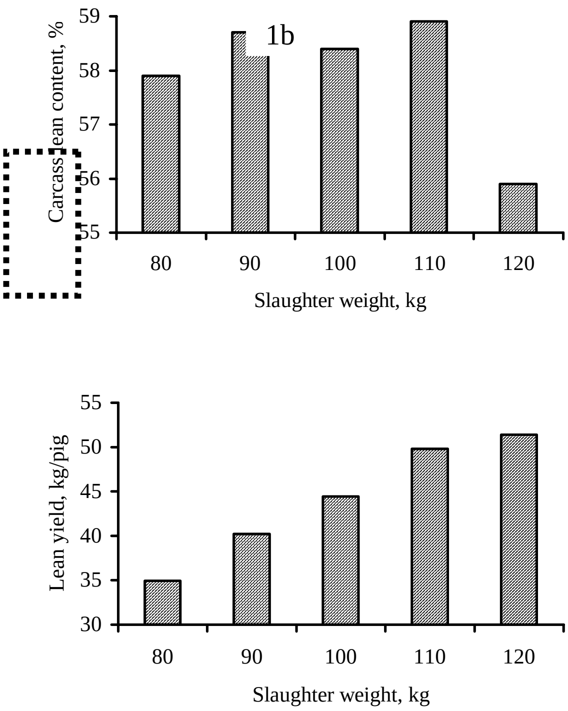


Figure 1a. **Average carcass lean content (g/kg) of pigs at each slaughter weight.** Figure 1b. **Effect of slaughter weight on lean yield per pig (kg/pig)**

Producing heavier boars

Entire males are more efficient in converting feed to meat than castrated males as they are leaner, faster growing and have a higher nitrogen (N) retention rate than castrates. Improved FCR reduces manure production per kg LM, which is beneficial from environmental and cost perspectives.

Dangers

Increasing slaughter weight increases the likelihood of boar taint in the meat. Boar taint presents itself as an unpleasant perspiration-like, faecal-like, or urine-like smell, when fat or meat from some entire mature boars is heated. Taint only occurs in certain male pigs and not all consumers are sensitive to it, however, the incidence rises with increasing age and carcass weight (Mullane, 2004). Taint is rarely detected in meat from gilts, castrated boars, or sexually immature boars (Babol et al., 2002). Castration of male pigs has been practiced for centuries to avoid the occurrence of boar taint. EU regulations (Council Directive 91/497/EEC, 1991) prohibit the sale of meat from entire male pigs over 80 kg carcass weight (excluding head and limbs) unless an inspector has tested the meat for pronounced sexual odours and declared it not to have such odours. If the meat has been found to have such odours, it must be treated in accordance with the procedures laid down in Council Directive 77/99/EEC (i.e. heating, salting or drying).

The main compounds associated with boar taint are ***skatole*** and ***androstenone***. According to Bonneau and Prunier (2005) the levels detectable by a trained sensory panel are 0.20 to 0.25ppm and 0.5 to 1.0ppm for skatole and androstenone, respectively. Backfat samples from castrates, gilts and boars slaughtered at 80, 100 and 120 kg were tested for these compounds and the results are shown in Tables 2 and 3. The levels of skatole and androstenone in castrates and gilts (Table 2) were below the levels detectable by a trained sensory panel.

Table 2. Effect of liveweight at slaughter on skatole and androstenone levels in the backfat of castrates and gilts

	Skatole (ppm)		*Androstenone (ppm)*	
Liveweight at slaughter, kg	*Castrate*	*Gilt*	*Castrate*	*Gilt*
80	0.05	<0.03	<0.20	0.25
100	0.02	0.02	0.33	<0.20
120	0.09	0.05	<0.20	<0.20

Lawlor et al. (2005)

With entire males skatole levels increased between 80 and 100kg and then dropped at 120kg (Table 3). Androstenone concentration in the backfat of entire males increased with slaughter weight. Androstenone levels were above the cut off levels for detection by a trained sensory panel in each of the weight categories examined. Skatole levels were only above the cut off point for detection (Bonneau and Prunier, 2005) for entire males slaughtered at 100kg. However, skatole levels can be manipulated by diet (Hansen et al., 2005) and management (e.g. dirtiness of pigs; Allen et al., 2001) and may not be as important as androstenone, which is to a large extent determined by weight, age, sexual maturity and genetics.

Table 3. Effect of liveweight at slaughter on skatole and androstenone levels in the backfat of entire male pigs

Liveweight at slaughter, kg	*Skatole (ppm)*	*Androstenone (ppm)*
80	0.16	***0.61***
100	***0.33***	***1.04***
120	0.18	***1.14***

Lawlor et al. (2005)

It is interesting to note that the cut off levels for detection, by a trained sensory panel, of skatole and androstenone were estimated using panels in continental Europe and Scandinavia where castration is the norm. For this reason sensitivity to boar taint may be higher than in Ireland and the UK where the production of pork from entire male pigs has been practiced since the 70's.

Incidence of boar taint

The incidence of boars with definite taint was found to be 8% (4/4 detections) in Ireland (Allen et al., 2001). A further 10 % of samples were scored as highly probable for boar taint (3/4 detections). For this reason the cut off level of 0.5 to 1.0ppm for androstenone may greatly overestimate the likelihood of boar taint being detected by Irish consumers. However c. 40% of Irish pigmeat is exported to countries where consumers may be more sensitive. In addition, even among Irish consumers where sensitivity is relatively low, market share for pigmeat may be lost due to the presence of a small percentage of sensitive consumers if slaughter weight of entire male pigs is increased further.

Nutritional requirements of heavier pigs

DFI increases with liveweight and FCR deteriorates for both entire male and female pigs because they deposit more fat and less muscle as weight increases. Female pigs have poorer FCR than males since they reach their maximum rate of lean deposition (max. growth rate) at lower weights (Table 5), and therefore, they begin to deposit fat at lower weights. Fat deposition requires more feed energy than lean deposition, deteriorating FCR. Figure 2 illustrates the increase in DFI and deterioration in FCR for both male and female pigs as liveweight increases (from O'Connell et al., 2005 a & b).

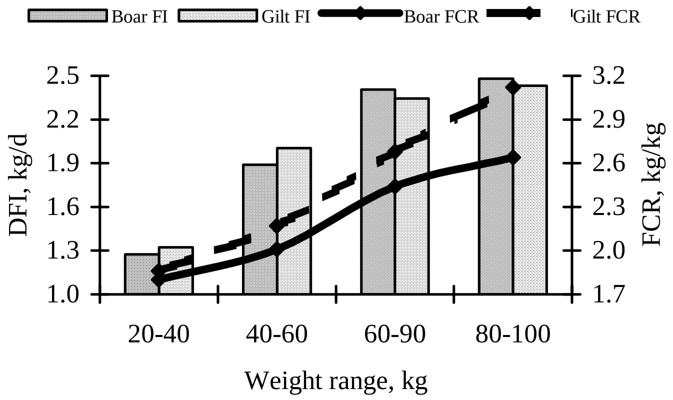


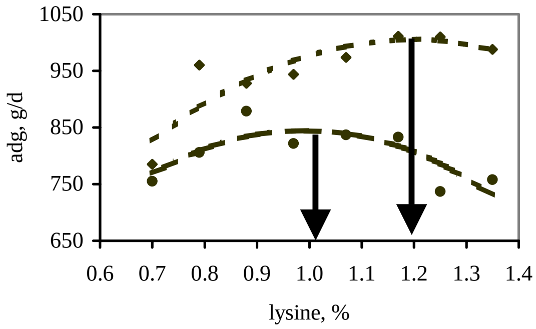
Figure 2. **Graph of increasing DFI and deteriorating FCR that occurs as liveweight increases**

Table 5. Maximum growth rates of male and female pigs in different weight ranges

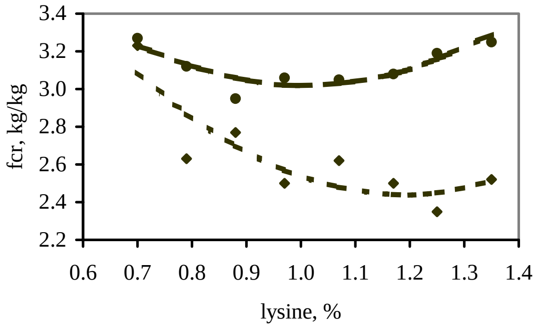
	Entire males	*Females*
40-60 kg	963	990
60-90 kg	1034	904
80-100 kg	1008	854

Nutritional requirements, in particular for amino acids (especially lysine) are affected by growth rate. In a paper presented last year (O'Connell, 2004), the effect of sex on nutritional requirements was clearly evident when weights exceeded c. 60 kg. Above this weight, boars require a higher concentration of lysine (protein), due to greater lean deposition. As weight increases, the difference in nutrient requirements becomes greater, because of differing growth rates (Table 5). Requirements of entire male and female pigs in the weight range of 80 to 100 kg and are presented in Figures 3a and 3b.

With such differences in requirements, it would appear wiser to implement a regimen of split-sex feeding. Not only would split-sex feeding lessen the likely incidence of boar taint, which some studies indicate may be less in single- compared with mixed-sex groups, but it could allow producers to make further savings through feeding sex- and age-specific diets.



3a



3b

Figure 3a. **For maximum ADG from 80 to 100 kg boars (991 g/d, -♦-) require 1.2 % lysine and gilts (845 g/d, -•-) require 1.0 % lysine.**

Figure 3b. **For best FCR from 80 to 100 kg boars (2.47 kg/kg, -♦-) require 1.2 % lysine and gilts (3.03 kg/kg, -•-) require 1.0 % lysine.**

Standards produced in Britain (Whittemore et al., 2003) do not differentiate between requirements of male and female pigs (Table 6). For comparison purposes, the values for intermediate pigs could be applied to female pigs, while those for lean and fast growing pigs are more suited to entire males. Table 6 indicates that daily requirement is not different between 60 to 90 kg and 90 to 120 kg, but concentration in the diet is reduced, due to increased DFI. Absolute differences between dietary concentrations in the British standards, and our own results can be attributed to differing DFI.

Skatole is the product of bacterial activity in the large intestine and levels in fat are influenced by diet, possibly by altering bacterial activity or availability of the substrate tryptophan. Higher energy diets can increase levels of androstenone and skatole as they have been associated with acceleration of pubertal development in entire males. Reducing protein fermentation in the hind gut could reduce skatole production and can be achieved by lowering the amount of protein or increasing the amount of carbohydrate (which is preferentially fermented by microbiota) reaching the hind gut (Jensen and Jensen, 1998). Fasting overnight prior to slaughter has also been associated with a reduction in skatole levels (Kjeldsen, 1993).

Table 6. Suggested lysine requirements of pigs up to 120 kg (Whittemore et al., 2003)

	Total lysine g/day	*Total lysine g/kg diet*	*Daily feed intake kg/day*
Intermediate			
60-90 kg	20.5	8.4	2.44
90-120 kg	20.2	7.3	2.77
Lean and fast growing			
60-90 kg	26.0	10.6	2.45
90-120 kg	27.0	9.8	2.78

Economic impact of increasing slaughter weight

Cost of production is determined by FCR, feed price (c/kg carcass) and non-feed costs (labour, housing, heat and power, healthcare, manure management, etc., c/kg carcass). Price received per kg carcass is determined by carcass LM content, base pigmeat price, adjustments to base price (preferred carcass weight range, variation in LM content), and payment bonuses (e.g. for delivery, batch size, quality criteria). Profitability is therefore determined by the volume of pigmeat, the return per unit volume and the production cost per unit volume.

From the producers' point of view, advantages of heavier slaughter weights include non-feed costs and sow feed costs being spread over a greater weight of carcass. Other benefits include, higher pen occupancy because less time is lost between batches, increased kill-out, and the possibility of cheaper diets for heavier pigs. Disadvantages include higher housing costs because of extra space requirements and extra labour requirements.

Apart from the risk of boar taint, it is also more economically successful to limit the maximum slaughter weight of entire male pigs. Table 4 shows the effect on economic parameters of implementing a strategy where gilts are slaughtered at higher weights than boars. Since average liveweight at slaughter is 93 kg, the table presents three scenarios:

1) All pigs currently slaughtered at an average weight of 90 kg
2) Slaughter weight increased to 100 kg for all pigs
3) Slaughter weight increased to 100 kg (boars) and 120 kg (gilts).

The figures in Table 4 were calculated using the Teagasc Accommodation calculator and the Teagasc Budgets and Cashflow program, using performance data from the Moorepark trial, and are based on 100 sows producing 21.9 pigs per year. Costs of increased finisher accommodation have been included (€250 per finisher pig place over 10 years @ 7 %). The surplus per kg carcass represents the price received minus the costs of production and increases when the split-sex strategy is adopted. The total weight of carcass produced also increases substantially.

Table 4. Effect of increased slaughter weight on economic parameters

	Slaughter strategy		
	All 90	*All 100*	*Boars 100 Gilts 120*
Finisher feed coats, €	29.2	34.8	39.6
Other feed cost, €	21.7	21.8	21.6
Non-feed costs per pig, €	31.8	33.1	34.6
Total cost per pig, €	**82.7**	**89.7**	**95.8**
Carcass weight, kg	68.5	76.1	83.7
Feed costs per kg carcass, c	74.3	74.4	73.1
Non-feed costs per kg carcass, c	46.4	43.4	41.3
Cost per kg, c	**120.7**	**117.8**	**114.4**
Price received per kg carcass, c	136.2	135.9	136.2
Surplus per kg carcass, c	**15.5**	**18.5**	**21.8**
Total carcass weight (tonne/yr/100 sows)	150	167	183
Total surplus, €/100 sows	**23,252**	**30,165**	**39,960**

The responsible way forward

As we export a considerable proportion of our pig-meat we must endeavour to minimize the occurrence of boar taint. However, in order to maintain profitability, producers must be allowed to increase target weights at slaughter. Castration is likely to be banned for welfare reasons by the EU in the near future and in any case castration is not a practice favoured by producers. For this reason it is unlikely to be a solution.

Separate feeding of entire male and female pigs is one way to gain the most benefit from increasing slaughter weights. Data from the Moorepark trials shows interesting contrasts between increasing slaughter weight of entire male and female pigs. Apart from increasing the risk of taint, increasing slaughter weight of entire male pigs beyond a maximum of 110 kg actually reduces profitability due to the negative effect of LM content on the price. In contrast, female pigs remain profitable up to the highest slaughter weight (120 kg) assessed.

Another benefit of split-sex feeding is the improvement in welfare of females, since in the absence of male pen-mates aggression is reduced. However, welfare of entire male pigs may be unchanged or even poorer compared with mixed-sex groups (Bjorklund, 2005).

Take-home points for the production of heavier pigs

- female pigs remain profitable at higher slaughter weights (120 kg) than entire males
- limit maximum slaughter weight of entire males (100 kg) to reduce the risk of boar taint and maintain profitability
- split-sex feeding has benefits as entire males require more lysine than females
- in a diet with 13.8 MJ DE/kg, lysine should be 1.0 % for females and 1.2 % for entire males

For references please contact Karen O'Connell

What does home compounding offer the pig industry ?

Brendan Lynch, Moorepark

Home compounding accounts for in the region of 30% of the feed used by the Irish pig industry. In most cases the equipment used is simple, comprising ingredient stores, grinder and weighing equipment and the wet feed system is the mixer.

Cereal prices have fallen over the past number of years and manufacturing and handling costs have become a greater proportion of the cost of finished feed. The cost of new regulations in relation to compound feed is inevitably passed on in the feed price. As this trend continues and unit size becomes bigger more pig producers will consider home compounding. Inability to expand the pig operation will also cause producers to consider home milling as an option.

Where are the savings ?

Being involved in home compounding is no guarantee of cheap feed or low production costs. Records from Teagasc PIGSYS herds show some of the lowest pig production costs on units where feed is purchased. A combination of clever buying and choosing the right diet combination will often generate more savings than home compounding. Home compounders need to include all feed ingredients purchased not just recorded usage which may miss shrinkage and be biased by inaccurate weighing systems. At the very least recorded use should be reconciled with purchases and inventory changes.

Savings arise from home compounding through reduction or elimination in the following costs:

- Haulage – the journey from the mill to the farm is omitted. Farm to farm purchase of grain is possible.
- Administration and office costs
- Sales
- Quality control
- Mixing of dry feed (if using a wet feed mixer)
- Pelleting
- Mill depreciation
- Bad debts
- Some insurance costs
- Taxation – producers may be able to avail of manufacturing tax rates

What are the costs ?

The home compounder incurs additional costs in:

- Energy for reception, storing and grinding
- Marginally higher grinding costs in the smaller mills used on farms
- Storage facilities for ingredients (bins, reception pits, elevators)
- Financing of ingredient stocks
- Depreciation of farm milling facility
- Shrinkage i.e. purchased ingredients which are not used or used inappropriately, losses prior to feeding
- Opportunity cost of time spent in buying ingredients and in operating feed manufacturing operation
- Higher ingredient costs due to small tonnages purchased and delivered
- Higher ingredient costs due to less timely purchase
- More expensive nutrients because of more limited choice of ingredients e.g. soya oil versus animal fat, full fat soya as a fat source.
- Higher supplement costs
- Increased feed wastage in a dry feed system

How much will home compounding save you ?

There is little reliable information on many of the cost items listed above. Those involved estimate the savings at about €20 per tonne but may not be including realistic costs for time and some other cost items. At face value €20 per tonne represents 10% of composite feed price or 8c per kg carcass. In the case of weaner feed the savings will be much greater.

Not all home compounders buy ingredients equally well. Proximity to a grain growing area and to ports will affect the price delivered to the farm. In a comparison of 14 home compounders purchasing ingredients over a three year period we found an average difference over the three year period of €10 per tonne finisher feed between the highest and lowest for the same barley-wheat-soya mix.

Be aware of hidden costs in home compounding. Changing from a dry pelleted feed to dry meal will inevitably increase wastage. Changing from dry feeding to wet feeding will increase manure handling costs.

Financing home compounding

Pig producers will be accustomed to paying a few weeks to several months after delivery. Home compounders will normally pay 7 days after delivery and depending on unit size will also be carrying stocks for at least one to two weeks usage. The difference may be 10 weeks or more (two months credit plus two weeks).

Assuming that diets are 75% cereals, 20% protein feed, 2% fat and 2% supplements a 400 sow unit will use about 2,270 tonnes per year or 44 t per week. This will be made up of 33t cereal, 9t protein feed, 0.9t fat and 0.9t supplements.

Based on a weighted feed cost of €220 per tonne the cost of 10 weeks feed is €97,000. The cost of the installation to produce 40t feed per week will be about €100,000 for a system with wet feeding and about €115,000 for a system with dry feeding. Neither estimate includes the distribution system to the troughs.

Legal requirements

Home compounders must be registered and/or approved by the Department of Agriculture and Food. Conditions of this regulation include retention of formulations, sampling all incoming ingredients and storage of these samples for a number of months. Addition of medication to home produced feed requires a further permit which is not easily obtained. Remember that top-dressing medication on to feeders is not permitted.

For further information see:
http://www.agriculture.gov.ie/index.jsp?file=feedingstuffs/index.xml or contact the Department of Agriculture and Food (Feedingstuffs Division).

New feed hygiene regulations are being introduced in 2006. These affect mainly importers and hauliers which will include pig producers whose own trucks haul feed.

Alternatives to home compounding

Contract milling of a fixed formula feed is used in other countries but seldom in Ireland. It requires a high level of trust between farmer and feed manufacturer. In view of the amount of excess capacity likely to be in the feed industry after decoupling of EU farm payments there is likely to be keen competition for feed sales in the future and more opportunities for contract milling.

Producers whose finances would allow home compounding will be able to extract significant discount for payment on delivery or payment in advance. Would you get a better price by taking larger loads? Could you reduce your current feed cost by e.g. switching pigs earlier to a lower specification finisher diet or feeding two sow diets.

Quality control in home produced feed

Compounders will give assurance as to the chemical composition of feed with minimum specifications for several nutrients. The quality assurance programme protects the feed manufacturer from breaching declared nutrient levels but also allows him to reduce costs by blending ingredients to meet the needs of the target pig. Modern systems based on rapid analysis using Near Infra Red methods allow for every truck load of ingredient to be sampled and analysed.

A home compounder will normally carry out minimal analyses on ingredients or on finished feed relying on the "average values" being correct. This is normally (but not always) a reasonable assumption.

Barley, wheat and soya are ingredients of very consistent quality but still vary. Tables 1 and 2 show variation in barley composition from year to year and from variety to variety.
Variety, growing conditions and weather are the principal influences.
Bushel weight is not a good guide to feeding value except at extremes.

Table 1. Variation in composition barley samples at Moorepark 1970 to 1990 (%)

	Average	Minimum	Maximum
Barley			
Crude protein	10.4	8.3	12.4
Crude fibre	5.0	3.4	6.7
Lysine	0.36	0.30	0.43
Wheat			
Crude protein	11.0	9.1	13.1
Crude fibre	2.4	1.9	3.5
Lysine	0.32	0.27	0.36

Table 2. Variation in composition and feeding value of eight barley varieties grown on the same site in Ireland c. 1980 (%)

	Average	Minimum	Maximum
Crude protein	9.7	8.4	11.1
Crude fibre	4.9	3.9	6.6
Lysine	0.35	0.33	0.39
DE, MJ/kg	12.9	12.5	12.1

Because of the known absence of regular quality control, there is a danger that substandard ingredients may find their way into home compounders. Appearance and smell should eliminate mouldy material or with a high screenings content.

Mould growth and mycotoxin contamination is a serious risk in stored grain. Insect presence in grain stores is another problem.

Feed formulation in home compounding

In most cases, formulation of diets will be carried out by the supplement supplier as a "free service". The inclusion levels of some nutrients (especially expensive ones) may vary. Nevertheless, it is important that prices from alternative suppliers be compared. Variation in the inclusion levels of amino acids will be the principal reason for variation. Ignore price per kg. Compare on price per tonne of finished feed.

It is important not to change ingredients without reformulating the blend. For example starting or stopping the feeding of whey means a different supplement will be required. Sometimes we see situations with poor performance on home compounded feed and the producer will provide a number of blends but is not sure when any one has been fed.

Vitamin-mineral mixes are high priced ingredients and under-dosing may affect pig performance while over-dosing will cost you money. Have you ever checked supplement usage against usage of other ingredients ?

Keep it simple

There is merit in making minimal formulation changes and staying with a small number of reliable ingredients. Table 3 shows the diets in use at the present time in Moorepark. These have been used continuously with little change (mainly adjustments to amino acid levels) for the past 30 years and have proven themselves to be very satisfactory.

Our feeding programme is as follows:

- Pregnant sow feed is fed to weaned sows and to dry sows until entry to the farrowing house
- Lactating sow feed is fed from day 110 of pregnancy to weaning
- Commercial starter is fed for about one week (2kg per pig).
- Commercial link is fed for about two weeks (5kg per pig)
- Weaner feed is fed to c. 35kg. More finisher accommodation would allow transfer closer to 30kg
- Finisher diet is fed from 35kg to slaughter
- Ideally a second finisher diet should be fed to gilt pigs from about 50kg. Karen O'Connell in the 2004 Teagasc conference showed that boars in the weight range 80 to 100kg respond to high lysine levels (about 1.2%) while gilt growth is depressed on these high lysine levels.

The nutrient content of the Moorepark diets is shown in Tables 3 and 4, and the composition of the mineral-vitamin supplement is shown in Table 5.

Barley, wheat and soya will be present in almost all diets. Inclusion of fat or oil will increase the nutrient density of a diet but since pigs eat to an energy threshold, they will consume less of a high density diet. Solid fats require a heated system for handling on the farm. Liquid oils are usually very expensive per unit of energy and are justified only in weaner feed and there the fat might be supplied by full fat soya rather than oil. A small inclusion of oil will reduce dust in a meal system but this is not needed with wet feed.

Amino acid levels and balance

Pigs require a certain level of amino acids in the feed to grow well and efficiently. Not all parameters are equally sensitive to amino acid deficiency. If one or other amino acid is in short supply carcass lean will be the first to be affected, followed by FCE and lastly daily gain.

The balance of amino acids is also important. Meeting the need for lysine is of little value unless others are present in adequate amounts. Levels of methionine, methionine plus cystine and threonine are critical.

A role for feed compounders

Purchase of high protein feeds (possibly a blend of ingredients) containing the minerals and vitamins, fat and crystalline amino acids would simplify storage of ingredients for many home mixers and might offer some savings. Feed compounders are ideally placed to supply such balancers.

Conclusions

Home compounding can give you cheaper feed but not everyone can afford the time and investment required. Before you invest, consider:

1. Can you afford to finance home compounding ?
2. How much will you save ?
3. What are the alternatives ?

Table 3. Teagasc Moorepark - composition of standard feeds 2005, kg/tonne

	Weaner	*Finisher*	*Finisher heavy*	*Sow Pregnant*	*Sow Lactating*
Barley	225.5	364.2	845.2	893	350
Wheat	455	404	0	0	424
Maize	0	0	0	0	0
Soya Full Fat	100	0	0	0	0
Soya Hi-Pro	180	200	125	75	160
Fat Tallow/Lard	10	10	10	10	40
L- Lysine HCl	4.0	3.0	3.0	0.5	2.0
DL-Methionine	2.0	0.8	0.6	0	0.7
L-Threonine	1.5	1.0	1.1	0	0.8
Di Cal Phos	5	0	0	5	5
Limestone Flour	11	13	11	11	12
Salt	3.0	3.0	3.0	4.0	4.0
Vit-Mins	3	1.0	1.0	1.5	1.5
Phytase	+	+	+	+	+
Total	**1000**	**1000**	**1000**	**1000**	**1000**

Phytase: *500 FTU per kg finished feed. Inclusion level will vary with supplier*

Table 4. Teagasc Moorepark -standard Feeds 2005, Calculated analysis g/kg:

	Weaner	*Finisher*	*Finisher heavy*	*Sow Pregnant*	*Sow Lactating*
Crude Protein	196	178	154	132	158
Lysine	13.1	11.1	9.4	6.19	9.1
Methionine	5.0	3.6	3.0	2.2	3.2
Meth + Cyst	8.5	6.9	5.9	4.9	6.3
Threonine	8.6	7.4	6.5	4.6	6.5
Tryptophan	2.5	2.3	1.9	1.6	2.1
Isoleucine	8.2	7.4	5.9	5.0	6.5
Leucine	14.4	13.1	10.8	9.4	11.6
Phenyl + Tyros	16.3	14.9	12.6	10.9	13.3
Valine	9.2	8.5	7.3	6.4	7.6
Lysine digestible	11.4	9.5	7.9	4.8	7.7
Methionine dig.	4.5	3.1	2.6	1.7	2.8
Meth + Cyst dig.	7.3	5.8	4.8	3.7	5.3
Threonine dig	7.0	6.0	5.1	3.4	5.2
Tryptophan dig	2.1	1.9	1.5	1.2	1.7
Dry matter	872	870	871	871	873
DE MJ/kg	14.1	13.7	13.1	13.0	14.2
Fat	43	27	31	31	56
Linoleic (C18:2)	16	8	9	9	11
Crude fibre	36	37	44	45	35
Ash	50	44	40	44	46
Calcium	7.6	7.0	6.0	7.0	7.6
Phosphorous	5.0	3.9	3.8	4.6	4.7
Phos dig	3.4	2.5	2.4	3.2	3.3
Potassium	8.6	7.7	6.7	5.9	6.9
Sodium	1.3	1.3	1.3	1.7	1.7
Starch + Sugar	436	469	471	489	469

Table 5. Teagasc Moorepark - standard diets 2005 - AA ratios

	Weaner	*Finisher 1*	*Finisher 2*	*Pregnant sow*	*Lactating sow*
Lysine as % protein	6.7	6.2	6.1	4.7	5.8
Total AA to total lysine					
Lysine	100	100	100	100	100
Methionine	38	32	32	36	35
Meth + Cyst	65	62	63	79	69
Threonine	66	67	69	74	71
Tryptophan	19	21	20	26	23
Isoleucine	63	67	63	81	71
Leucine	110	118	115	152	127
Phenyl + Tyros	124	134	134	176	146
Valine	70	77	78	103	84
Lysine digestibility %	87	86	84	78	85
Digestible AA to total lysine					
Lysine digestible	100	100	100	100	100
Methionine dig.	39	33	33	35	36
Meth + Cyst dig.	65	61	61	77	69
Threonine dig	61	63	65	71	68
Tryptophan dig	18	20	19	25	22
Total lysine					
per MJ DE	0.93	0.81	0.72	0.48	0.64
per MJ NE	1.34	1.18	1.02	0.67	0.90
Digestible lysine					
per MJ DE	0.81	0.69	0.60	0.37	0.54
per MJ NE	1.16	1.01	0.86	0.52	0.76

Table 6. Vitamin Trace Mineral Inclusion Levels 2005 (per tonne finished diet)

	Starter/weaner	Finisher	Sow
Copper sulphate. $7H_20$ g	620	60	60
Ferrous sulphate monohydrate g	450	120	200
Manganese oxide g	60	40	80
Zinc oxide g	150	100	100
Potassium iodate g	1	0.5	1
Sodium selenite g	0.6	0.4	0.4
Vitamin A miu	6	2	10
Vitamin D_3 miu	1	0.5	1
Vitamin E (* 1,000 iu)	100	40	100
Vitmin K g	4	4	2
Vitamin B_{12} mg	15	15	15
Riboflavin g	2	2	5
Nicotinic acid g	12	12	12
Pantothenic acid g	10	10	10
Choline chloride g	250	-	500
Biotin mg	-	-	200
Folic acid g	-	-	5
Vitamin B_1 g	2	2	2
Vitamin B_6 g	3	3	3
Endox g	60	-	-
Inclusion levels of minerals			
Copper	155	15	15
Iron	90	40	70
Manganese	47	31	62
Zinc	120	80	80
Iodine	0.6	0.3	0.6
Selenium	0.3	0.2	0.2

The Nitrates Action Programme and its Implications for Pig Producers

Gerard McCutcheon, Bagenalstown

The proposed Nitrates Action Programme (dated 28/07/05) submitted to the European Commission is to be implemented on a phased basis commencing on 01/01/2006 and will operate for a period of 4 years. The action programme (as proposed) will be monitored on an ongoing basis by reference to water quality and to agricultural practices including thorough studies of mini – catchments. It will be reviewed after a period of 3 years of operation and appropriate adjustments will be introduced in the context of the second 4 year action programme. The relevant sections for pig producers of the proposed action programme are printed below to create awareness of the issues involved.

The primary aims of the proposed action programme are to "reduce water pollution/eutrophication caused or induced by nitrates and phosphates from agricultural sources and to prevent further such pollution/eutrophication. In addition, a specific objective is to increase the efficiency of nitrogen use in agriculture using 2006 as a base year".

The current notional value of the annual organic-N of 67kg/sow plus progeny to slaughter for pigs is being revised significantly because of high protein levels in current diets and the increase in pig slaughter weights.

Consistent with the requirements of the Nitrates Directive, the action programme provides for a general limit in relation to the amount of livestock manure that may be applied to land of 170kg nitrogen per hectare per annum. However, an application has been made to the EU Commission, in accordance with paragraph 2(b) of Annex III of the Directive, for approval of amounts of up to 250kg nitrogen per hectare per annum. It is not expected that an application for a derogation will be made before November 2005 and it may be mid-2006 before the final details of such a derogation are approved by the EU Commission.

Most of the terminology used in the action programme has its everyday meaning but a glossary of definitions is set out in Annex 1 in the interests of clarity. Attention is drawn to the fact that, unless otherwise indicated, the word "fertiliser" includes livestock manure and other forms of organic fertiliser e.g. spent mushroom compost, sewage sludge. The aforementioned nitrogen limits of 170kg and 250kg relate to livestock manure only.

A draft of Regulations to give statutory effect to certain elements of the action programme will be issued for public consultation and interested parties will have an opportunity to comment. The Regulations will be made available as soon as possible thereafter (possibly in September 2005).

A guidance document will be prepared and issued for the information and assistance of farmers in complying with the requirements of the action programme and the regulations.

Zones

The national territory has been sub – divided into three zones (group of counties) by reference mainly to soil type, rainfall and length of growing season. The zones are as follows:
Zone A comprises the counties of Carlow, Cork Dublin, Kildare, Kilkenny, Laois, Offaly, Tipperary, Waterford, Wexford and Wicklow.
Zone B comprises the counties Clare, Galway, Kerry, Limerick, Longford, Louth, Mayo, Meath, Roscommon, Sligo and Westmeath.
Zone C comprises the counties of Cavan, Donegal, Leitrim and Monaghan.

Periods when land application of fertilisers is prohibited

The periods during which the application to land of certain types of fertiliser will be prohibited (both dates inclusive) are as follows:

Zones	**Chemical Fertiliser**	**Organic Fertiliser**	
		All Organic Fertilisers Excluding Farmyard Manure	**Farmyard Manure**
	Grassland and Other Land	**All Land**	
A	15 Sept. to 12 Jan.	15 Oct. to 12 Jan.	1 Nov. to 12 Jan.
B	15 Sept. to 15 Jan.	15 Oct. to 15 Jan*.	1 Nov. to 15 Jan.
C	15 Sept. to 31 Jan.	15 Oct. to 31 Jan.	1 Nov. to 31 Jan.

Note* An end date of 25 January will apply in Zone B to holdings joining REPS and extensive holdings availing of the reduced storage capacity requirements as described below.

These prohibited periods will apply with effect from 1 January 2006 in all areas in relation to the application of chemical fertilisers.

The application of chemical fertilisers between the specified dates will be permitted under suitable weather and soil conditions, in the case of lands, other than grassland where it is necessary to meet the needs of certain crop types e.g. Autumn-planted cabbage, or where there is a demonstrable crop need.

Capacity of storage facilities for livestock manure:
Storage capacity on holdings in all zones shall be sufficient for the full housing period and should provide an adequate level of storage for difficult years. Livestock holdings shall have the following minimum storage capacity for **bovine livestock manure:**

16 weeks in Zone A
18 weeks in Zone B, and
20 or 22 weeks in Zone C.

Recognising the high water quality in counties Donegal and Leitrim and the lesser intensity of agricultural production, the required minimum storage period will be 20 weeks for counties Donegal and Leitrim. Prohibited periods and all the other measures commensurate with categorisation in Zone C shall apply to counties Donegal and Leitrim. The minimum storage period for counties Cavan and Monaghan will be 22 weeks.

Storage capacity of 26 wks will generally be required in all areas for pig / poultry units.

Holdings with 100 pigs or less will be required to provide the general manure storage capacity specified for bovines above, based upon the zone in which the pig unit is located (16, 18 or 20/22 weeks as appropriate), in respect of the pig unit. The availability of this provision will be conditional on the holding having adequate lands, wholly under the control of the holding, to utilise all of the livestock manure produced on the holding without exceeding the nitrogen and phosphorus limits set out in the implementing Regulations. The storage capacity facilities for pigs shall be in place no later than 31 December 2006. The storage capacity facilities required for all other livestock shall be in place no later than 31 December 2008.

Spreading of Livestock Manure to Farmland:
Livestock manure, other organic fertilisers and soiled water shall not be applied to land

within 10m of a surface water body (other than a lake)
within 20m of a lake
within 15m of exposed caverous (karstified) limestone or karst limestone features such as swallow holes and collapse features
with 50m of a borehole, spring or well used as a drinking water source (e.g. private well) or such other distance as may be specified by the relevant local authority
within 250m of any surface waterbody or borehole, spring or well used for the abstraction of drinking water for human consumption in public or group water schemes i.e. schemes supplying more than 10m³ per day or serving more than 50 persons (commercial/public)
within such area as may be specified by the relevant local authority around designated groundwater source protection zones.

Having regard to the special circumstances presented by buffer zones within narrow parcels of land the 10m buffer zone can be reduced to a 5m zone where the area adjacent to flowing waters has an average incline of less than 10% towards the watercourse. This buffer zone can be further reduced to 3m where the peripheral adjoining area is a narrow parcel of land not exceeding one hectare and not more than 50m in width, or the watercourse is a drainage ditch.

Application of liquid manure by high trajectory splash plate or rain gun is prohibited.

Record Keeping

Under existing legislation, holdings with cattle and sheep are already required to maintain livestock registers (e.g. Herd Register of Bovine Animals, Sheep Flock Register) on the holding in respect of these enterprises. These registers will be considered as acceptable records for the purposes of maintaining records for the action programme where appropriate. Suitable other records will have to be maintained in relation to other livestock. Every effort will be made to co-ordinate and the Single Payment System (Council Regulation (EC) No. 1782/2003), including those for the Nitrates Directive.

With effect from 1 January 2006, records shall be maintained for all farm holdings, which should indicate –

total area of the holding
net area of the holding
cropping regimes and their individuals areas
livestock numbers and category
storage capacity on the holding

an estimation of the annual fertiliser requirement for the holding
quantities and formulations of chemical fertilisers used on the holding, including opening stock, records of purchase and closing stock
livestock manure and other organic fertilisers moved into or off the holding including quantities, type dates and details of donor/recipients
a copy of any Nutrient Management Plan in relation to the holding
the results of any soil analysis carried out on the holding.

Records (a) to (h) above shall be prepared for each calendar year. All records shall be retained for a period of not less than five years.

Competent Authorities

The Department of Agriculture and Food, the relevant local authorities and the Environmental Protection Agency (EPA) will be the competent authorities for the purposes of implementing the proposed action programme.

The Department of Agriculture and Food will prepare and keep updated register of all farm holdings. Information available to the Department of Agriculture and Food in relation to farm size, crops and animals on the holding will form the basis of the register. A copy of the register will, on request, be made available to the relevant local authority and the EPA, for the purpose of compliance/control.

The Department of Agriculture and Food will be responsible for carrying out compliance checks each year on holdings (except intensive agricultural holdings issued with a licence under the EPA Act, 1992) at a level of at least one percent of holdings generally. The selection of holdings will be based on risk analysis, which will take account of waterbodies identified as being "at risk" from agricultural pollution. Compliance inspections under the Nitrates Directive will be integrated, to the maximum extent possible, with other inspections under the Single Payment Scheme.

Implications of the Nitrates Directive for Pig Producers

The imposition of 170 kg/ha organic N limit proposed in the nitrates action programme will severely limit the ability of livestock-farmer customers to acquire pig manure. Many grassland farms that traditionally imported pig or poultry manure already have an organic N production level approaching or in excess of 170kg/ha N from their own livestock.

Examples of Organic-N (ON) loading and potential for pig manure use

Stock type	Livestock No. per hectare	ON loading from livestock on farm, kg	Potential for ON from pig manure, kg[1]
Dairy Cow	2	170	80 (1.2 sows)
Dairy Cow	1.75	150	100 (1.5 sows)
Suckler Cow	2	130	120 (1.8 sows)
Suckler Cow	1.5	97.5	152.5 (2.3 sows)
Maize	0	0	250 (3.7 sows)

[1] Based on ON loading only. Restrictions on phosphorus levels in soil and P application rates will restrict these rates. Note ON limit for REPS farms is 170kg.

Calculations show that when the organic N limit is 250 kg/ha (current limit of organic N) a specialist dairying farm for instance, stocked at 2.0 LU/ha, can take in 80 kg of organic-N/ha in the form of pig manure or a pro rata amount of poultry manure. If the limit is 170 kg/ha organic N as proposed the same farmer cannot import any manure and only those farms with very low stocking rates can take in significant quantities.

A high proportion of farms (c 30%) with low stocking rates are in the Rural Environment Protection Scheme (REPS). These farms are precluded from exceeding 170 kg/ha. This has reduced the farmer customer base to acquire pig manure onto farms. The imposition of the 170 kg/ha limit in the nitrate action programme could involve both licensed (EPA) pig producers, in many instances, having to make arrangements with farmers customers for an additional 40 % - 50% more farmland grounds. It also means that pig units below the IPPC thresholds for IPPC licences will also have to demonstrate adequate farmer customers for their pig manure. This will impose additional transport and spreading costs on producers.

Customer farmers with low stocking rates will not solve the problem. Soil phosphorus levels can rise rapidly in response to relatively low manure applications due to the low off-takes in farm produce. This increases the need to apply very low rates and acquire new customers with low stocking rates on a regular basis.

Tillage farmer customers may be an option for some pig producers—but the opportunities for spreading may require extra storage for these users of pig manure. Autumn spreading is not allowed unless there is a growing crop in place, or where there is a demonstrable crop need.

Details of a derogation to allow a farmer exceed the 170kg/ha of organic N have not been finalised and will not be dealt with at EU level until the action programme is fully accepted by the European Commission.

There will be a much greater level of regulation for all farmers in relation to the information that they must record and the cross-check on this information will be rigorous between the Department of Agriculture officials and the EPA/Local Authority officials. Given that this will have implications for farmers "Single Farm Payment" the real question is whether customer farmers may be less willing to acquire pig manure from any pig producer.

There appears to be no incentive in the action programme to encourage farmers to utilise locally produced organic fertiliser. There is a serious risk that farmer customers will not take pig manure because of the increased level of records required and the risk of losing or having their Single Farm Payment reduced because of inadvertent or minor errors being picked up by the DAF/EPA/Local Authority personnel. For example each fertiliser plan is based on a projection of the stock numbers that will be on a farm in any given year—the farmer customer may increase the numbers during the year and this might cause him to exceed the 170kg/ha threshold—because he may also have imported some pig manure. This could lead to a reduction in the "cheque in the post" for that farmer.

For the future pig producers need to convince both their farmer customers and the authorities that pig manure is a resource rather than a "waste". This will also require a renewed focus on ensuring that there is no ingress of water into the manure from leaking nipples, water pipes, rainfall sources etc. –i.e. a focus on ensuring a good quality (high dry matter) pig manure. Increasing DM of manure from 3% to 6% would halve the volume to be stored and handled.

Conclusion

The legislation will be the main area that will determine how the action programme applies in practice. The draft of this legislation is expected to become available in September 2005. Hopefully the legislation will encourage the use of pig manure and other locally produced "organic fertilisers" as a nutrient source for crops in preference to imported fertilisers. This would require that there be no penalties for using such "organic fertilisers" and perhaps some incentives to encourage their use.

Note: This paper was completed on 1/09/005 and is the best account of the situation at that time.

Summary of Teagasc Pig Research programme 2004 - 2005

The pig research programme at Moorepark covers a range of areas of nutrition and management, welfare, meat quality, manure management. Many projects involve graduate students who carry out their studies for Master and Doctorate degrees. These students are registered with Irish or overseas universities. Detailed reports on projects are published in our end of project reports. These reports are published on the Teagasc website www.teagasc.ie.

For further information contact any of the Teagasc Pig Development Unit staff.

1. Amino acid nutrition of pigs

This study ran from October 2001 to March 2005. In all, about 12 feeding trials were completed looking at:

1. responses of pigs in c. 20kg weight bands, 15 to 30, 20 to 40, 60 to 90, 80 to 100 to lysine levels.
2. Phase feeding of pigs from 30 to 100kg
3. Management strategies to increase pigmeat output
4. Responses to levels of threonine and methionine

In each lysine response trial, six diets ranging from below the expected requirement to above the requirement were fed. Other amino acids were fed in a fixed ration to lysine. Pigs grew faster and more efficiently in response to increasing lysine up to a maximum and further increases in lysine depressed performance. Males and females responded similarly at lower weights but from 80kg up boars had a higher requirement than females.
An end of project report has been completed.
Project leader: Brendan Lynch
Student: Karen O'Connell

2. Pig Growth rate study

This project started in October 2003 and is due to finish in October 2005 and was part funded by the Pig Research Levy operated by the IFA and IAPP.
The following experiments have been completed.

a. Survey of farms with low and high pig growth rates (n = 24). A proportion of pens (10 to 20% depending on the size of the unit) in weaner 1, weaner 2 and finisher stages were examined and stocking rate, water flow, feed system and availability, room temperature were measured. While there were no outstanding consistent differences in management between high and low growth rate herds, deficiencies in stocking rate, feed availability and water availability were noted.
b. A study of growth rates of pigs with high and low birth weights and high and low weaning weights was carried out in France at INRA St. Gilles and pigs were slaughtered 14 days after weaning at 28 days of age. The objective was to examine hormone levels and muscle characteristics in these pigs in order to explain why some pigs differ in growth rate in the immediate post-weaning period. Lightweight pigs at birth/weaning grew slower and had different concentrations of some hormones than fast growing pigs. A similar trial was carried out at Moorepark from weaning at 27 days to 35 days later.
c. A trial with weaned pigs (stage 1) examined feeding behaviour and growth rate when an extra feeder was provided in addition to the 75cm hopper. The feed was pelleted and supplied ad libitum and group size was 15. There was little benefit from the extra feeder but groups tended to prefer to eat from one or the other.

Project leader: **Brendan Lynch;**
Student: **Amii Cahill**

3. Effect of slaughter weight on pig performance and meat quality
Pigs were slaughtered at a range of weights from 80 to 120kg. A proportion of carcasses were dissected into lean, skin plus fat and bone. An end of project report has been completed
Project leader: Peadar Lawlor
Student: James Mullane

4. Behaviour of heavy boar pigs after removal of part of the group
The aim of this experiment was to compare the behaviour, welfare and performance of pigs finished at 105kg in single or mixed sex groups and to determine the effects of split-marketing on the behaviour and welfare of heavy pigs.

It was concluded that there are welfare benefits for males of finishing in mixed sex groups because they are exposed to less aggression than in all male groups. Females who are exposed to less mounting in all-female compared to mixed sex groups. Split marketing did not stimulate aggression in the reduced groups and the practice was responsible for a reduction in average slaughter weights.
Project leader: Laura Boyle
Student: Linda Bjorklund

5. Salmonella control
This three-year project which was funded by the Department of Agriculture and Food Research Stimulus programme involved intensive monitoring of 12 herds in Salmonella Category 2 and 3 using different control programmes. All herds in the study have made progress and supplementation of the diet with acid seems most promising. The project will finish in early 2006.

Washing effectiveness
The aim of this study was to assess the efficacy of washing and disinfecting finisher units on category 1 and category 3 farms, in reducing or eliminating levels of *Enterobacteriaceae*. *Enterobacteriaceae* counts were used as indicators of the contamination of the environment with enteric bacteria, which could include *Salmonella spp*. There was a decrease in levels of *Enterobacteriaceae* on pen floors after cleaning and disinfection, regardless of category. However, on all farms, significant residual contamination remained on the surfaces of the feeders and drinkers following cleaning and disinfection.
Project leaders: Brendan Lynch and Nola Leonard (Vet College, UCD)
Students: Celine Mannion, MRCVS and Maciej Kozslowski

6. Sow feeding and piglet development
A new three-year project on sow feeding commenced in early 2005. The objective is to examine the effect of extra feed at particular stages of pregnancy on piglet birth weight, post-natal growth, muscle development at birth and carcass growth to slaughter.

A Walsh Fellowship (Teagasc Post-Grad Scholarship) has been secured by Peadar Lawlor and the Royal Veterinary College, University of London to study the muscle development of pigs from these sows. Some sows from this project have recently been slaughtered and samples collected. The first pigs were weaned in August 2005.
Project leader: Peadar Lawlor
Student: Philippa Feely

7. PIGSYS herd performance analysis
A new project started which will have as its objectives to:
1. carry out a comprehensive analysis of the PIGSYS records from c. 120 herds and
2. develop mathematical models to simulate the effect of various changes to management on pig unit output, costs and profitability.

This project is part funded from the Pig research levy and by six feed manufacturing companies.

Project leader: Karen O'Connell

8. Effect of sow feeding and management on productivity and longevity

The project will examine sow feeding and management practices on commercial farms and their relationship to sow productivity and longevity.

Preliminary studies in this project have looked at sow backfat patterns on commercial farms and the relationship between weigh, body condition and sow body size (chest girth, length, height) with a view to estimating body weight without actual weighing of animals.

This project is part funded from the Pig research levy and by six feed manufacturing companies.

Project leaders: Peadar Lawlor and Karen O'Connell

9. Development of objective measures of pig welfare

This project ran from 2002 to 2005 and had its objective the evaluation of biochemical indicators of welfare and stress in blood and saliva. These would be expected to be more objective and repeatable than behavioural measures.

Project leader: Laura Boyle
Student: Sara Llamas Moya

10. Fibre in diets for sows

The objective of this trial which is scheduled to run from 2005 to 2008 is to examine ways of delivering fibrous material to sows in groups and in stalls. This is a requirement under welfare regulations. Options include straw, silage, oat hulls or other ingredients in the feed.

This project is part funded from the Pig research levy.

Project leaders: Laura Boyle and Niamh O'Connells (Hillsborough and Queens University)

11.Control of odour from pig units

This was a desk study of causes of manure odour and mean of reducing odour emissions from pig units. A booklet is being prepared for producers.

This project was part funded from the Pig research levy.

Project leaders: Brendan Lynch

12. SFT scholarship

Dr. Karen O'Connell received a scholarship from the Society of Feed Technologists to study the effect of pellet size on mill operations and pig performance. There was little difference in performance of pigs fed large (5-6mm) and small (3mm) pellets. The report will be present an SFT meeting in 2006.

Project leader: Karen O'Connell

Teagasc Services to the Pig Industry

Teagasc provides a range of services to the pig industry in research, advice and training, as well as confidential consultancy on all aspects of pig production, meat processing, feed manufacture, economics and marketing. Contact numbers are as follows

Teagasc Headquarters, Oak Park, Carlow. Phone 059-9170200, Fax 059-9170239.

Name	Phone No.	Fax No.	E-Mail
Dr. Brendan Lynch, Moorepark Research Centre, Fermoy, Co. Cork.	025-42259 (DD) 025-42222 (S) 087-246 63 86 (M)	025-42340	Blynch@moorepark.teagasc.ie
Dr. Peadar Lawlor, Moorepark Research Centre, Fermoy, Co. Cork.	025-42217 (DD) 025-42222 (S) 086-8214674 (M)	025-42340	Plawlor@moorepark.teagasc.ie
Dr. Laura Boyle, Moorepark Research Centre, Fermoy, Co. Cork. Mr. Seamas Clarke, Teagasc, Ballyhaise, Cavan.	025-42389 (DD) 025-42222 (S) 049-4338108 087-258 09 48 (M)	025-42340 049-4338540	*Lboyle@moorepark.teagasc.ie* s.clarke@cavan.teagasc.ie
Mr. Michael Martin, Teagasc, Resource Centre, Athenry, Co. Galway.	091-84 52 30 (DD) 091-84 52 00 (S) 087-273 59 56 (M	091-844296	mmartin@athenry.teagasc.ie
Mr. Ciarán Carroll, Moorepark Research Centre, Fermoy, Co. Cork.	025-42388 (DD) 025-42244 (S) 087-246 29 25 (M)	025-42384	*Ccarroll@moorepark.teagasc.ie*
Mr. Ger McCutcheon, Teagasc, Bagenalstown, Co. Carlow.	059-9721267 (DD) 059-9721305 (S) 086-830 39 69 (M)	059-9721537	*g.mccutcheon@carlow.teagasc.ie*
DD = Direct Dial; S = Switchboard; M = Mobile.			

Notes