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Temperature control made simple

Brendan Lynch, Moorepark

Mechanical ventilation is used on most pig units to-day but often the operation of the system is less than satisfactory. When well planned and in good working order mechanical systems give better control of temperature and better distribution of incoming air than does natural ventilation. Malfunctioning or poorly designed systems give poor temperature control, waste heat and contribute to poor pig performance.

Ventilation is required to remove:

- heat,
- moisture

as well as

- gases from manure
- gases from the pigs' breathing
- dust.

Removal of these contaminants improves pig performance, pig health and operator health and comfort.

Usually we set the temperature we require to keep the pigs comfortable and we expect the ventilation system to keep the air temperature in the room or house from going too much above or below this. We assume that if the air temperature is correct then the levels of gases, dust, humidity etc are reasonable. Most units now operate with computer-based controls which can work very well. However, they can be intimidating if problems arise. As a result, few people are comfortable making adjustments.

Target or recommended temperatures

The thermal comfort of a pig depends on much more than temperature and involves:

- Air temperature
- Air speed
- Floor temperature
- Bedding
- Freedom to move around
- Radiation

- Dampness
- Level of production (feed intake, growth rate, lactation)
- Stage of production (newly weaned pig, newly weaned sow, pregnancy)
- Group (ability to huddle) versus individual penning
- Body condition
- Health

Nevertheless we can make a guess as to what is a reasonable target temperature for each category of pig (Table 1).

Temperature displays on ventilation systems are often wrongly calibrated and need to be regularly compared with a calibrated thermometer such as a digital one with read-out display. These can now be bought very cheaply. Old-style maximum-minimum thermometers are really cheap and give very valuable information.

Table 1. Recommended temperatures for various classes of pig

Class of pig	**Optimum temperature range, ^{o}C**
Pregnant sow in stall	20 – 22
Pregnant sow in group (no bedding)	18 – 20
Pregnant sow in group (bedding)	15 – 20
Lactating sow	15 – 20
Suckling pig (first 72 hours)	24 – 25
Suckling pig (after first 72 hours)	20 – 22
Weaner first stage	28 in week 1 reducing by 2^{o} per week
Weaner second stage	20 – 22
Finisher	18 – 20

What makes air move

Air moves through an opening from the high pressure side to the low pressure side. In pig house ventilation, the biggest influence on air pressure is wind followed by the difference in air temperature between inside and outside.

Wind causes a build up of pressure on the windward side of the house (walls and roof) and low pressure on the sheltered side (walls and roof). This drives natural ventilation but also has a large influence on fan systems.

There is seldom complete calm in Ireland but where this happens, the temperature difference between inside and outside causes the hot air to rise and exit through higher level opening (usually the chimneys or ridge) and enter at the lower level (inlets, open doors, manure channels).

The output of fan systems is also influenced by the wind. Wind will usually increase the output of ceiling mounted fans or fans on the sheltered wall but decrease (or even stop) wall-mounted fans on the windward side.

Cold weather - setting the minimum rate

The minimum ventilation rate is that which you wish the system to deliver regardless of how cold the house has become. The minimum is often set at 5% or 10% of maximum. This is fine where the fan capacity is low but causes over-ventilation in cold weather especially where fan capacity is too great. Setting the minimum ventilation rate even higher (up to 15%) will cause severe chilling, poor growth, depressed FCE and ill-health especially in weaners. Wall-mounted fans are very vulnerable to being stopped (or even reversed) by wind pressure and a high minimum rate or speed may be chosen to protect the fan.

Hot weather - setting the maximum rate

In warm weather e.g. the summer of 2006 it is impossible to keep daytime house temperatures even close to those shown in Table 1. Note that the daily range tends to be greater in July (at least slightly) than in January (Table 2). Monthly means hide the day to day variation. In July 2006 we recorded a maximum of 28.7^{o}C in Moorepark, but one nightime minimum was only 4.9^{o} and in one 24 hour period the temperature went from 28.7^{o} to 7.5^{o} a drop of 21.2^{o}. It would not be reasonable to plan a ventilation system to cope with the very occasional 28^{o} day.

Table 2. Mean daily temperature maxima, minima and ranges in January and July, ^{o}C

	January			*July*		
	Max.	*Min.*	*Range*	*Max.*	*Min.*	*Range*
Cork	8.7	4.3	4.4	18.0	12.4	5.6
Kilkenny	7.6	1.1	6.5	19.6	10.9	8.7
Clones	6.5	1.1	5.4	18.2	10.5	7.7
MPK means 2006				22.5	12.3	10.2
MPK extremes July 2006				28.7	4.9	21.2

Meteorological Service 1931-1960

Planning for the house temperature to rise about 4° C (when operating at maximum capacity) above outside temperature is a more reasonable objective in sizing the system. You need to double fan capacity if you opt instead for a 2°C temperature rise.

For convenience and to avoid confusion room temperature settings should only be changed very infrequently (except where this is necessary to cater for changing pig weight or age). Choosing a higher setting in summer (say + 2°) will reduce chilling at night and help to improve air quality in winter. However, an experiment in Canada's Prairie Swine Centre found that pigs could tolerate large daily fluctuations (up to 15°C) provided the change was gradual.

Setting the band width

When room temperature is at or below the set temperature the fan should be running at minimum speed (Figure 1). By the time the room reaches a higher temperature (which can be pre-set) the fan runs at its maximum speed. The difference between the set temperature and the high temperature is referred to as bandwidth. Setting the bandwidth between 1.5 and 2.0°C provides a nice gradual increase in air movement that will be comfortable for stock. You may want to make the bandwidth wider during the winter (3 to 4°C). Heating systems should be set to switch on at a temperature slightly below the set-point.

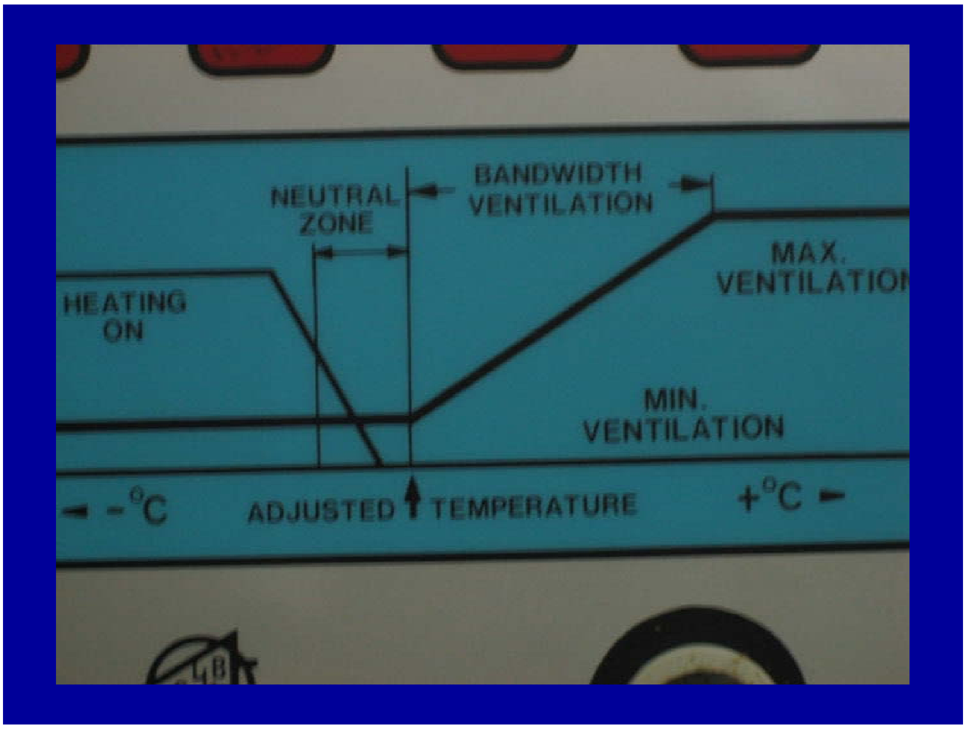


Figure 1. Typical relationship between room temperature and fan speed

Air speed at entry and at pig level

Excessive air movement at pig level chills animals more than does a drop in temperature. Incoming air is usually colder than room air and tends to fall towards the floor especially if the speed of entry is low. If speed of entry (through the inlet) is high then the incoming air will be thrown further into the room and is likely to be mixed (and heated) before reaching pig level. The location of inlets, shape of the inlet and presence of obstructions (beams, light fittings, pen divisions) will affect how air is perceived at pig level. Smoke pellets or tubes can be used to visualise air movement e.g. at inlets and the demonstrate draughts at pig level.

Door ventilation delivers slow moving cold air that can cause chilling (and undesirable dunging behaviour) if it reaches pig level from openings around pen fronts, under feeders or under slats.

Assessing the ventilation system (pig behaviour; dunging pattern)

Lying and dunging behaviour shows the pattern of air movement. Pigs lie where they are most comfortable and this will usually mean away from the draughts. They tend to dung away from the areas used for lying.

Sizing and siting inlets

The position and size of inlets and not the fans dictates the pattern of incoming air. A small inlet area means air speed is higher and the amount of air will be reduced. Too much inlet area means that the pattern of incoming air is determined by the wind speed and direction rather than the inlets. If inlets are not opening, closing or adjusting properly this can greatly affect the room conditions (temperature, humidity, odour) and the conditions down at pig level especially air speed.

Sizing the system

There is no single correct fan capacity for a house. Having too big a fan capacity is a bigger problem than having too little capacity.

The mechanical ventilation system should be sized taking account of:

- Minimum stocking (lowest number of pigs or lightest weight)
- Maximum stocking
- External maximum design temperature (should be exceeded only for a period of hours or days per year)

- External minimum design temperature (should be exceeded only for a period of hours or days per year)
- Internal maximum design temperature (should be exceeded only for a period of hours or days per year)
- Internal minimum design temperature (should be exceeded only for a period of hours or days per year)
- Insulation standard
- Pig performance and heat output

Using this approach we know that the system will keep the house within our target range for almost all the time and we can judge whether it is acceptable to deviate from this target range for a certain amount of time each year.

Fans should be compared on their output against a certain level of static pressure (back-pressure) usually 1/8 inch or 30 Pascals and not at their rating in free air (which is a higher figure). Outputs of typical fan sizes are shown in Table 3 and guideline requirement figures in Table 4. Different models of fan should be compared on their output against the same static pressure. Fans vary in efficiency (power consumption per unit of air moved) and may be more or less efficient than the figures shown in Table 3. Seamas Clarke will be discussing energy costs and strategies for energy saving in more detail later.

Table 3. Output of typical fans (Multifan, 50Hz, sinle phase, 1,400rpm)

Fan diameter, mm (inch)	*Watts*	*Watts/1000m^3/h*	*Max output m3/hr at 0Pa*	*Max output m3/hr at 30Pa*
300 (12)	104	43	2,400	1,870
400 (16)	237	49	4,840	4,030
450 (18)	317	50	6,400	5,860
500 (20)	443	53	8,300	7,610
630 (24)	1,600	93	17,290	16,500
630 (24) **	600	50	12,020	10,920

*** 900 rpm; all others are 1,400 rpm: Other fan models may be more or less efficient, check with the suppliers*

Using the figures in Table 3, one can calculate the number of pigs fans of various sizes will cater for (Table 5).

Improving environment by management

If ventilation has the aim of removing pollutants (gases, dust and moisture) then reducing the amounts of these generated within the house will improve the atmosphere (Table 6).

Table 4. Indicative fan capacity required, m^3 per pig per hour

Pig type	Wt range, kg	All-in All-out	All-in All-out	Continuous	Continuous
		Max	Min	Max	Min
Pregnant sow, boar, gilt	150 - 300	**	**	120	20
Lactating sow	200 - 300	200	25	**	**
Weaner 1	6 – 18	20	2	**	**
Weaner 2	15 – 35	60	6	40	10
Finisher 1	30 – 60	75	10	50	10
Finisher 2	50 - 100	90	20	75	12

These figures are for guideline purposes only. Every installation should be sized for the prevailing conditions. Minimum is that required by a house full of the pigs at the lowest end of the weight range in winter and maximum that required by a house full of pigs at the heavy end of the weight range in summer..

Table 5. Indicative number of pigs per fan in warm conditions

Pig type	Required m^3/hr	Fan 450mm (1,400rpm)	Fan 630mm (1,400rpm)	Fan 600mm (900rpm)
Pregnant sow, boar, gilt	120	50	140	90
Lactating sow	200	30	80	55
Weaner 1	20	290	800	550
Weaner 2	60	100	275	180
Finisher 1	75	80	220	145
Finisher 2	90	65	180	120

These figures are for guideline purposes only. Every installation should be sized for the prevailing conditions.

Role of insulation

Insulation conserves heat in cool weather and reduces gain of heat in very warm conditions. Good insulation allows a higher ventilation rate, diluting pollutants such as water vapour and providing a better environment within the house. A higher standard of insulation is justified where the target temperature is high e.g. first stage weaner and farrowing accommodation. By eliminating condensation insulation reduces odours and also reduces corrosion.

Table 6. Management actions to improve air quality

Problem	***Action***
Excessive dust	Pelleted feed; wet feed; fat in feed
High level of ammonia	Low protein diets; fully slatted floor; less manure stored underneath
High humidity	Lower water:feed ratio; slatted floors; good insulation

Air leakage or unplanned ventilation

Air leakage can greatly increase the actual ventilation rate especially in windy weather. Sources of air leakage include:

- Badly fitting doors, windows, inlets
- Manure channels
- Damaged or badly jointed insulation

Maintenance

Fans, controllers and inlets should be maintained regularly to improve their efficiency and to extend their working life. Dust build up reduces fan throughput which means it has to run faster and/or longer to achieve temperature control. Dust also interferes with inlet flaps, chimney flaps and sensors. Over 80% of the heat lost from a piggery is through the ventilation system so its correct functioning is important to minimise fuel costs.

Conclusions

- The pig knows best !! Watch pig behaviour rather than the temperature reading
- Use a digital thermometer and maximum – minimum thermometers to confirm display readings
- Make sure the fan system is correctly sized and in a good state of repair
- Match inlet open area to fan speed
- Have a regular maintenance programme especially cleaning
- Use management strategies e.g. low protein diets, minimise water spillage to improve the atmosphere within the house.

Using feed efficiently for growing pigs

Karen O'Connell, Moorepark

Feed accounts for 65% of your cost of production, therefore it is in your best interest to ensure it is utilized as efficiently as possible. Without adequate nutrient intake (determined by feed intake) growth is **restricted**, throughput is **suboptimal** and unit productivity, and hence profit are **reduced**. Selection of pigs for improved feed efficiency and leanness has inadvertently selected for reduced voluntary DFI (Webb, 1989). Consequently, DFI is now generally recognized as a factor limiting production.

Feed intake versus feed disappearance

It is important to distinguish between ***feed intake*** and ***feed disappearance***. The difference between the two is ***waste***. If intake of a nutritionally balanced diet is high and growth rate is disappointing then waste is the only explanation.

Table 1. Target feed intake values for pigs in different stages of growth.

	Target intake range, g/day
Week 1-2, post weaning	250-300
Week 3-4, post weaning	600-800
Weaner stage (4-10 weeks)	800-1,000
Finisher	1,750–1,900
Weaning to sale	1,350-1,500

What are the factors that influence changes in voluntary feed intake?

Daily feed intake is affected by:

- Genetics
- Environment (temperature)
- Diet (energy density, protein/amino acid content, ingredient choice)
- Housing (group size, space allowance)
- Feeding system (wet v dry, hopper, feeder design).

Genotype

Potential for gain and voluntary DFI varies with genotype. Certain breeds of pigs, particularly Duroc, have a higher capacity for *ad libitum* DFI than others. In a study in Moorepark, pigs born from seven different sirelines had differences in DFI during weaner stages 1 and 2, which ranged from 742 to 818 g/d (Lynch et al., 1998). Eggert et al (1998) reported that Duroc sired pigs had greater DFI than either Pietrain or Large White from 75 to 120kg. Recently many Irish producers have used Pietrain sires because of perceived resistance to PMWS. However, a study of feeding behaviour of different pig breeds from 30kg to slaughter indicated that Pietrains had lower ADG and DFI than Large White or Landrace pigs and took longer to reach slaughter weight (Table 2).

Table 2. Effect of breed on performance traits (Baumung et al., 2006)

	Large White	*Landrace*	*Pietrain*
Daily gain, g	869	854	714
Daily feed intake, g	2,214	2,277	1,704
Feed conversion ratio	2.57	2.68	2.40
Days	88	90	99

Effect of gender

Female pigs tend to eat more than entire males. However, they have lower ADG and poorer FCR. Consider separate diets for females, which have lower requirements for protein and amino acids at heavier weights. Table 3 shows the difference between DFI, ADG and FCR of groups of male and female pigs in difference weight ranges (O'Connell et al., 2005b, 2006). This was also discussed at the 2004 Teagasc Pig Conference (O'Connell, 2004).

Table 3. Effect of gender on DFI, ADG and FCR at different weights.

	DFI		*ADG*			*FCR*		
	M	*F*	*M*	*F*	*sig*	*M*	*F*	*sig*
40-60 kg	1,868	1,953	801	814	ns	2.34	2.45	*
80-100 kg	2,494	2,509	882	750	***	2.92	3.30	***

Temperature

Animals perform well within a certain temperature range, the thermal neutral zone (or comfort zone, TNZ), which for newly weaned pigs is in the range 28 to 30^{o}C, falling to 18 to 20^{o}C as they approach slaughter weight. Higher temperatures decrease DFI and ADG, while FCR may be unchanged. The effect on DFI is more pronounced in heavier pigs. Figure 1 shows the decline in DFI with each degree increase in temperature from the TNZ. Lower temperatures result in increased DFI and (usually) poorer FCR.

Pigs on a high level of feed have a lower optimum temperature range. Pigs with low DFI (e.g. newly weaned or ill pigs) have a higher optimum. During the summer months DFI is reduced. Figure 2 shows the fluctuation in DFI from weaning to slaughter between quarters (1:Jan-Mar, 2:Apr-Jun, 3:Jul-Sep, 4:Oct-Dec) over two years (2003 and 2004).

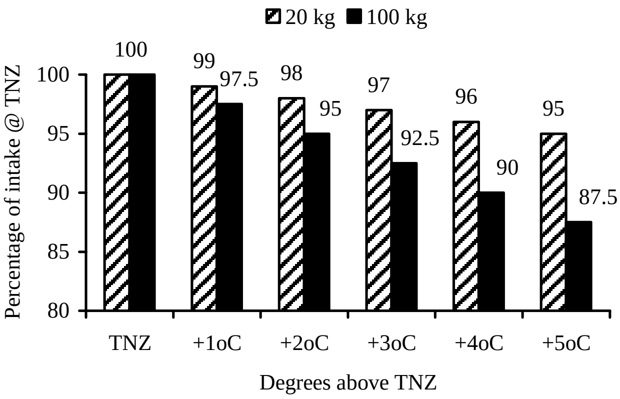


Figure 1. Effect of an increase in temperature from the TNZ on DFI of pigs at 20 or 100kg. For 20kg pigs, 1^{o}C increase in temperature results in 1% decline in DFI, for 100kg pigs 1^{o}C increase in temperature results in 2.5% decline in DFI.

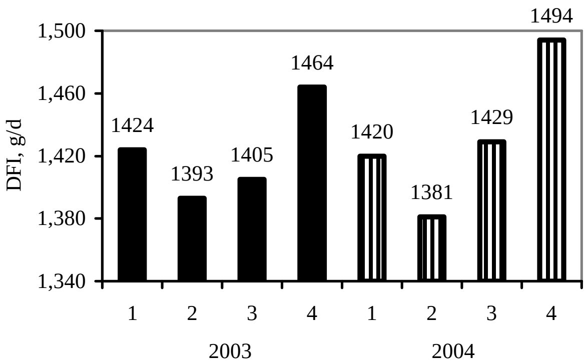


Figure 2. DFI from wean to slaughter (6.6-95kg). The solid bars indicate the four quarters in 2003 and the lined bars indicate the four quarters in 2004 (PIGSYS).

Group size and floor space allowance

See paper by Mike Ellis at this conference.

Feed space allowance

Feeder space restriction reduces DFI. In an automated system, delivering feed 2 or 3 times daily, all pigs must have adequate space to feed together. In *ad libitum* systems, less space is required. *Ad libitum* fed pigs require up to 75mm of space (depends on weight) and restricted fed pigs 1.1 x shoulder width (Table 4). Shortage of feeder space reduces individual DFI causing greater variation in weight at slaughter.

Wolter et al. (2002 and 2003) found that pigs performed better when allowed 4cm of trough space compared with 2cm from weaning to 31kg (2002) or 55kg (2003). Spoolder et al. (1999) found a significant improvement in ADG when there were 2 hoppers per 20 pigs compared with only 1 (36 to 85kg, ADG 769 and 752g/d for 2 and 1 hoppers, respectively). Turner et al. (2002) also noted increased DFI when feeder space was increased from 32.5 to 42.5mm in groups of either 20 or 80 pigs from 29kg for 6 weeks. A study in Moorepark showed a decline (although non-significant) in DFI and ADG when group size increased from 11 to 13 to 15 per pen (37 to 99kg), with a reduction in feed space allowance from 14 to 12 to 10cm per pig (O'Connell et al., 2005a; Table 5).

Table 4. Feeding space allowance for an *ad libitum* or a restricted feeding system

Ad libitum		*Restricted*		
Pig weight (kg)	***Feeder space (mm)***	***Pig weight (kg)***	***Shoulder width (mm)***	***Feeder space (mm)***
10	33	10	130	140
15	38	30	190	210
35	50	50	230	260
60	60	70	270	290
90	70	90	290	320
120	75	110	320	350

Table 5. Effect of group size and feeder space allowance on daily gain, daily feed intake and feed conversion ratio of grower-finisher pigs (O'Connell et al., 2005a)

Group size	***11***	***13***	***15***
Feeder space allowance, cm	***14***	***12***	***10***
Daily gain, g	840	835	822
Daily feed intake, g	2,242	2,223	2,190
Feed conversion ratio	2.67	2.67	2.67

Re-grouping

Re-grouping, e.g. at weaning or transfer to fattening, affects DFI and ADG for a period. For younger pigs (e.g. 8 weeks old), the effects of re-grouping are overcome with time, without long term effects on production. However, re-grouping is not recommended in the finishing facility, due to increased aggression, and less time to overcome the effect.

When some pigs are removed from the pen there is disruption to feeding as a new 'pecking order' is established. By removing 1/3 or 1/4 of a pen to slaughter (one to two weeks before the rest), DFI of remaining pigs increased from 1,833 to 2,245g/d (remove 1/3 of pigs) and from 1,829 to 2,098g/d (remove 1/4 of pigs; O'Connell et al., 2005a). However, the pigs remaining had the poorest overall carcass ADG and carcass FCR (Table 6). While this is probably because those were the slower growing, less efficient pigs, increased wastage as the pigs compete to establish the social order may also be a factor. DeDecker et al., (2005) found that over a 19 day period post removal of 25 or 50% of pigs from a pen, DFI and ADG was greater in the remaining pigs when compared to a control where no pigs were removed. They attributed this partly to increased feeder space. Scroggs et al., (2002) found that removal of 50% of the heaviest pigs 1 week before their pen-mates lead to increased DFI and poorer FCR post removal compared with pens where no pigs were removed.

Table 6. Effect of removal of pigs to slaughter over a number of days.

		Number of removal Days			
		1	***2***	***3***	***sig***
Day 1	Proportion of pigs removed	1	0.37	0.25	
	Daily feed intake to Day 1, g	1,954	1,833	1,829	
	Carcass daily gain, g	674	731	758	*
	Carcass feed conversion ratio	2.90	2.51	2.41	**
Day 2	Proportion of pigs removed		0.63	0.25	
	Daily feed intake Day 2-Day 3, g		2,245	2,098	
	Carcass daily gain, g		599	687	**
	Carcass feed conversion ratio		3.19	2.71	*

Increasing DFI post-weaning

Most piglets will find the source of feed and water within 36 hours of weaning, but it is up to you to identify those that have not. Weaning age is extremely important for maturity of the digestive system. A piglet weaned at 3 weeks weighing 6 kg is not as physiologically mature as a 4 week old piglet at the same weight. This is very important where split-weaning is practiced or where heavier pigs are weaned ahead of their litter mates. A study in Moorepark showed 16% less feed intake, 25% lower ADG and 30% poorer FCR when pigs of the same weight were weaned at 21 days rather than 28 days (Table 7).

Weaning heavier pigs at the same age as lighter pigs will result in increased DFI, and ADG, and this advantage will continue to slaughter. Results from Moorepark indicate 4% higher DFI and 3% higher ADG with the same FCR when heavy and light pigs at weaning are compared through to slaughter (Table 8).

Providing an extra feeder during the first weeks post-weaning has been suggested to stimulate feed consumption. Groups of 15 pigs weaned at 27 days were provided with a 77cm long hopper feeder and half were provided with a circular 'turkey feeder' similar to ones used for creep feeding pre-weaning. There was no significant difference in DFI or ADG over the following 28 day period. Pig weights were 7.0kg at weaning and 15.4 and 15.6kg for 1 feeder and 2 feeders respectively (Cahill, 2005).

Table 7. Weaner stage 1 performance (21 days) of pigs weaned at 3 or 4 weeks and 6kg.

	Wean age, weeks		
	3	***4***	***sig***
Wean weight, kg	6.0	6.1	
Final weight, kg	9.9	11.1	**
Daily feed intake, g	319	378	**
Daily gain, g	182	242	**
Feed conversion ratio	1.91	1.60	*

Table 8. Effect of weaning weight on post weaning performance.

	Heavy	***Light***	***Difference***
Wean weight, kg	8.9	7.5	16 %
Slaughter weight, kg	88.4	85.9	3 %
Daily feed intake, g	1,385	1,334	4 %
Daily gain, g	750	726	3 %
Feed conversion ratio	1.85	1.84	-

Some studies show an increase in ADG of newly weaned pigs when fed liquid diets compared with dry feeding. This is likely due to increased DFI. Lawlor et al., (2002) found that acidified liquid diets may have some benefit (weaning to day 27 post-weaning). They also found increased DFI on fresh liquid, acidified liquid and fermented liquid feeds when compared with dry pelleted diet. However, the effect on ADG and FCR was variable, possibly due to feed wastage, rather than intake.

Energy density

Dietary energy content affects DFI but has less effect on daily energy intake. Pigs that have access to a nutritionally-adequate diet in a thermo-comfortable zone adjust their DFI to meet their energy demand. Within a range of energy density diets pigs adjust voluntary DFI so there is little change in energy intake. However, DFI may be limited by the physical nature of the diet, gut fill or the passage rate so that energy intake is reduced on low density diets. This is rare in commercial pig production. A reduced intake of high energy diets means that the expected benefit in increased growth rate may not be achieved.

Feed ingredients and palatability

Some ingredients may become unpalatable if included in high amounts. E.g. canola may contain sinapine (a bitter tasting compound) that may reduce palatability at high inclusion levels (Thacker, 1990). A reduction in performance (due to reduced DFI) of weaned pigs has been found when canola meal in the diet exceeded 9% (McIntosh et al., 1986). Given a choice of a diet containing soybean meal or canola meal, pigs prefer the soyabean.

Pelleted feed

Providing feed as a pellet compared with a mash can improve voluntary DFI by 3-12%, depending on fineness of grind. Pellet size, within reason, does not appear to influence DFI of younger pigs who are capable of consuming larger pellets, provided they are soft enough to chew. If pellets are too hard, DFI younger piglets is reduced. A study in Moorepark comparing 3mm and 5mm pellets showed that DFI did not differ, although smaller pellets resulted in greater ADG (non-significant) and better FCR (19 to 39kg; Table 9). This may be because the smaller pellets tended to be softer and less durable, and easier to chew.

Table 9. The effect of pellet size on daily gain, daily feed intake and feed conversion ratio of pigs from 19 to 39kg (O'Connell, 2005)

	5-mm	*3-mm*	*sig*
Daily gain, g	569	592	
Daily feed intake, g	1,032	1,011	
Feed conversion ratio	1.82	1.71	*
Pellet hardness, kg	1.61	1.13	0.08
Pellet durability, %	61.0	53.5	**

Water supply

A 60kg pig fed *ad libitum* will consume approximately 2kg of feed per day. This feed contains about 14% moisture, giving a water intake of 0.28 litres/day. In a wet feed system, water to feed ratios range from 2.5 to 3.5:1. Thus, the pig receiving 2kg dry matter would receive between 5 and 7 litres of water.

Newly weaned pigs dehydrate rapidly and must have ready access to drinking water. A supplementary water source may help e.g. turkey or cube drinker. The water ***must*** be fresh. Make sure that the correct type of water devices are installed, that piglets can reach and operate them without difficulty. All pigs over 2-weeks of age ***must*** (by law) have access to fresh water (even if using a wet feeding system). Willingness to drink water will be influenced by water quality and water flow rates. Water must be ***clean***. Figure 3 shows intake from fouled and clean bowls.

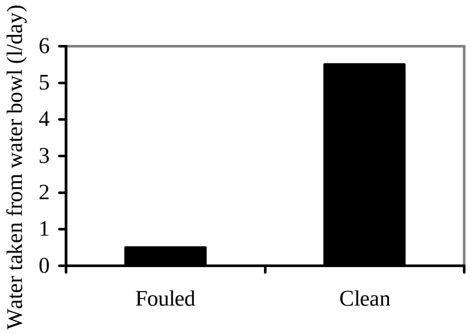


Figure 3. Effect of fouling of water bowl on water consumption (Carpenter and Brooks, 1989, unpublished data, from Brooks and Carpenter 1990).

There should be one nipple drinker per 10-12 weaners and one per 20 grower-finishers or one bowl per 15-20. Flow rate is also important (Table 10).

Table 10. Daily requirements and minimum flow rates from drinkers for pigs at different stages

Pig weight / type	*Daily requirement (L)*	*Min. flow rate (L/min)*
<20 kg	1.5–2	0.5 –1
20–40 kg	2–5	1–1.5
Finisher	3–6	1–1.5

Water to feed ratio

Too much (in a wet feed mix) or too little water can depress feed intake and growth as shown in French experiments as shown in Table 11.

Table 11. Effect of water: feed ratio on finisher pig performance (Chauvel, 1990)

	Exp. 1		*Exp. 2*	
Water to feed ratio	3:1	6:1	3:1	1.25:1
Daily feed, kg	2.33	1.97	2.39	2.41
Daily gain, g	708	602	721	625

At higher water to feed ratios (WFR) pigs can chill (they have to use energy to warm feed) and because of bulk may not consume sufficient nutrients. WFR varies from about 1.9:1 on wet/dry feeders to >4:1 with wet feeding. Excessive water depresses DFI and ADG. Aim for WFR of <3.0:1 by reducing bends and/or increasing pump capacity.

Feeders

Feed disappearance is only equal to feed intake when there is no waste. Researchers in Hillsborough (O'Connell et al, 2002) compared a number of different feeders for weaned pigs (4-11 weeks) (Table 12).

Table 12. Effect of feeder type on performance of pigs from 4-11 weeks (O'Connell et al., 2002).

	Dry multi space	*Wet/dry multi space*	*Maximat*	*Lean machine*	*Verba*
Feed disappearance, g/d	897	951	863	839	824
Daily gain, g	598	605	577	572	575
Feed conversion ratio	1.50	1.58	1.49	1.47	1.42

Feed disappearance was highest on the wet/dry multispace feeder, with a corresponding poorest FCR - likely due to increased wastage.

There was less aggression and competition on the dry multispace feeder. The Maximat feeder was difficult to adjust. Although, FCR was best on the Verba, this feeder registered the lowest feed disappearance and ADG. Previously, single space wet/dry feeders were shown not to promote optimum performance in weaner pigs (Walker et al., 1993). If using wet/dry feeders, allow a *maximum* of 15 pigs per feeder. With more than 15 pigs in the pen, use corner or head to head wet/dry feeders. Gonyou and Lou (2000) found that wet/dry feeders result in higher DFI and ADG in grower-finisher pigs compared with dry feeders. Wet/dry feeders have been shown to increase feed intake and body weight gain by 5-8% and 4-6%, respectively (Payne, 1991) over traditional dry feeders.

How much feed in the tray?

Ensure feeders are closed before adding feed. Then open the slide/gate so that a small amount is visible in the trough. Adding feed with the slide open makes it difficult to adjust correctly. If there is too much feed in the tray, pigs sort through it, causing a build up of fines and a blockage. Smith et al., (2002) suggest that the optimal feeder gap size (opening) for weaned pigs is achieved when 40% of the trough is covered with feed (60% of trough base is visible). If the opening is too small, pigs spend more time at the feeder, but intake is reduced. For grower-finisher pigs adjust the feeders so that at least 70% of the feeder tray is ***visible*** and NOT covered with feed (i.e. approx 25% feed coverage, DeRouchey et al., 2003; See, 2000). Keep pictures of feeders with 25%, 40% and excessive feed coverage. Smith et al., (2002) examined the effect of feeder gap openings on performance of weaners (7-28kg). They concluded that a feeder gap of 18mm, allowing ~40% tray coverage was optimal (Table 13).

Table 13. Effect of feeder gap width on weaned pig performance.

	Feeder gap, mm				
	9	***12***	***18***	***25***	***32***
Daily gain, g	480	520	**530**	520	530
Daily feed intake, g	720	750	**780**	770	780
Feed conversion ratio	1.50	1.44	**1.47**	1.48	1.47
Tray area clear, %	94	88	**63**	32	9
Tray coverage, %	6	12	**37**	68	91

Feed waste

It is generally assumed that if there is spilt feed visible around the feeder, there is 10% wastage (Nelssen et al., 1999). Although the greatest amount is consumed in the finisher stage, do not overlook weaners, as the diet is more expensive. It is better that only one person checks the feeders in each house preventing accidental closing or opening of feeders.

What can YOU do on site to improve feed efficiency?

- Check your DFI recorded in PIGSYS over the last number of quarters.
- Can wastage be reduced?
- Keep thermometers in all rooms and observe your pigs for signs of thermal comfort.
- Do not wean younger, lighter pigs.
- Ensure ALL weaned pigs are eating and drinking.
- Have drinkers working optimally – flow rate, accessibility, cleanliness.
- Provide additional water at weaning.
- Check feeders – not too much feed nor too little, adjust and clean.
- Make sure pigs can eat and drink comfortably.
- Multispace feeders are best for weaned pigs.
- Add feed a little (weaned pigs) and often and adjust feeders regularly (all pigs).
- Consider separate-sex feeding.
- Post-weaning 40-50% feed coverage; Grower-finishers 25% feed coverage.
- Replace old, worn, wasteful feeders.
- Keep pictures of properly adjusted feeders.
- Assess your selling strategy, is it working?
- Check that the nutrients in the diet are supplied in the correct amounts for your DFI.

Are Your Herd Records Accurate Enough?

Ciaran Carroll, Teagasc, Moorepark

Good record keeping and analysis is essential for the long term survival of any pig unit. It highlights problem areas, allowing prompt action to be taken. Good records are also useful where units are renovating or expanding as they can be used to demonstrate the expected economic benefits of the proposed change.

However, recording and measuring performance is only of use to if done properly. How accurate are the records you keep? Do you pay enough attention to details, especially in the area of non-feed costs? What about accurate stock counts at the beginning and end of a recording period? What about the "missing" pigs that go unaccounted for from quarter to quarter? Where do they go and how do you record them? What about the hidden costs that were never considered before (e.g. manure handling) but now have a real impact on production costs? Do you account for the family labour on the unit? Do you even account properly for our own time? These are real costs that often go unnoticed and unrecorded.

Why Keep Records?

You keep records in order to measure herd performance in terms of:

- Pig Price
- Production Costs
- Sow Productivity
- Sow Replacement
- Growth Rates
- Feed Conversion Efficiency
- Feed Usage

You measure herd performance in order to:

- Identify where improvements can be achieved
- Quantify production costs and relate these to pig price
- Compare performance with realistic targets
- Compare herd performance with other comparable herds (Benchmarking)

While standard production costs are a useful guideline for producers they are no substitute for accurate herd records. Each producer must know the true production costs for their herd.

Question Time:

Two questions that will indicate how accurate your herd recording system is:

1. What price are you currently getting for pigs?
2. How much does it currently cost you to produce 1kg deadweight?

Guidelines to Keeping Accurate Records

- **Stock Counts:** carry out a full stock count of all pigs. Ideally this should be done every four weeks but at least every quarter (13 weeks). Stock counts are one of the areas where records either succeed or fail. Without an accurate stock count records are useless. Inaccurate reports on herd performance will be generated.

  Counting can be made easier by using recording sheets identifying pen numbers. Keep the numbers chalked up over pens. In large groups, walk the pigs past the counter. Record the number once **each** pen is counted.

- **Feed Inventory:** record the quantity and value of the different diets on hand at the start and end of the recording period.

- **Daily Record Sheet:** use the Teagasc Daily Record Sheet (manual or computerised). Fill each evening. This minimises the risk of error, e.g. forgetting to record events. It saves time later in putting data together for analysis, eliminates unnecessary duplication and makes the calculation of weekly totals and stock numbers easier.

- **End of Each Week:** add up all totals, calculate stock numbers, calculate production, enter the data in the Teagasc Pig Record & Account Book (if recording data manually). Update feed costs and enter details of all pig sales including weights and prices. Enter all non-feed costs under the following categories.

  - Healthcare
  - Heat/power/light
  - Artificial Insemination
  - Manure – all costs associated with transport and spreading
  - Transport
  - Miscellaneous Costs
  - Labour - including PAYE & PRSI, pension contributions, health insurance, accommodation, vehicle allowances

- ❖ Repairs - where VAT repayment is claimed on buildings and fixed equipment the expenditure is not repairs but capital
- ❖ Office / Phone costs
- ❖ Repayments – interest and capital paid on all term loans, interest paid on overdraft and all leasing charges.
- ❖ Management Costs – cost of management and own/family labour is often underestimated. Where the owner is full time manager the annual salary should be greater than €40,000. Use personal/family drawings as a minimum. Always use a separate personal/family account.
- ❖ Environmental Costs – IPPC license application, annual fee, cost of compliance (soil & water sampling, recording and reporting)
- ❖ Insurance
- ❖ Building Depreciation – structure (55% of building cost) depreciated over 20 years at 5% per year; equipment (45% of building cost) depreciated over 10 years at 10% per year. This figure will change each year and when new capital investment is made. It will be higher for new units and will be nil for units over 20 years old if not refurbished.

- **End of Recording Period:** ideally data should be analysed quarterly (every 13 weeks). Shorter periods produce unreliable results due to short-term variations in performance. Longer periods mean that problems are not identified quickly enough.

  Carry out a full stock count at the end of the recording period, total all weekly data (production, feed, sales, non-feed costs) and calculate feed usage. After the stock count check the stock balances immediately. Try to account for "missing" pigs. These may well be deaths not recorded or they could be internal transfers not recorded (piglets to weaners, weaners to finishers).

- **Prepare the Data Input Sheet:** complete (or print-off) the data input sheet and send to the advisor for analysis.

Key factors to remember are:

1. Opening stock numbers for one period should be the same as the closing stock number for the previous period. Using different stock numbers may conceal "missing" pigs.

2. Adjusted Herd Size - this is the Average Herd Size for the previous quarter. It takes account of changes in herd size from quarter to quarter.

3. Average Stock Number – add the stock number for each week and divide the total by the number of weeks in the period. If stock numbers are incorrect it will affect the average stock number which will in turn distort key performance measures, e.g. litters/sow/year, weaning age, feed/sow/year, daily feed intake, average daily gain (ADG).

4. Average Closing weight of weaners – this is usually the average weaning weight plus average weight of weaners transferred/sold divided by two.

5. Average Closing Weight of Finishers – this is usually the average weight of weaners transferred/sold plus average weight of finishers sold divided by two.

These weights must be accurate. If over or under-estimated then A.D.G. and F.C.E. will be incorrect. The effect is greater for short periods. It will also affect figures for the next period.

All or Nothing

No information is better than wrong information. While it is bad enough having no data for some items, having inaccurate information is worse. It gives a false sense of security that you are recording everything required, yet you are getting a distorted and untrue picture of your real production cost. Table 1 below highlights how inefficient producers are in recording non-feed cost data. The figures are from the 2005 PigSys Analysis Report.

As can be seen, there is a serious lack of information in the data recorded on too many units. This means that on average over 50 percent of units that record that do not know their true costs of production, never mind the units that don’t record at all!

How Often Should You Analyse Data?

Just because you record data doesn’t mean you know your costs or are on top of what’s happening. It depends on how often you analyse the data and what you do with the results. Data should ideally be analysed quarterly. Leaving it longer than that can prove costly. Table 2 shows an analysis of two years PigSys data by Dr. Karen O’Connell. Group 1 are units that kept eight consecutive quarters of records while Group 2 units missed quarters or recorded only once / twice a year. Weaning weight is set at 6kgs and a seven day turn around between batches in assumed, with 100 weaner-finisher pigs per batch. A base price of €1.35/kg deadweight was used.

Table 1: Number and Percentage of units recording various items in 2005

Item	**Percentage Units Recording Data Out of Total (85)**
Productivity Data	100
Feed Costs	88
Common Costs	
Healthcare	58
Heat/Power/Light	61
Transport	47
A.I.	74
Manure	47
Miscellaneous	59
Labour/Management	55
Repair	59
Phone/Office	46
Environment	21
Insurance	40
Stock Depreciation	55
Herd Specific Costs	
Interest	25
Building Depreciation	46

Units keeping frequent records received €652 more per 100 weaner-finisher places per year. Although lean meat content was slightly higher for Group 2, the faster growth rates of Group 1 allowed 21 pigs more per year (per 100 weaner-finisher places). In conjunction with faster growth rates, pigs in Group 1 had lower daily feed intakes (required 34kg less feed per pig or €7.89/pig). This resulted in a saving of €556 per 100 weaner-finisher places. In total these factors resulted in over €1,200 more per 100 weaner-finisher places in Group 1. Table 3 shows the estimated value of this for different sized units.

Further analysis of the data between units that recorded data quarterly (Group 1) and less frequently (Group 2) show a difference of 0.4 pigs more produced per sow per year for Group 1 units. The extra value of this is approximately €16 per sow or €8,000 per 500 sow integrated unit, giving a cumulative saving of over €60,000 per 500 sow integrated unit. Now, what more information do you need to encourage you to keep regular accurate records?

Table 2: Quarterly (Group 1) versus Less Frequent (Group 2) Record Analysis

	Group 1	Group 2	
Weaning – Sale ADG (g)	596	545	
Live weight @ sale (kg)	94.7	95.2	
Dead weight @ sale (kg)	71.6	71.8	
Days weaning to sale	149	164	
Batches/year (wean-sale)	2.34	2.13	
Finishers/Year (per 100 places)	234	213	
Lean meat (%)	57.4	58.7	
Total carcass/year (kg)	16,754	15,293	
Total lean meat/year (kg)	9,617	8,977	
Price (€/kg)	1.44	1.47	
Value of lean meat (€)	13,848	13,196	
Value difference/year (€)			**652**
Average daily feed intake			
Weaning to sale (g)	1,430	1,505	
Total feed intake, wean-sale (kg/pig)	213	247	
Weighted feed cost (€/tonne)	233	231	
Feed cost/pig (€)	49.6	57.1	
Feed cost/year (€)	11,606	12,162	
Feed cost difference/year (€)			**556**
Total difference per 100 wean-sale pig places (€)			**1,208**

Table 3: Estimated Value of Savings Made as a Result of Regular Accurate Recording for Different Sized Units.

Unit Size (No. Sows)	Value (€)
100	10,570
Ave. Herd Size 500	52,850

Depop – Repop, is it for you?

Michael Mc Keon, Tullamore

It is well known that high health herds have significantly better performance and lower cost of production compared with conventional health herds. This means higher ADG, lower FCE, increased born alive, lower mortality and lower healthcare costs.

However it is very difficult to maintain a high health herd over a long period and most herds will eventually have a health breakdown. If this is a mild breakdown then the unit may be able to continue to operate with only a slight negative effect on performance and cost of production. However, if the breakdown is severe or if there is an additive chronic disease effect then the only option may be to restock.

This paper examines the considerations, method and financial implications for a unit depopulating, resting and repopulating with high health gilts.

Considerations:

Before a decision can be taken, it is important to get accurate data on the unit's current performance. This will allow an assessment of the unit profitability and the impact of disease. When the current situation has been assessed it will be possible to examine if this is sustainable in the medium term (3-5 years) and if not whether depop - repop is an option.

It is also important to consider the distance from your unit to the nearest conventional health unit. Air/wind transmission is the most common form of disease transmission and one that you have least control over. The general 'rule of thumb' is that you must be at least 5km from the nearest conventional health unit to have a good chance of remaining high health for a reasonable period. If there are such units within this distance it may be possible to convince them to restock at the same time

The big fear with depop-repop is that the herd will breakdown after a short period. However, if you repopulate and then become reinfected you may not be back to 'square one'. A number of units have recently repopulated and then become reinfected (PMWS) but with less negative performance effects, primarily due to the absence of secondary diseases.

Benefits:

The principal benefit of high health is increased growth rates and improved feed efficiency. The high health environment allows increased nutrient intake to be utilized for growth instead of being diverted to the immune system. The sow herd is also healthier and therefore more productive resulting in improved conception rate, less empty days and greater born alive.

This high health status therefore results in less morbidity and less healthcare / medication costs. This has a knock on effect in reducing labour required for vaccinating, medicating, removing sick pigs etc, allowing increased labour input on more productive tasks.

How to depop – repop:

The most important principal in depop-repop is minimizing the duration of no sales. It is critical to begin selling slaughter pigs as quickly as possible after the unit has been cleaned and disinfected. Fixed costs (labour, bank charges, power etc) still have to be paid in the down time so it is vital to begin generating income as quickly as possible.

This paper outlines how this can be achieved by acclimatizing and serving gilts off site, allowing the unit to be destocked, washed/disinfected, rested for four weeks and then repopulating within 2 weeks of farrowing. In this scenario approximately 10 weeks of weaners will be finished off-site/sold, with all other pigs been finished on-site.

The main elements of a depop- repop are as follow:

1. Timetable
2. Breeding Stock Supply
3. Service Unit
4. Cleaning / Disinfection
5. Repairs/ Refit
6. Biosecurity

1. Depop – Repop Timetable

When planning a restock it is very important to draw up a timetable to ensure that the down time is minimized. Table 1 below gives an example of a timetable of events.

2. Breeding Stock Supply:

Gilts must have a minimum of 14 teats, good confirmation and strong legs with even toes. The source unit must be high health with a recent veterinary health certificate stating the diseases tested for and results achieved. The breeding company should also supply you with performance and contact details of units that have been recently restocked or that are receiving gilts on a regular basis. The breeding program must be decided before gilts are selected as this will determine the type, number of gilts per week, AI to be used and number of replacement gilts required.

It is important that 2 – 3 terminal teaser boars are also supplied from the same unit/health status to enable gilt heat checking.

Table 1. Schedule of events for a depop-repop programme

Wk	Date		Home Unit		Service Unit
1	01-10-06		Last sows served		
5	01-11-06				Begin gilt purchase (100 kgs)
11	13-12-06				Vaccinate Gilts
16	22-01-07		Begin to move/sell weaners @ 25 kgs (pigs +25kgs will be finished on unit)		
16	24-01-07				Start serving
16	25-01-07		Last sows Farrow		
26	06-04-07		Move/sell last of pigs - Weaners @ 20-25 kgs Fatteners @ 80-85 kgs		
30	04-05-07				Return gilts to unit
32	18-05-07		Begin to Farrow		
53	12-10-07		Begin to sell slaughter pigs		

3. Service unit:

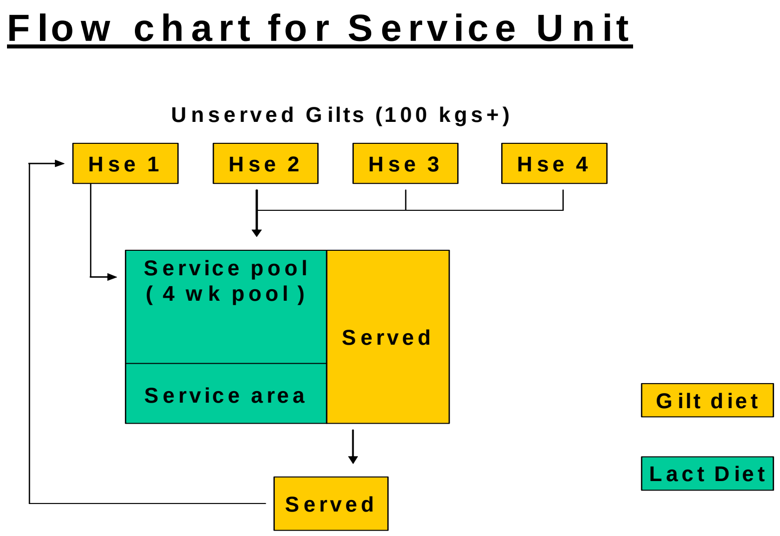
The service unit is the key to a successful restock. The main points are a) Location/Type

b) Gilt flow/Operation

c) Nutrition

a) Location / Type: Ideally the unit should be well isolated (min 5km from nearest unit) with a number of different houses to facilitate the different sizes/ages of gilts required. Large, enclosed, dry, straw bedded sheds are ideal as they give the gilts plenty space and produce fit gilts with strong legs. Alternatively an empty cleaned fattening unit could be used providing the slats are in good condition. Ensure a minimum space of 1.3 m^2 ($14ft^2$) / gilt.

b) Gilt flow / Operation: The flow chart below gives a description of how this unit could operate.



The service pool is set up by creating a pool of 4 weeks services, selected at 90-100kgs and fed a gilt diet for 9 weeks before being fed a lactation diet until service. The teaser boars are preferably housed in another area and introduced through the gilts each day to find the gilts 'on heat'. These gilts are then served in the service pen and held until the 2nd service the following day and then released into the served pen. When a gilt is served she is issued a sequential tag number which is then recorded in the service book with date and AI used. If a gilt repeats she is issued a new tag.

When the weekly target has been achieved, another week's services are entered into the pool always maintaining a four week pool. After a number of weeks the served pool is removed to an empty house.

c) Nutrition: Diets are fed in bulk bins, one per house. Feed a gilt diet from selection (100kgs) until entry into the service pool and then after service until farrowing. Because the gilts are on ad-lib feeding it is important that the energy and protein spec of the diet is low to prevent the gilts becoming too fat and to allow a sufficient flushing effect at service. Table 2 shows the recommended spec for a gilt and lactation diet.

Table 2. Recommended Specification for Gilt + Lactation Diets

Diet	Lysine %	Energy MJ DE	Biotin ppm	Cal	Phos (total)	Vit A	Vit D	Vit E
Gilt	0.65	12.4 -12.5	300	1.0	0.8	10,000	2,000	120
Lactation	1.0	14	300	0.8	0.65	10,000	2,000	120

4. Cleaning / Disinfectant:

The clean-up should be undertaken in a methodical and planned fashion.

a) Clean houses as they are emptied. This allows the bulk of the cleaning to be completed by the time the last pig leaves the unit

b) Empty manure tanks

c) Clean feed bins and pathways

d) Clean header tanks and drinkers

e) Disinfect all buildings and thoroughly ventilate to ensure they are fully dry.

f) Fumigation. This must be undertaken by professionals and requires the houses to be sealed for number of days and then completely ventilated. This is very effective for disinfecting in-house fixed electrical equipment and eliminating rodents etc.

5. Repair / Refit:

This is an ideal opportunity to undertake any needed repairs, servicing of equipment, replacing old feeders etc. and for conversions/ refits. Any unit with sows in baskets, undertaking a destock in the next few years, would be strongly advised to use the opportunity to convert to loose sow housing.

Biosecurity:

a) Personnel: When undertaking a restock using a service unit it is important to allocate specified staff to either the service unit or the home unit. The service unit personnel are stationed there full time and will not return to the home unit until the gilts return or they are a number of days pig-free before they return.

b) Transport: It is important to inform your mill that the unit is high health and you require the transport to be as clean as possible. For the mill to ensure this requires orders to be given well in advance. Trucks used to bring the gilts back to the unit must be clean, disinfected and pig-free for a number of days. The pigs should be moved over the weekend and if possible avoid routes running beside a pig unit.

c) Future: Before the unit has been destocked examine existing biosecurity procedures to see if they are sufficient for a high health herd e.g. access points, visitors, showers, carcass skips, factory truck etc.

Financial Implications

The objective of depop-repop is to increase the productivity and profit margin of your unit. The extent of the increase in profit margin and therefore the time it will take to recoup the expense incurred will obviously be the key factor in deciding whether to destock or not.

Cost of Depop – Repop:

The cost of this depop – repop operation (Table 3) is estimated based on 12 weeks of no sales and spending a minimum amount on unit repairs / refit.

Table 3. Estimated cost of depop – repop, €/sow

Direct costs:	€ / Sow
Replacing Gilts	85
Rent of service unit	35
Extra Labour required	45
Extra feed for gilts	50
Repairs / maintenance	120
Fixed Costs	
Heat / Light (€66/sow/yr)	16.5
Bank charges (99/sow/yr)	24.75
Labour (€209/sow/yr)	52.7
Healthcare (€33/sow/yr)	8.55
Manure/EPA (€44/sow/yr)	11.0
AI (€22/sow/yr)	5.0
Insurance (€22/sow/yr)	5.0
Misc. (€22/sow/yr)	5.0
Total Costs	**€463.50**

The comparison of the unit's performance before and after restocking is shown below. The parameters used in this calculation are shown in the Appendix.

TECHNICAL SUMMARY

NO PIGS PRODUCED / SOW / YR		22	24
FINISHER SLAUGHTER WT KG		100	105
AVERAGE FEED PRICE PER TONNE €		221.43	224.19
WEANING TO SALE	*FCE*	2.47	2.32
	ADG g	601	700
	DAYS	*155*	*139*

BUDGET ANALYSIS

		EXISTING		REPOP	
FEED COST PER KG DEADWT (cent)			**82.2**		**77.3**
NON-FEED COSTS PER KG DEADWT.					
	HEALTHCARE	3.9		1.9	
	HEAT/POWER/LIGHT	3.9		3.8	
	TRANSPORT	2.6		2.5	
	A.I.	1.3		1.1	
	MANURE HANDLING	2.6		2.3	
	MISCELLANEOUS	1		0.9	
	LABOUR	13.3		11.6	
	REPAIRS/MAINTENANCE	1.5		1.3	
	PHONE/OFFICE COSTS	0.2		0.1	
	ENVIRONMENT	1.3		1.2	
	INSURANCE	0.9		0.8	
	LOAN REPAYMENTS	7.2		6.3	
	INTEREST	2.4		2.1	
	STOCK DEPRECIATON	2.6		2.3	
	TOTAL		**37.5**		**31.9**
COST PER KG DEAD (Excl Building Deprec)			**126.9**		**115.5**

Implications:

The implications of the analysis are shown below:

Increased profit margin after repop 11.4c/kg dead wt = €9.09/pig

@ 24 pigs/sow/year 24 x €9.09 = €218.16/ sow

Direct cost of repop = €463.50/ sow

Repayment time €463.50 / €218.16 = 2.12 years

This demonstrates that the cost of restocking would be recouped in approx two years. The longer the unit can remain high health after this period then the greater the return on the initial restock investment.

Key points for depop – repop

- Decide if restocking is an option after examining current performance, medium term outlook, unit location etc
- If you decide to restock draw up a timetable and detailed plan before commencement
- Check availability of breeding stock
- Locate suitable service unit
- Identify restructuring that is required on the home unit
- Allocate personnel between sites
- Examine future biosecurity requirements

Appendix *

	EXISTING		REPOP	
NO.SOWS	350		350	
NO.PIGS PRODUCED/SOW/YEAR.	22		24	
AVERAGE WEANING AGE-DAYS	26		26	
AVERAGE WEANING WEIGHT KG	7		8	
FEED/SOW/YEAR TONNES	1.15		1.2	
WEANER FOOD CONVERSION.	1.85		1.75	
WEANER WT.TRANSFER KG.	32		40	
WEANER AVE. DAILY GAIN G.	420		515	
FINISHER SALE WEIGHT KG	100	DEAD	105	DEAD
KILL OUT%	76	76	76	79.8
FINISHER FCE	2.7		2.6	
FINISHER ADG g	715		850	
SOW CULLING RATE /YEAR %	45		45	
HEALTHCARE COSTS PER PIG €	3		1.5	

* Only factors which are different in the two scenarios are shown

Effect of Group Size and Stocking Rate on the Grow-Finish pigs

Mike Ellis, Department of Animal Sciences, University of Illinois

Introduction

Everyone involved in pig production is aware of the importance of the grow-finish part of the production process. Feed is the major production cost and in the US around 85% of the feed required to produce a finished animal (at ~125 kg live weight) is consumed by the grow-finish pig between weaning and slaughter. Research with grow-finish pigs has been underway for many years, however, recently there has been increased interest into approaches to improve the rate and efficiency of production during this critical stage. This paper will summarize recent developments in the management of growing-finishing pigs in the Mid-west of the US together with the results of the research that has supported these developments. Much of this research has been carried out on commercial operations and the results, therefore, directly relate to practical swine production.

Recent Developments in the Management of Grow-Finish Pigs

In the past decade, we have seen several major developments in production systems and management practices for grow-finish pigs. These include wean-to-finish production, all-in/all-out management combined with age-segregated, multiple-site production, large group sizes, and automatic sorting technology. These developments have improved performance levels but have also brought with them a number of challenges. In particular, all-in/all-out management has focused attention on variation in both growth rate and, therefore, weight within a group of pigs and stimulated interest in minimizing this variation.

It is interesting to speculate on the growth potential of our modern genotypes and how much of that potential we actually achieve in practice. Under commercial production conditions in the US, growth rates between 30 and 125 kg live weight typically average around 750 grams/day. In research studies, the same genetic lines as used in the industry have grown at around 1100 grams/day and have the potential to grow considerably faster than that if they were reared in a "perfect" environment. It's a sobering statistic that today we probably achieve no more than 50 to 60% of the animal's genetic potential for growth in our commercial operations. There is obviously a tremendous opportunity for producers' to improve the performance of the grow-finish herd.

One factor contributing to these low growth rates under US conditions is that producers often crowd pig in finishing, thus, reducing average growth rates but maximizing the total weight of pigs produced from a facility, which is a better index of the economic performance of an operation than absolute growth rates *per se*.

Wean-to-Finish Production: Perhaps the most significant recent development in Midwestern swine production has been a move from two-phase systems for grow-finish pigs (i.e. nursery and grow-finish) to a one-phase system, with pigs being kept in the same facility from weaning to slaughter. The major potential advantages of wean-to-finish production are improved performance (due to reduced stress on the pigs as result of less moving and mixing), and reduced labor and transportation costs. There are potential disadvantages to this system including under utilization of building space when the pigs are small resulting in a reduction in total facility output. Many producers get round this problem by double-stocking the pens with small pigs (i.e., placing twice as many pigs in the pen at weaning as can be taken to slaughter weight) and moving half of the pigs to conventional finishers at 8 to 10 weeks post-weaning. Most of the research described in this paper has been carried out in commercial wean-to-finish facilities.

Large Group Sizes: There is considerable interest in the use of large groups (defined as 100 pigs or more) for pigs from weaning to slaughter. Claimed advantages for larger groups include reduced facility costs, greater choice of microclimates for the pigs, reduced labor costs (particularly for bedded systems), and reduced stress on the pig during transport as a result of reduce mixing of pigs on the trailer from different farm groups. Another advantage of large groups is the ability to presort pigs prior to shipping and to pen them separately during the last 12 to 24 hours before loading onto the truck. This reduces the stress on the pigs during the loading process and also allows the use of feed withdrawal prior to loading, two factors that have been shown to reduce transport losses (dead and non-ambulatory pigs).

Major factors to consider when deciding on the optimum group size to use in any situation include any effect of large groups on pig performance, animal health, behavior and welfare, facility design and management, and economics.

We have carried out a number of research studies (summarized in Table 1) comparing the performance of large (100 pigs) to small (20 to 25 pigs) groups. The results of these, which are similar to the results of other studies carried out elsewhere, suggest that growth performance can be reduced in the large groups in the nursery stage. However, large groups of finishing pigs either have similar or improved growth performance compared to the small groups. Thus, if we considered the whole of the growth phase from weaning to slaughter weight, there is unlikely to be any effect of group sizes of up to 100 pigs on growth performance. The impact of much larger group sizes of 500 pigs or more on growth performance has not been established.

In general, research studies have shown that rearing pigs in large groups has little or no effect on variation in either growth rate or weight within a contemporary group or on carcass composition and grading profile. In addition, there is no evidence that aspects such as disease problems, levels of morbidity and mortality, or incidence of injuries and lameness change with increasing group size. Pig behavior does appear to be different in large groups (e.g. aggression directed towards newly-introduced or re-introduced animals is lower in large than in small groups), however, this does not appear to have any negative impact on production.

Table 1. Effect of group size on growth performance (Wolter & Ellis, 2002)

	Difference (%) between large (100 pigs) and small groups (20 pigs)	
	Nursery	*Grow-Finish*
Live weight at end of phase	-3	+1.0
Average daily gain	-4.5	+2.5
Average daily feed intake	-5.9	0
Gain:feed ratio	0	+3

A number of aspects of facility design and management need to be modified for larger groups. One potential advantage of designs of pen for larger groups is the ability to include a temporary sort pen within the pen structure that can be used with sick or injured animals or to sort pigs prior to shipping. An issue that has received considerable attention is the optimum floor space to use in large compared to small groups. Free space in a pen of pigs (i.e., the space not used for the pigs for lying) actually increases with increasing group size. It has been suggested that the minimum floor space for maximum growth rates may decrease as group sizes increase because pig are able to share this “free space”. However, this concept has not been proven and reducing floor space allowances for larger groups cannot be recommended.

Ultimately, the economics of large compared to small groups will be a major factor influencing their adoption by the industry. Generally speaking, the reduction in costs resulting from the adoption of large group pens is relatively modest. Having said that, many producers in the mid-west are using large group systems to capture this reduction in cost as well as the management advantages that such systems can offer.

Optimum Floor Space: At present in the US, there are no regulations dictating the floor space that should be provided to pigs on commercial operations and producers make decisions based upon the impact of floor space on economics. There has been a considerable amount of research attempting to define optimum floor spaces in the US and elsewhere going back many years. Gonyou et al. (2006) carried out a retrospective analysis of a number of research studies in an attempt to define the floor space requirements for maximum growth performance. These authors used the general equation $A = k \times BW^{0.667}$ to estimate the optimum floor space, where A is the floor space in m^2/pig, k is a constant, and BW is body weight. From the analysis of historical studies, these authors estimated values for k of between 0.032 to 0.035 to predict the optimum floor space. To put this into perspective, using a k value of 0.035 equates to a floor space of 0.80 m^2/pig for animals of 110 kg live weight. As previously mentioned, slaughter live weights in the US currently average around 125 kg. However, it is common commercial practice to remove the heaviest pigs from a pen when the average pen weight is around 110 kg. Obviously, removing these pigs from the pen increases the floor space available for the remaining animals. Interestingly, in the analysis of Gonyou et al. (2006) this critical value of k (0.035) was similar for pigs kept on fully- and partially-slatted floors and also for both the nursery and the grow-finish stages.

In commercial practice in the US, floor spaces used for finishing pigs generally average around 0.64 m^2/pig which is well below the floor space required for maximum growth predicted by the equation developed by Gonyou et al. (2006) discussed above. Producers restrict floor spaces in an attempt to maximize the total output from the facility.

In the US, and elsewhere, there is increased interest in the welfare of animals and it has been suggested that on commercial operations grow-finish pigs should be given a floor space that at least allows them to maintain maximum growth performance. Based on the above discussion and the equations of Gonyou et al. (2006), this floor space is likely to be substantially greater than that currently used in practice. It is obviously critical that the k value that is chosen to predict the minimum floor space at which growth performance is maximized is validated under commercial conditions, i.e., under the conditions in which it will be applied. We have recently carried out a number of such studies in various commercial wean-to-finish facilities with surprising results which has brought into question the appropriateness of the k value proposed by Gonyou et al. (2006). Our studies suggest that the minimum floor space allowance at which growth rate is maximized for pigs weighing up to 110 kg is around 0.68 m^2/pig, substantially below the value of 0.80 m^2/pig predicted from the Gonyou equation.

This raises an extremely important question. Should recommendations for use in commercial practice be based on research studies carried out within specialist research facilities or within the environment and under the conditions that the recommendations will be applied. The example above relating to floor space suggests that the recommendations would be different for these two cases and also that this difference would have substantial economic implications for the industry.

Variation in Growth Rate and Live Weight: Like all biological populations, groups of pigs of the same age show considerable variation in growth rate and range in live weight. In fact, this variation starts early in utero; there is substantial variation in the weight of piglets at birth and birth weight does influence subsequent growth performance to slaughter weight. Although biological variation is valuable in terms of genetic selection programs, variation in weight in a population of pigs of similar age creates significant management problems, particularly in all-in/all-out systems where buildings have to be emptied on a fixed date to allow the next group of pigs to be brought in. Often, the last group of pigs that are shipped from a barn contain a significant number of animals that are too light for the requirements of the slaughter plant and have to be sold at a discount.

There is considerable interest in the US in identifying ways to reduce this variation in weight within a contemporary group of finishing pigs and a number of approaches have been attempted. Before discussing these, it is important to quantify the extent of the variation in weight that is commonly observed in practice. To do this we use some simple statistics: the standard deviation (SD) and the coefficient of variation (CV) of the population. The coefficient of variation is the standard deviation expressed as a percentage of the mean. In the vast majority of pig populations, the range in weight from lightest to heaviest is within plus or minus 3 SDs of the mean. As a "rule of thumb", we have found that the CV of weight in a population of slaugher weight pigs of similar age is about 10%. On this basis, if the mean of the group is ~100 kg, we can predict that the SD is ~10 kg and also that the range in weight in this population will be from ~70 to ~130 kg. This approach allows us to estimate, for example, when to start sending pigs to slaughter to hit a target weight window for a particular plant and also to calculated the number of light weight pigs in the population that are likely to be below this weight window.

Interestingly, the CV of weight in a population of pigs decreases as the pigs get heavier typically being ~15% at 25kg live weight decreasing to ~10% at ~100 kg live weight.

However, the range in weight actually increases from ~20 kg at a live weight of 25 kg to ~60 kg at a live weight of 100 kg.

The important question is "how can we minimize this variation in weight for age and, particularly, how can we reduce the number of light weight pigs in the group?" It makes no sense to try and slow down the growth of the heavier pigs to minimize variation; the focus needs to be on increasing the growth rate of the lightest animals or of all pigs in the group.

We have investigated a number of potential approaches to reducing the variation in weight within a population of pigs including:

- sorting pigs by weight early in the growth period
- removing the heaviest pigs from the group towards the end of the growth period and shipping these for slaughter
- increasing the growth rate of the entire population

In one study, we sorted pigs at ~30 kg live weight into light and heavy groups with reduced variation in weight within a group compared to unsorted control pens (Table 2). Although at the start of the study the CV of weight within the sorted groups was lower than for the unsorted groups, there was no difference in CV at the end of the study at ~110 kg live weight (Table 2). Obviously, sorting pigs early in the growth period had little if any impact in the variation in weight within a population at slaughter weight.

Table 2. Effect of sorting pigs by weight on subsequent performance (DeDecker, 2006)

	Weight		
	Normal (unsorted	*Heavy*	*Light*
Start weight, kg	31.4	34.2	26.6
End weight, kg	112.0	112.3	112.8
Coefficient of variation, %			
Start	10.7	6.3	7.6
End	9.3	9.2	8.5

Shipping the heaviest pigs from the group as they reach the weight window required by the slaughter plant is standard practice on most units. As well as ensuring that we send pigs for slaughter at the optimum weight, this approach results in increased growth rates in the remaining animals, thus, reducing the variation in weight in the population as a whole. We have carried out a number of studies investigating the impact of removal of the heaviest pigs from a group on the subsequent performance of the remaining animals. These studies have shown substantial increases in growth rate (averaging ~11%), in daily feed intake (~6%), and in gain:feed ratio (~6%). The optimum strategy, in terms of the timing and frequency of removal of the heaviest pigs from a population of pig, will depend on the particular situation in question and cannot be generalized.

Increasing the growth rate of the population of pigs makes a lot of sense both in terms of increasing overall productivity and in managing variation in weight at slaughter, particularly, in reducing the number of light weight animals. For all-in/all-out management systems, increasing growth rates will result in pigs reaching the target weight window earlier and when this is combined with sorting and shipping of the heaviest pigs from the group will lead to a greater number of pigs reaching the target weight window before the building has to be emptied. Minimizing disease, feeding appropriate diets, and providing the optimum environment for the pig are areas that need to be focused on to improve overall growth performance. In the US, we have another tool to help increase growth rates in the form of the growth promoter Ractopamine (trade name Paylean). Fed in the last 3 to 4 weeks of the finishing period, Paylean produces substantial increases in growth rate. The optimum Paylean use strategy, in terms of timing of introduction and level of feeding of the product, is very dependent on the specific situation in question.

Conclusions

Growth performance under commercial conditions is typically well below the animal's genetic potential and there is considerable opportunity for improvement. There are a range of improvements in facility design and management practices that can be used to increase average growth performance of pigs and to manage the variation in growth rate and weight within a population.

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Manure Treatment – Has it a role?

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The Nitrates Directive is to be implemented in Ireland in accordance with Statutory Instrument 378 of 2006 - European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2006. This imposes constraints immediately on the application of pig and other organic manures to land. In the absence of any derogation, the amount of Organic Nitrogen (N) that may be applied to land is limited to 170kg per hectare per annum. From 1st January 2011 restrictions on the amount of Phosphorus (P) that may be applied will further curtail the application of pig manure especially to grassland.

The rules in relation to the use of pig manure as a fertilizer have changed. The maximum amount that can be applied per hectare is reduced. The amount of land required by pig producers will be very substantially increased if pig manure is to be utilised as a fertiliser. Inevitably, this means transporting manure greater distances and leads to significantly increased costs.

Pig Manure as a Fertiliser

Pig manure is an excellent source of the plant nutrients Nitrogen (N), Phosphorus (P) and Potassium (K). The nutrient content per m^3 depends on the composition of the diets fed on the unit and especially on the total solids or dry matter content of the manure. The solids content is directly related to the amount of water used on the unit and collected in the storage tanks.

Based on the average nutrient content of pig manure as specified in SI 378 the value of $1m^3$ as a fertiliser is currently €2.86 (Table 1). This is for manure at about 4.3% solids and equates to €0.67 per m^3 for every 1% solids.

Table 1 Value of pig manure as a fertiliser

Nutrient	*N*	*P*	*K**
Kg per m^3 (4.3% Solids)	4.2	0.8	1.9
Availability to Crop %	35	100	100
Cost per Kg c	73	131	39
Total Value €	1.07	1.05	0.74

** Potassium content is based on diets fed at Moorepark*

This valuation assumes that there is a crop requirement for each of the nutrients

N, P and K.

Utilising Pig Manure

If possible, pig manure should be utilised as a fertiliser to meet the crop requirements on lands in the vicinity of the unit thereby minimising transport costs. Regular application of manure over a number of years will have reduced the amount of nutrients that can now be applied to these lands.

As unit size increases and/or restrictions on spreading in the vicinity of the unit increase, transportation by road tanker to farmed lands away from the unit is the next best option. In particular, transport to tillage areas can be a logical solution. However, this will require the provision of manure storage facilities on these farms. Grant aid is available to encourage the provision of such storage. Given the limited timeframe available to tillage farmers to apply organic manures the storage capacity required could amount to the volume of manure that would be applied annually on the farm. As transport distances increase transport costs escalate. Increasing oil prices are adding considerably to transport costs.

Where this is not a viable proposition consideration will have to be given to treating the manure with a view to reducing handling costs.

Treating Pig Manure

Various methods of treatment have been devised. These include biological, chemical and physical methods as well as various combinations of these methods. There is on-going research throughout the world into treatment methods.

The reasons for treatment need to be considered.

1. To reduce handling and transport costs while facilitating its use as a fertiliser
2. To reduce the nutrient content and thereby reduce the land area required while complying with regulations.
3. To reduce odours
4. To utilise pig manure as an energy source

Treatment Costs

The initial capital investment (less any grant-aid obtained) will have to be financed consisting of interest payments in addition to the repayment of the capital borrowed.

The treatment facility can be depreciated over 10-15 years but not over more than 20 years for any part of the facility.

Operating cost include energy costs as well as repairs and maintenance. There are also likely to be additional labour costs involved.

Treatment costs can be expressed per m^3 treated. Reducing the volume of manure to be treated is critical in minimising treatment costs. This means minimising the amount of water used or allowed to get into collection/storage tanks without compromising the welfare or performance of the pigs. Water management to minimise volumes is the staring point in dealing with manure.

Manure Separation

Raw slurry can be separated into a solid and a liquid phase. This can be done to make further processing easier or it may be used as a separate treatment producing two different products which must be handled, stored, transported and spread.

The size of the "liquid" and "solid" fractions produced from $1m^3$ of manure of a given solids content will be different depending on the method used. The solid phase can make up 10-20% of the initial mass. The distribution of the nutrients between the solid and liquid phase varies widely reflecting the solubility of the particular nutrient. Potassium is highly soluble and is largely unaffected whereas Phosphorus is largely removed in the solid phase. The organic N part of total N accounts for nearly all of N removed in the solid phase. Ammoniacal N is soluble and is largely unaffected by separation. Generally, the nutrient separation efficiency increases as the total solid content of the raw slurry is increased.

The major advantage of manure separation is that much of the P is concentrated in the solid phase with a corresponding reduction in the amount in the liquid phase. Where the amount of P that can be applied to land is limited, manure separation could allow the liquid fraction to be applied up to the organic N limit while having the solids transported to land with a higher P requirement.

A number of practical methods of manure separation are available including gravitational settling and mechanical separation. The latter can be classified into:

- **Screen separators**: manure is passed over a screen and particles smaller than the screen size pass through.
- **Centrifuges**: use centrifugal force to separate particle of different density.
- **Presses**: Mechanical pressure is exerted on the raw manure.

The addition of chemicals to the manure can improve the separation process and enhance nutrient removal but they add to the treatment cost.

Among the types of separator used are

- Sieve
  - Fixed
  - Vibrating
- Centrifuge
  - Rotating sieve
  - Decanter
- Press
- Screw
- Filter

These vary widely in price and the costs usually reflect the level of sophistication and performance. (Table 2)

Table 2 Comparison of manure separators

Separator	*Investment Cost €000*	*Running Cost per m3 €*	*N Reduction* %*	*P Reduction* %*
Static/Vibrating Sieves	3.5-15	low	10-15	10-15
Rotating Sieve Centrifuge	17-40	variable	10	10-15
Decanter Centrifuge	40-100+	1.5-1.8	20-25	75
Screw Press	17-21	0.5-0.9	8	15
Belt Press With flocculants	25-50		25-30 50	65-70 90

* Amount removed to solids fraction.

Source: Traitement des effluents porcins: Pascal Levasseur, ITP 2004

The best nutrient separation results are achieved with decanter centrifuges especially in P reduction.

Table 3 Nutrient separation efficiency and technical data of common manure separators

	Belt Press	*Sieve Drum*	*Screw Press*	*Sieve Centrifuge*	*Decanter Centrifuge*
Flow Rate m^3/hour	3.3	8-20	4-18	1.9-5.5	5-15
Separation efficiency %					
-Dry Matter	56	20-62	20-65	13-52	54-56
-Nitrogen	32	10-25	5-28	6-30	20-40
-Phosphorus	29	10-26	7-33	6-24	52-78
-Potassium	27	17	5-18	6-36	5-20
Volume Reduction* %	29	10-25	5-25	7-26	13-29
kWh per m^3	0.7	1	0.5-2	2.2-6.7	2-5.3

*Amount removed to solids fraction.

Source: Manure Management - Treatment strategies for sustainable agriculture 2003

Decanter centrifuges are capable of producing a fresh solids material with 30-35% dry matter. One tonne of this material will contain about 11kg N, 9.2kg P and 0.8 kg K. With manure of at least 4% dry matter the end product can contain more than 50% solids. It is likely that the solid material would be transported a substantial distance.

Manure separation results in three products to be handled and stored. Existing equipment will be capable of handling the liquid fraction but few units have equipment to handle the solid fraction.

Composting is an aerobic process requiring oxygen, moisture, carbon and nitrogen in the proper ratios for the correct bacteria to thrive. Composting this material involves air being mixed with the solids to produce the aerobic fermentation. This results in a natural drying of the material. Initially, the material should, ideally, contain 45 to 65% dry matter. The carbon to nitrogen ratio in the material is critical to promote efficient microbial activity and should be at least 20:1. A carbon-rich material such as straw or sawdust may have to be added. In pig manure the ratio is less than 10:1.Composting reduces the weight of material to be transported.

An Australian study compared the cost of different methods of separation in 2002. (Table 3)

Table 4 Cost of Solid-Liquid Separation Technologies for a 200 sow Farrow to Finish Operation

Method	*Capital Cost €*	*Annual Costs €*	*Removed Solids %*	*Cost per Pig €*
Screw Press	38000	4750	20	1.35
Belt Press	64000	8500	20	2.42
Centrifuge	77500	13000	30	3.74
Rotating Screen	25500	4250	15	1.21
Vibrating Screen	21000	3800	20	1.08
Inclined Screen	17000	3000	20	0.85
Settling Basin	5400	4600	50	1.33

Source: Watt et al, Australian Pork Limited 2002

Mobile manure separators can be hired capable of treating $40m^3$ per hour at a cost of about €5 per m^3 equivalent to about 5c per kg dead weight.

Nitrification / De-nitrification

Biological treatment of pig manure involves the activity of micro-organisms, mainly bacteria. The process of nitrification followed by de-nitrification is capable of converting 70% of the nitrogen present in the manure to non-polluting nitrogen gas. Prior to this treatment solid separation is used to remove much of the P (about 70%) from the liquid to be treated.

Nitrification: During this process the addition of oxygen to the manure enables the bacteria to convert N in the form of Ammonium to Nitrite initially. Then the Nitrite is converted to Nitrate by different bacteria.

$NH_4^+ + 3/2O_2 = NO_2^- + H_2O + 2H^+ + \text{energy}$

Nitrosomas, Nitrosococcous, Nitrosolobus

$NO_2^- + 1/20_2 = NO_3^- + \text{Energy}$

Nitrobacter, Nitrococcus, Nitrospira

Typically over-ground concrete tanks are used for this process. The biological reaction is facilitated by agitation of the liquid in the tank.

De-nitrification: In the absence of oxygen, other bacteria convert Nitrate to harmless N_2 gas which is released into the atmosphere.

$$4H^{+} + 5(CH_2O) + 4\ NO_3^{-} = 5CO_2 + 7H_2O + 2N_2$$

Pseudomonas, Acinetobacter

This process takes place in an over-ground tank but without agitation i.e. under anaerobic conditions

Following this stage the liquid can be transferred to a settling tank to allow more of the remaining solids to settle before the liquid is pumped to a lagoon for storage. The stored liquid with its low nutrient content can be irrigated or spread on land in the vicinity of the treatment plant. The solids removed by settling may be further separated or removed for land application.

The capital investment in a complete system including separation, nitrification / de-nitrification, lagoon storage and irrigation is large. There are also substantial running costs. (Table 5). These two treatment plants are processing the manure from the equivalent of 750-800 sow integrated units.

Table 5 Capital and operating costs for some manure treatment plants in Brittany

Farm	*A*	*B*
Capital Cost €	378,000	616400 460,400 net of grant (25%)
Quantity treated m3	12806	14048
Annual Operating Cost €	71100	47000*
Cost per m3 treated €	5.57	3.34*
Cost per kg carcass c	5	3*

* Excludes cost of financing. The annual repayment on a 10 year loan at 6% interest would amount to €61,072 or €4.36 per m^3 or 4c per kg carcass.

Note: These costs are based on French electricity prices

A study of the costs of manure treatment in Brittany was reported on in Porc Magazin in 2005 (Table 6). All plants involved in the study carried biological treatment i.e. nitrification / de-nitrification. On 8 farms no separation was carried out while in 6 others only simple separation was done.

Table 6 Cost of biological treatment of pig manure with or without separation

Treatment	*No Separation*	*Simple Separation*	*Forced Separation*
No. Units	8	6	37
N Reduction %	73	77	89
P Reduction %	0	22	80
Volume treated / yr, m^3	4088	6643	10037
Costs €/m^3			
Amortisation	6.28	7.57	6.43
Operating	1.91	2.50	2.69
Total	8.19	10.07	9.12
Cost per kg carcass c	8.4	10.3	9.3

Source: Porc Magazine Juin 2005

The cost of electricity per KWh in France (9.3c) is significantly lower than in Ireland (14.4c) for domestic use.

This scale of investment and operating costs could be justified where there is no more economical method of dealing with an excess of Organic N. Treating pig manure to convert a valuable source of nitrogenous fertiliser to nitrogen gas at great cost does not make any sense in either economic or environmental terms. This should be addressed in the discussions in relation to a derogation from the 170kg per hectare limit on organic N. Throughout the world huge quantities of oil and gas are used to carry out the opposite process in the manufacture of chemical nitrogenous fertiliser which then has to be transported and distributed to farms throughout this country.

Anaerobic Digestion

This is based on the basic premise that if raw manure is placed in a tank, in the absence of air, bacteria break it down into other compounds. The biogas that is produced consists mainly of methane but also includes carbon dioxide, ammonia and hydrogen sulphide. The methane makes the gas combustible and useful as an energy source for heat or electricity generation. There are different types of digesters which operate at different temperatures and have retention times related to the operating temperature.

Thermophilic: 40-70^{o}C

Mesophilic: 20-40^{o}C

Psychrophilic: <20^{o}C

Both thermophilic and mesophilic plants require the provision of heat but have short retention times of 15-25 days. Psychrophilic plants are unheated but have retention times of 40 days or over.

Pig manure is a good source material for the production of biogas and compares very favourably with other agricultural substrates and is comparable to sewage sludge.

Table 5 Typical biogas yields from various agricultural biomass

Substrate	*Mean biogas yield (litres per kg Volatile Solids)*
Pig manure	450
Cattle manure	250
Poultry manure	460
Grass	410
Vegetable residues	350
Sewage sludge	450

Source: Werner et al 1986

An anaerobic digester with the associated electricity generation capacity requires a very large capital investment. In addition to electricity substantial amounts of heat are produced. The returns obtained for electricity generated and the savings from the heat produced will determine the financial viability of any such treatment plant. To date, the financial projections have been less than convincing.

Of perhaps more immediate concern is the negligible impact this treatment method will have on the amount of N and P to be dealt with from the pig unit. Anaerobic digestion does nothing to reduce the amount of N and P to be used as a fertiliser. There are some marginal benefits in improvements in the fertilisation values of slurries.

Anaerobic digestion of pig manures is irrelevant in the context of dealing with excess N and P nutrients. Pig manure has potential as part of the substrate used to produce biogas.

When Pig Manure Is Not Waste

The European Court of Justice (ECJ) in 2005 (C 121/03) held that livestock effluent may "fall outside classification as waste, if it is used as a soil fertiliser as part of a lawful practice of spreading on clearly defined parcels and if its storage is limited to the needs of those spreading operations". The ECJ further clarified that "it is not appropriate to limit that analysis to livestock effluent used as a fertiliser on land forming part of the same agricultural holding as that which generated the effluent". "It is possible for a substance not to be regarded as a waste within the meaning of Directive 75/442 if it is certain to be used to meet the needs of economic operators other than that which produced it".

The implications of this judgement would appear to be that

- when pig manure is used as a fertiliser to meet crop requirements it is not a waste
- treatment of pig manure involving reducing the nutrient content could change the classification.

Any proposals in relation to manure treatment need to take account of whether this treatment changes the classification of pig manure to that of waste and, thereby, making it subject to Directive 75/422.

Summary

1. Pig manure is a rich source of plant nutrients and is valuable.
2. It should be applied to land as a fertiliser to meet crop requirements.
3. Irrespective of how it is used or treated, aim to maximise the dry matter content.
4. Any consideration of manure treatment must be based on clear reasons for adopting the technology and a proper cost/benefit analysis.
5. Separation into solid and liquid fractions can be used to deal with the high P content of raw manure.
6. Nitrification /de-nitrification are only relevant when there is no economical solution to excess organic N.
7. Anaerobic digestion has nothing to offer in dealing with excess N and P.
8. Successful manure treatment involves a major capital investment and very substantial running costs.

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Litter size – what factors are limiting it?

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Introduction

In the past 20 years litter size in Irish sows has increased by almost 1 pig. However most of this increase had occurred by 1996. Since then, litter size has increased by only 0.35 of a pig (Table 1). When broken down into quartiles, the 2005 PIGSYS data show that there is a difference of 1.1 pigs in number born alive and total born between the top 25% and bottom 25% performing herds (Table 2). However, even the top quartile in Ireland is falling behind our European competitors who have made tremendous strives in this regard (Table 3). Denmark for example had an average born alive figure of 12.7 in 2004 compared to the 11.6 figure for the top 25% of Irish herds in 2005.

This paper will attempt to address some of the factors that are limiting litter size on Irish pig units. Genetics is obviously an important factor but will be discussed only briefly here. However, genetic improvements are worthless unless we possess the management and nutritional information to exploit these advances. Therefore, this paper will concentrate on the management and nutrition factors that can make the most improvements in litter size.

Table 1. Trend in litter size from sows in Ireland over the past 20 years (PIGSYS report 2005).

Year	No. Born alive	No. Born Dead	Total Born
1986	10.3	0.63	11.0
1996	10.8	0.74	11.6
1997	10.9	0.76	11.6
1998	10.8	0.74	11.6
1999	10.9	0.76	11.7
2000	10.9	0.76	11.6
2001	10.8	0.75	11.5
2002	11.0	0.76	11.7
2003	11.0	0.78	11.8
2004	11.2	0.74	11.9
2005	11.2	0.74	11.9

Table 2. Litter size in Irish sows based on Number born alive (PIGSYS data, 2005)

	Top 25%	Mean	Bottom 25%
Number born alive	11.6	11.2	10.5
Number born dead	0.73	0.74	0.79
Total born	12.4	11.9	11.3

Table 3. Number of pigs born alive in selected European countries (InterPIG, 2004)

Country	Number born Alive
Denmark	12.7
France	12.5
Sweden	12.1
Netherlands	11.9

1. Genetics

Both breed and heterosis of the dam will influence litter size. Crossbred sows have on average 0.25 to 0.5 pigs per litter larger than purebreds (Aherne, 2002). Gilts selected from prolific sows served by boars from a prolific dam line will generally increase litter size (Evans *et al.,* 1996) because litter-size and its component traits, ovulation rate and embryonic survival are heritable and respond to selection (Johnson, 1999). However, it has been suggested that genetic improvement programmes should emphasise live born pigs and weight of live born pigs because of undesirable genetic relationships of ovulation rate and number of foetuses with numbers of stillborn and mummified pigs and because birth weight has decreased as litter-size increased (Johnson, 1999).

One of the most important determinants of litter-size in pigs is prenatal mortality. This occurs most frequently in the first few weeks of gestation and is associated with abnormalities in the developmental process. Improvement in litter size in the past was achieved by phenotypic selection, however, it is now possible to use marker assisted selection (MAP) which utilises genotypic information for selection. Use of this technology will greatly shorten the generation interval as the selection decision can take place early in the life of the animal (Spötter and Distl, 2006).

Selection for uterine capacity and in particular for reduced placental size and increased placental efficiency may also lead to increases in litter-size (Ford et al., 2002; Wu et al., 2006)

2. Gilt Selection and Management

There are more gilts served and farrowed than sows of any other parity, and therefore if gilt litter size is low, the average litter size for the herd will be reduced. In addition maximising the litter size in gilts will maximise lifetime performance (Dewey et al., 1995; Aherne, 2002). For this reason it is important that gilt selection and management is done correctly.

A retrospective examination of the records from more than 20,000 farrowings on the data bank of a Swedish breeding organisation found that:

- An increase of one piglet in the litter in which a gilt is born results in an increase of her own litter size (both total born and born alive) of between 0.07 and 0.1 piglets per litter (Tummaruk et al., 2001).
- An increase in growth rate from birth to 100kg body weight of 100g/day resulted in an increase in litter size (both total born and born alive) of between 0.3 and 0.4 piglets per litter as well as a reduction in weaning to oestrus interval and an increase in farrowing rate. (Tummaruk et al., 2001).
- Gilts with a high backfat at 100kg had increased litter size in parity 2 as well as a shorter weaning to oestrus interval and a higher farrowing rate (Tummaruk et al., 2001)
- As age at first mating increased so too did litter size (Dewey et al., 1995; Tummaruk et al., 2001). However, there is a critical age above which litter size will not be increased. When this critical age is reached litter size will be determined by the number of oestrus cycles that the gilt has reached (Dewey et al., 1995)

See Carroll and Lawlor (1996) and (Young, 2003) for a review on gilt management and nutrition.

3. Sow feeding

3.1. Feed quality

Mycotoxins such as zearalenone, if ingested in early pregnancy can result in increased embryo mortality and therefore in reduced litter-size (Aherne, 2002). It is advisable that sow feed is clean, fresh and free of moulds.

3.2. Gestation

Moderate energy intake (31 MJ DE / day) compared to low energy intake (18 MJ DE / day) in the first 3 days after mating may reduce litter-size in gilts but not in sows (Kongsted, 2005). Tokach et al. (1999) recommended limiting intake in the first 12 days (28 MJ DE / day) after service as a safety measure to prevent embryo mortality in the early stage of pregnancy. However, very thin sows should receive a high level of intake immediately after mating until body condition is restored (Tokach et al., 1999).

Litter size may actually be reduced by feeding a very low energy level in the first 4 weeks of pregnancy (Kongsted, 2005) especially where sows are in a very poor condition (Tokach et al., 1999). Where condition is poor additional feed should be provided between day 12 and day 45 of gestation. Sows should be at the body condition desired for farrowing by day 45.

Day 75 to day 100 of gestation is the period that is critical for mammary development and Tokach et al., (1999) recommends that excess feed intake should be avoided particularly during this period. However, in practice feed intake should be such that it only meets requirements for maintenance and conceptus growth at this time as sow body condition should have been restored by day 45.

Day 100 to day 112 of gestation is when there is rapid foetal growth. Feed intake should be increased by 1 to 2 kg during this period to prevent sows losing weight. Failure to increase feed intake during this period results in sows in an extremely catabolic state at farrowing which contributes to gorging and sows "going off feed" (Tokach et al., 1999).

From day 112 to farrowing it is recommended to feed 2kg per day (Tokach et al., 1999).

See Appendix 1 for example gestation curves for sows and gilts.

3.3. Lactation

Improvements in genetics have resulted in sows with higher milk production and maintenance requirements, however, body fat reserves have decreased and voluntary feed intake may have decreased at the same time. As a consequence, voluntary feed intake of sows during lactation is frequently insufficient to meet nutrient demands (Eissen et al., 2000).

Increasing feed intake of lactating sows reduces backfat and body-weight losses as well as increasing litter weight gain (Eissen et al., 2003). Minimising weight loss during lactation is critical when attempting to achieve an early return to oestrus after weaning (Tantasuparuk et al., 2001; Eissen et al., 2003; Thaker and Bilkei, 2005) and a high litter size at the subsequent farrowing (Thaker and Bilkei, 2005; Eissen et al., 2003). In the study by Thaker and Bilkei (2005) it was evident that weight loss during lactation should not be greater than 5% (c. 9kg) for first parity sows and 10% (c. 22kg) for older parities if early return to oestrus, high farrowing rate and a high subsequent litter size are to be achieved. Low parity sows are most affected by lactation weight loss because of their inherent drive to achieve their target lean body mass (grow) and therefore even after weaning they continue to mobilise body fat to sustain lean tissue deposition (Foxcroft et al., 1997). This leads to an unfavourable endocrine and metabolic state which impacts negatively on their fertility. Ovulation rate has been shown to be reduced by lactation weight loss (Zak et al. 1997).

In the sow only extremes of either under or over-nutrition influence milk yield (NRC, 1998). The number of piglets suckling the sow has the greatest positive influence on total milk production (Hartmann et al., 1997). For this reason sows on a low level of nutrition will mobilise body reserves for milk production thus losing weight. The extent of weight loss will depend on the energy deficit between requirements for maintenance and for milk production (the number of piglets suckling the sow and their growth rate will determine this) and that provided by the feed (NRC, 1998).

Greater energy and feed intake during lactation is associated with higher embryo survival rates during the subsequent early gestation and greater litter size (Koketsu and Dial, 1998). This study also found that increasing feed intake during lactation can reduce the negative association between short lactation length and subsequent litter-size.

Computerised liquid feeding

At Moorepark we are currently looking at ways to increase feed intake during lactation in order to minimise weight loss. Appendix 2 shows 3 feed curves. Curve 1 is the baseline, curve 2 is curve 1 plus 15% and curve 3 is curve 2 plus a further 15%. Curve 1 provides on average 74.3MJ DE /day (5.2kg; 14.2 MJ /kg DE diet) and is easily consumed but results in a lactation (26 day) weight loss of between 23 and 33 kg (depending on sow weight; Table 4). Curve 2 provides on average 85.5MJ DE /day (6.2kg) and led to very little feed rejection and results in lactation weight losses of between 8.4 and 18.1kg (depending on sow weight; Table 4) over a lactation of the same duration. Curve 3 provides on average 98.3MJ DE /day (6.9kg) and if consumed in its entirety would actually put weight on most sows over a 26 day lactation (Table 4). However, approximately 50% of sows cannot consume their full allocation of feed on this curve and valves need to be “minused” regularly.

It is suggested that curves similar to either curve 2 or 3 be used. If curve 2 is adopted, it should be fed as 2 splits (morning and evening) and personnel should provide supplementary dry feed at mid day to sows that will take more. If curve 3 is used, personnel should monitor troughs (morning for previous evenings feed and mid day for morning feed) and when significant quantities of feed are left individual valves should be "minused".

If it is rarely necessary to minus a valve for a particular feed curve then it is reasonable to assume that the curve is too low and that the majority of sows are under fed. Voluntary food intake of individual sows differs greatly and is influenced by factors such as ambient temperature, genotype, parity, sow health, lactation stage and litter-size (O'Grady et al., 1985; Farmer et al., 2001). It is the responsibility of the stockperson to ensure that these individual requirements are satisfied. This will involve additional work but the return will be very worthwhile with improvements in weaning to service interval, farrowing rate and litter size.

Another very obvious though often overlooked consideration is the trough capacity with liquid feeding. Ensure that trough capable of taking the level of feed and water that the sow will require by the second week of lactation

Dry Feeding

Where lactating sows are hand-fed dry feed it is extremely difficult to match the ad-libitum feed requirement. Peterson et al. (2004) found a 7% improvement in intake when lactating sows were given dry feed ad-libitum using a self feeder. Lactating sows tend to eat more wet feed compared with sows given dry feed. O'Grady and Lynch (1978), Koketsu (1994) and Lynch (2001) found the intake of lactating sows to increase by 12%, 11% and 7%, respectively when feed was wet.

A recent study by Peng et al. (2006) compared an ad-libitum wet-dry feeder to hand feeding. Intake for the two systems were similar up to day 14 after which the ad-libitum wet-dry fed sows had a 9% increase in intake. In this study ad-libitum wet-dry fed sows gained more than 6 kg body weight over the 21-day lactation. Piglet weight at weaning was increased and variation in individual weight within litters was reduced. Wastage of water was also reduced on the ad-libitum wet-dry feeding treatment as nipple drinkers were incorporated in the trough and not external to it as was the case where sows were hand fed.

Therefore, it is recommended that where meal or pelleted dry feed is fed to lactating sows ad-libitum wet-dry feeders should be used.

Table 4. Energy Requirement of sows during lactation (MJ DE / day) and sow weight loss during lactation (kg over 26 days) associated with 3 different lactation feed curves (see Appendix 2).

	Energy Requirement during lactation				Curve 1		Curve 2		Curve 3	
Sow weight (kg)	Maintenance (MJ DE)[1]	Milk (MJ DE)[2]	Total /day (MJ)	Total /day (Kg)	Fed (MJ)	Weight loss[3] (kg)	Fed (MJ)	Weight loss[3] (kg)	Fed (MJ)	Weight loss[3] (kg)
180	22.6	69.0	91.6	6.45	74.3	23.4	85.5	8.4	98.3	-9.1
190	23.6	69.0	92.6	6.52	74.3	24.7	85.5	9.6	98.3	-7.8
200	24.5	69.0	93.5	6.58	74.3	26.0	85.5	10.9	98.3	-6.5
210	25.4	69.0	94.4	6.65	74.3	27.2	85.5	12.1	98.3	-5.3
220	26.3	69.0	95.3	6.71	74.3	28.4	85.5	13.3	98.3	-4.1
230	27.2	69.0	96.2	6.77	74.3	29.6	85.5	14.5	98.3	-2.9
240	28.1	69.0	97.1	6.84	74.3	30.8	85.5	15.7	98.3	-1.7
250	28.9	69.0	97.9	6.90	74.3	32.0	85.5	16.9	98.3	-0.5
260	29.8	69.0	98.8	6.96	74.3	33.2	85.5	18.1	98.3	0.7

[1]DE for Maintenance (MJ DE /day) = ((110 x $BW^{0.75}$) / 1000) x 4.1853 (NRC, 1998) where BW is body weight.

[2]DE for Milk (MJ DE /day) = ((((6.83 x ADG x pigs) – (125 x pigs)) x 4.1853) / 1000) / 0.96) (NRC, 1998) where ADG is the daily gain of suckling pigs (assumed here as 250g/day) and pigs is the number of piglets suckling per sow (assumed here as 10).

3 (Total energy requirement during lactation – Energy fed) / ((5 x 4.1853 x 0.88) / 0.96) (Noblet et al., 1990).

3.4. Weaning to service

Tummaruk et al. (2000) found that subsequent litter-size decreased by about one pig when weaning to service interval increased from 4 to 10 days. Weaning to service interval is likely to be shorter for sows that have lost least body weight during lactation.

Low energy intake compared to high energy intake before mating may reduce litter size in gilts and sows that experienced severe weight loss during lactation (Kongsted, 2005). For this reason it is recommended that sows should be fed *ad-libitum* from weaning to service.

4. Lactation length / Weaning age

The majority of Irish herds wean at about 28 days. The endometrium in the uterus is regenerated between 14 and 21 days after farrowing. This process, called involution may not be complete in sows weaned at 21 days or less (especially with older sows). For this reason, sows weaned at 21 days or less are likely to have a reduction in litter-size at the subsequent farrowing (Koketsu and Dial, 1998). Each day increase in the farrowing to conception interval (less than 36 days) was responsible for a subsequent increase in number born alive of up to 0.09 pigs (Clark and Leman, 1987).

5. Parity distribution

The annual sow replacement rate in Ireland is 52.2% (46.2% culling rate and 6% sow mortality; PIGSYS, 2005). Based on an average 2.28 litters per sow per year (PIGSYS, 2005) 23% of litters born have to be from gilts so as to maintain sow herd size. Carroll (1999) proposed an ideal parity distribution and according to his data, gilt farrowings should only account for 17% of farrowings (Table 5).

Table 5. Ideal Parity distribution (Carroll, 1999)

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

It is evident that a large number of young sows are culled. To avoid this it is suggested that strict selection procedures for gilts on entry to the herd are adopted (Lawlor, 2005).

Litter size usually increases from first to second litter and again from second to third litter, but then plateaus until approximately the seventh or eight litter (Hughes and Varley, 1980; Hughes, 1998). For this reason it is essential when attempting to achieve a high herd litter size that a high proportion of older sows remain in the herd. To achieve this goal culling rates must be optimised and it is especially important to avoid situations where excessive numbers of young sows are culled.

Again using PIGSYS (2005) figures and to achieve the ideal parity distribution in Table 5 the ideal replacement on Irish herds would be 39%. It is also important that a high proportion of cullings are voluntary (i.e. based on age and reproductive performance). Rodriguez-Zas et al. (2006) found that reducing involuntary culling at early parities results in increased profitability. It is advisable that sows are culled on age after parity 7 since number born dead tends to increase with age and number born alive tends to decline.

6. Diseases

Parvo-virus is usually recognised when a herd suffers an outbreak of SMEDI (stillbirth, mummification, embroyonic death and infertility). The clinical signs include a low number total born and a high number born dead/mummified leaving a very low number born alive. However, Parvo-virus infecting sows in early pregnancy can cause a reduction in litter-size without the presence of mummies. A comprehensive Parvo-virus vaccination programme is needed. Gilts and sows should be vaccinated 3 weeks before service.

Leptospirosis, PRRS and occasionally enterovirus are reproductive diseases that may also reduce litter-size (Aherne, 2002).

7. Movement/stress

Sows should be moved from the service area to their gestation quarters either within the first 72 hours post-breeding or else 28 days after breeding. The stress of moving or mixing sows before embryo implantation can result in lower farrowing rates and litter size (Aherne, 2002).

8. Boar fertility

If boars are either over- or under-worked a reduction in litter-size is likely (Table 6). Ideally each boar should be used for one double service per week. A boar chart should be used to monitor usage. These records will also be useful in detecting fertility differences.

9. Timing of service

Timing of mating / AI is very important. Sows generally ovulate sometime during the last half of their oestrus period and it is critical that sperm are in the tract before ovulation occurs. If fertilization does not occur within 4 hours of ovulation a sharp reduction in litter-size will result (Table 7). Sperm must have time to capacitate or mature in the tract and must be present at the site of fertilisation at or very shortly after ovulation. It is recommended that sows are served when first detected on heat and again 24 hours later as sperm is likely to survive for 24 hours in the sows' reproductive tract.

Table 6. The effect of resting boars on litter-size (Ashenhurst, 1983).

Rest period prior to mating (days)	Number of Litters	Litter-size
0	289	9.5
1 - 2	455	10.1
3 - 4	253	10.1
5 - 6	241	10.5
7 - 9	167	10.4
10 - 30	200	9.6
>30	36	9.8

Work at North Carolina State University has shown that when sows exhibit a strong standing heat reflex, have a tight cervical lock on the catheter, and very little semen flow-back occurs, that a higher conception rate will occur (Steverink et al., 1998; Anonymous, 2000).

Table 7. Effect of age of eggs at fertilisation on the number of viable embryos (Hunter, 1983)

Age of eggs at fertilisation (hours)	% eggs normally fertilised	Number of viable embryos at day 25
0	90.8	12.0
4	92.1	11.7
8	94.6	8.7
12	70.3	6.8
16	48.3	4.8
20	50.9	5.0

10. Other considerations

- Monitor litter-size from natural service and AI. If AI has poorer litter-size than natural service, check the timing and/or technique
- Ensure that it is handled and stored appropriately to maintain quality.
- Provide adequate and effective lighting in the service area and dry sow house for 12 to 16 hours per day
- Maintain temperature in the dry sow house at 18 - 20^{0}C. Each ^{0}C below this will require an additional 1 MJ DE per day to maintain body temperature (NRC, 1998).
- Maintain temperature in the farrowing house as low as possible (provide supplementary heat for piglets). This will encourage sow appetite.

List of references is available from the author

Appendix table 1. Gestation feed curve for sows calculated from NRC (1998) equations and using the feeding pattern proposed by Tokach et al. (1999)[1]

Days after service	MJ DE / Day[2]
0 – 12	24.2
13 – 45 [3]	30.4
46 – 100	25.1
101 – 112	38.1
113 – 115	25.1
Total Intake (MJ DE)	**3208**
Mean Daily intake (MJ DE)	**28.0**
Mean Daily intake (Kg/day)	**2.15**

[1] For a sow of 180kg, gaining 10kg in body weight (above the normal weight increase due to uterine growth, uterine fluids, products of conception and mammary tissue; assumed to be 22.8kg) during pregnancy and fed a diet containing 13 MJ DE / Kg. [2] Increase feed curve at each stage by (0.92 MJ DE per day) or c.3.5% for each 10 Kg in sow weight above 180 Kg. [3] Increase curve at day 13 – 45 by 6.2 MJ /day for each additional 10 Kg in body weight gain required during gestation.

Appendix table 2. Gestation feed curve for gilts calculated from NRC (1998) equations and using the feeding pattern proposed by Tokach et al. (1999)[1]

Days after service	MJ DE / Day[2]
0 – 12	20.3
13 – 45 [3]	39.0
46 – 100	23.2
101 – 112	36.2
113 – 115	23.2
Total Intake (MJ DE)	**3313**
Mean Daily intake (MJ DE)	**28.8**
Mean Daily intake (Kg/day)	**2.22**

[1] For a gilt of 140kg, gaining 30kg in body weight (above the normal weight increase due to uterine growth, uterine fluids, products of conception and mammary tissue; assumed to be 22.8kg) during pregnancy and fed a diet containing 13 MJ DE / Kg. [2] Increase feed curve at each stage by (1 MJ DE per day) or c.4.0% for each 10 Kg in sow weight above 140 Kg. [3] Increase curve at day 13 – 45 by 6.2 MJ /day for each additional 10 Kg in body weight gain required during gestation.

Note:

1. The above curves should not be used without consulting the footnotes. If unsure of any of the details an Advisor or Nutritionist should be consulted.
2. Sows that are extremely thin or that have lost excessive condition during lactation should always be fed to condition from the beginning of pregnancy.
3. An additional 1 MJ DE / day should be fed where effective temperature is below 18^{0}C.
4. Sows with mange or other parasites will require additional food.
5. Sows condition should always be closely monitored during gestation. If expected weight gains are not achieved then adjustments in the curve may be necessary.

Appendix 2. Lactation feed curves (MJ DE per day).

Days	Curve 1	Curve 2	Curve 3
0	25.0	28.8	33.1
1	35.0	40.3	46.3
2	38.3	44.1	50.7
3	41.7	47.9	55.1
4	45.0	51.8	59.5
5	50.0	57.5	66.1
6	55.0	63.3	72.7
7	60.0	69.0	79.4
8	65.0	74.8	86.0
9	68.8	79.1	90.9
10	72.5	83.4	95.9
11	76.3	87.7	100.8
12	80.0	92.0	105.8
13	83.3	95.8	110.2
14	86.7	99.7	114.6
15	90.0	103.5	119.0
16	91.7	105.4	121.2
17	93.3	107.3	123.4
18	95.0	109.3	125.6
19	95.6	109.9	126.4
20	96.2	110.6	127.2
21	96.8	111.3	128.0
22	97.4	112.0	128.8
22 to 28	98.0	112.7	129.6

29 days			
Total MJ DE	**2226.5**	**2560.5**	**2944.5**
Av. MJ DE/day	**76.8**	**88.3**	**101.5**
Total feed, kg	**156.8**	**180.3**	**207.4**
Av. feed kg/day	**5.4**	**6.2**	**7.2**

26 days			
Total MJ DE	**1932.5**	**2222.4**	**2555.7**
Av. MJ DE	**74.3**	**85.5**	**98.3**
Tot feed, kg	**136.1**	**156.5**	**180.0**
Av. feed, kg/day	**5.2**	**6.0**	**6.9**

Controlling Manure Volume and Costs

Gerard McCutcheon, Bagenalstown

The cost of managing manure on pig farms is increasing including storage, and transport to customers. This paper gives some advice to minimise the volume thereby reducing the cost. There may be ingress of rainwater or "soiled" water to storage tanks on some sites - this presentation does not cover such site specific issues.

Storage

Under SI – 378 of 2006 (EC Good Agricultural Practice for Protection of Waters Regulations) the manure storage capacity required depends upon the unit size, unit type and the water to meal ratio for finisher pigs (Table 1).

Table 1: Manure storage capacity required for sows and pigs

Unit Type *Water: Meal Ratio* *changing for finishers only*	***m³/week¹***				
	2.0:1	*2.5:1*	*3.0:1*	*3.5:1*	*4.0:1*
Breeding unit (per sow place)	-	-	-	-	0.174
Integrated unit (per sow place)	0.312	0.355	0.398	0.441	0.483
Finishing unit (per pig)	0.024	0.031	0.039	0.046	0.053
¹ An additional 200mm freeboard must be provided in all covered tanks and 300mm freeboard in all uncovered tanks. Allowance must also be made for net rainfall during the specified storage period for uncovered tanks.					

Source: SI – 378 of 2006.

There is a legal requirement to have 26 weeks storage on units with more than 100 pigs on or before 31/12/2006, unless the holding has sufficient land to comply with SI – 378 (2006).

A recent comparison (Mc Namara and O'Dowd 2006) of manure storage costs shows the following (excluding VAT) based upon the storage of 500m³ (110,000 gallons):

Concrete underground store	€78/m³.
Overground steel tank	€71/m³.

Transport Costs

There is wide variation between pig units in the cost of manure handling. The cost of contractor, the speed and distance to travel, the type of equipment used, volume to be transported are the main factors. Based on a contractor charge of €45/hour and a transport rate of 20m^3/hour (4,400 gallons/hour) the cost of transporting pig manure is €2.25 per m^3. In practice, this figure appears to range from €1.50 to €3.00 per m^3.

What is Pig Manure ?

Pig manure consists of the neat excreta (faeces and urine) as well as the water added from various sources. It also contains spilled feed and other organic debris arising within the unit. It is a valuable source of plant nutrients especially Nitrogen (N), Phosphorus (P) and Potassium (K). The fertiliser value is closely related to the solids or dry matter content. The higher the solids content the higher is the fertiliser value.

In Ireland the vast majority of pigs (c. 85%) are produced on integrated units. The remainder are produced on specialised breeding units, reared to about 35kg and transferred to specialised finishing units where they are finished to a live weight of, typically, 96-100kg.

Manure Solids Production

The amount of manure **solids** produced by pigs is determined by the amount of feed consumed and by the efficiency with which that feed is digested e.g. Table 2.

Table 2. Annual feed usage per sow on an integrated unit.

No. Pigs produced per sow per year	21.9
Feed per sow per year, tonnes	1.22
Weaning weight, kg	6.6
Live sale weight kg	98.5
Feed conversion weaning to sale	2.46
Total feed per sow per year, kg	6,171
Feed used per pig, kg	282

The calculations in Table 2 are based on data from Pigsys recorded herds in 2005. The amount of feed used is expressed in terms of kg of meal diet or its equivalent.

Feed usage and manure dry matter production will vary depending on:

- slaughter weight
- number of pigs produced per sow per year
- amount of feed used per sow per year
- the efficiency with which feed is converted to live weight gain.

The typical meal diet for pigs consists of feed with about 86% dry matter. The 6,171kg feed consumed in Table 2 is therefore 5,307kg of dry matter (DM).

The digestibility of the dry matter is about 83%. The amount of DM / solids excreted in Table 2 is therefore 902kg/year (17% of 5,307kg of dry matter consumed).

Water Intake

Pig welfare must never be compromised by an inadequate supply of fresh clean drinking water. The daily water requirements of the different classes of pig can vary significantly depending on various factors

- diet composition: high protein diets mean increased consumption
- Salt levels: water demand can be increased by 25% if levels are high.
- ambient temperature
- pig health: Enteric diseases, mycotoxins and urinary tract infections increase demand.
- milk production

Table 3. Drinking water requirements of pigs

Type of Pig	*Litres per Head per Day*
Suckling Sow and litter	25
Dry Sow / Boar	10
Maiden Gilts	10
Weaner	2
Finisher	
Water : Meal Ratio 2:1	4
Water : Meal Ratio 2.5:1	5
Water : Meal Ratio 3:1	6
Water : Meal Ratio 3.5:1	7

The figures used in Table 3 do not allow for spillage or other losses which can be substantial on some units. Table 4 shows typical daily water intakes per pig and Table 5 shows annual intake per sow and progeny.

Water Intake and Manure Composition

The water consumed by the pig is used either as a constituent of live weight gain (or of sows' milk), is lost through respiration or is removed in urine and faeces (neat excreta). Therefore the greater the water intake the greater is the volume of neat excreta. By minimising water intake while not compromising pig welfare, the amount of manure can be minimised.

The water intakes of finishing pigs in particular exert a major influence on the volume of neat excreta. Finishers account for a very high proportion of the total water consumption.

Table 4. Daily feed and water intakes by type of pig

Type	*Daily Feed, kg*	*Daily Water Intake l*	*Water: Meal Ratio*
Suckling Sow and Litter	6.25	25	4:1
Dry Sows	2.2	10	4.5:1
Maiden Gilts	2.75	10	3.5:1
Weaners	0.8	2	2.5:1
Finishers			
Water: Meal 2:1	2	4	2:1
Water: Meal 2.5:1	2	5	2.5
Water: Meal 3:1	2	6	3
Water: Meal 3.5:1	2	7	3.5

Table 5. Annual water consumption per sow on an integrated unit

Type of Pig	*Number per 100 Sows**	*Litres per Day*
Suckling Sow and Litter	18	450
Dry Sows / Boars	85	850
Maiden Gilts	12	120
Weaners	400	800
Finishers Water: Meal 2:1	525	2,080 (3,655)
Total per Day – litres		4,300 (5,875)
Total /Sow/Year- litres		**15,695 (21,424)**

Figures in brackets are for a finisher water : feed ratio of 3.5 : 1

As the water to meal ratio is increased, the additional water is excreted.

Particular attention must be paid to the water to meal ratio for finishing pigs (Table 6).

Wet Feeding Systems

Ideally, the water to meal ratio should be dictated by the requirements of the pig. Where a high water to meal ratio is used to ensure that the mix can be pumped there will be more manure and higher manure handling costs.

Table 6. Effect of water to meal ratio for finisher pigs on volume of neat excreta produced

Water: Meal Ratio	*Water Intake litres per week*	*Neat Excreta litres per week*
2:1	28	20
2.5:1	35	27
3:1	42	34
3.5:1	49	41
4:1	56	48

Based on 2kg feed per day

The main factors that determine the thickness (viscosity) of the feed mix that can be used in a wet feeding system include:
Pump: a mono (screw) type pump is capable of pumping a thicker mix than a centrifugal type pump.

- Length of the circuit or feed line.
- Number and type of bends on the line
- Diameter of the feed line (usually 63mm).
- Feed ingredients differ in how they behave when mixed with water. The viscosity of the mix may be improved though the use of enzymes.
- Feeding trough. Where feed is required to flow significant distances in long troughs a more dilute mix is required compared to ad-libitum feeders with sensor probes.

Newer systems convey the feed to the pen dry before adding the required volume of water. This offers the opportunity to reduce the water to meal ratio.

Dry Feeding

Pigs may be offered meal or pellets in hoppers or in wet/dry feeders. When young growing pigs have free choice access to water, they will consume 2.2 to 2.8 litres per kg feed. Thus a pig eating 2kg feed will normally consume 4.5 litres of water (Prairie Swine Centre).

A Canadian comparison between dry feeders with separate drinkers and wet/dry feeders for grower/finisher pigs showed that the wet/dry feeders reduced the water disappearance and the water content of the manure. In this trial carried out at Prairie Swine Centre the pigs were fed a pelleted diet with water provided by nipple drinkers 5 cm above the shoulder height of the smallest pig and delivered at a flow rate of 700 ml per minute (Table 7).

Table 7: Water disappearance and manure production by pigs using dry and wet/dry feeders

Stage	*Grower*		*Finisher*	
Feeder	*Dry*	*Wet/Dry*	*Dry*	*Wet/Dry*
Water Disappearance kg /day	6.0	5.4	9.3	6.2
Reduction %		10		33
Manure Water kg / day	5.5	4.4	8.9	5.4
Reduction %		20		39

Source: Prairie Swine Centre.

Water Wastage or "Disappearance"

In most of the reports in the literature the figures for water intake are, in reality, figures for disappearance which includes wastage.

Table 8: Water intake and wastage of growing finishing pigs

Stage	**Grower**	**Finisher**
Body weight kg	52.6	71.9
Feed Intake (kg per day)	1.69	2.54
Water Disappearance l/day	5.29	7.31
Water Intake l/day	4.0	5.38
Water Wastage l/day	1.29	1.93
Water Wastage %	**24**	**26**
Water Intake per kg Feed l/kg	2.43	2.13

Source : Li and Gonyou PSC

Wastage was 25% of the usage. This is likely to be well below the actual wastage on farms because the drinkers in the trial were set at the proper height and had the correct flow rate.

Wastage increased when the water flow rate was increased to 2 litres / minute. Water use with wet/dry feeders was reduced by 10-15% compared with dry feeders and bowls. Wet/dry feeders also increased feed intake by about 5% compared with dry feeders and separate nipple drinkers. In a US trial lactating sows fed by wet-dry feeders with a nipple within the trough wasted only 15 litres (total per sow during the 21 day lactation) compared with wastage of 227 litres for sows fed dry meal with a nipple-in-bowl to one side (and outside) the feeder.

In general, if wet/dry feeders require pigs to drink directly from the within-feeder drinker there should an additional drinker elsewhere in the pen. If the feeder allows the pig to drink from a pool of water e.g. bowl, an additional drinker does not appear to be warranted. Additional drinkers in this case will increase water wastage.

Drinkers

Water can be supplied to pigs through different types of drinkers. These include

- Valve: requires the pig to open the device and drink directly from it. These can be further sub-divided into
  - Nipple. Pigs must move the activating nipple and water will flow.
  - Bite. Require the pig to bite on the mechanism for activation.
  - Button. Require the animal to push the activator in to open the valve.
- Bowl: allows the pig to drink directly from a pool of water. Water is added to the pool by a number of means;
  - Float valve used to maintain a relatively constant level.
  - Nipple and button type valves
- Trough: allows several pigs to drink together from a pool of water.

Bite drinkers, which require pigs to have their mouth properly positioned on the valve, reduces wastage compared to nipples. Water use is less with bowls than with nipples. Danish trials indicate that water use might be reduced by 15% and wastage by up to 30% by using bowls rather than bite drinkers. These reductions may be less if bowls with a shallow cup and a high flow rate are used since the pig may have difficulty in drinking at a speed corresponding to the flow rate. These bowls should have an adjustable flow rate.

Water Leakage

Where leakages occur in the lines into or within the unit and the leaked water drains into the manure store considerable additional volumes may be added. Early detection and repair will help to minimise this. Fundamental to the detection of leaks is the use of a meter to monitor water use. Any unexplained deviation from the norm should immediately raise suspicions. At least this will cause an increased use and cost of water. At worst the leaked water will finish up in the manure storage effectively reducing the storage capacity and increasing manure handling costs.

Water meters are not expensive e.g. €80 (excluding VAT) for a manual meter up to €175 for a meter linked to a computer. Each source of water to a unit should be metered. Meters fitted to individual sections of the unit, can be used to identify where problems occur.

A leak of 0.5 litre per minute amounts to 720 litres per day or 0.72m^3. This is over 5m^3 per week or 1 tanker load of manure/water.

Remember this is from a leak of just 8.3ml per second.

Other Requirements for Water

Water is also required for routine washing and disinfecting of houses and passageways as well as canteen, toilet etc).

Washing of Houses

Routine washing and disinfecting of pens between batches is a standard recommendation. Washing should only be undertaken where individual rooms have been fully emptied of pigs. Washing of pens in partially emptied rooms is likely to be counter-productive.

The VIDO Swine Technical Group in Canada set out to survey units to establish the amount of wash water used at the different stages of production.

Table 9: Wash water requirements for different pig houses

Stage	*Time - minutes*		*Volume - litres*	
	Average	*Range*	*Average*	*Range*
Farrowing per pen	15	7 - 29	152	85 - 318
Nursery per pig place	1		10	
Finishing per pig place	1.8	1.1 - .8	80	21 - 246

Source: VIDO Swine Technical Group

There was huge variation between units indicating that significant reductions can be achieved.

Table 10: The effectiveness of the different methods of washing pens (Hurnik)

Water	*Detergent*	*Pre-soak*	*Time mins.*	*Time Saved %*
Cold			68.03	-
Cold	Detergent		59.8	12
Cold		Pre-soak	41.39	39
Cold	Detergent	Pre-soak	36.38	47
Hot			52.61	22
Hot	Detergent		46.24	32
Hot		Pre-soak	41.88	38
Hot	Detergent	Pre-soak	36.81	46

Source: Hurnik, Atlantic Swine Research Partnership

- Compared to a cold wash, hot wash reduced time by 22%.
- Pre-soaking reduced time by nearly 40% for cold washing and 38% for hot.
- A detergent was more effective in pens that were hot washed (32% versus 12% time reduction) but the volume reduction over hot wash alone was only 10% and similar to that over cold wash (12%).
- A combination of detergent and pre soaking reduced the time required by 46% irrespective of the use of cold or hot wash.

Detergents may not reduce the time or water used dramatically helping to remove the greasy film of organic matter that sticks firmly to the pen floor or wall. This biofilm can shelter bacteria and viruses from removal and disinfection.

Pre soaking pens prior to washing has a major impact on the time required. The impact on the amount of water required will be less and depends on the volume used to pre soak (which is likely to be small). While pre soaking is very effective it is still important to only use the minimum amount of water to achieve effective soaking of the pen. Excessive sprinkling increases manure volume. Sprinklers operated on a time switch are recommended.

Conclusions

The cost of managing pig manure is increasing. It makes sense to minimise the volumes produced while not compromising animal welfare. Producers need to measure/assess the volumes being produced and focus on methods to reduce the costs associated with the management of pig manure.

If you don't measure, you can't control!

Economizing on Electricity usage on the pig farm

Seamas Clarke, Teagasc, Ballyhaise

The Irish pig herd at present levels of production has the capacity to consume ninety six million units of electrical power per annum, the equivalent of 20,000 domestic dwellings. At today's costs this amounts to almost €12.5 million / year, or 620 kWh (units) / sow / year.

A Teagasc survey carried out in the north eastern region representing approximately three percentage of the national pig herd reveals major variation between units with (on the eight integrated farms surveyed), ranging from 17 to 37 units [kilowatt hours] per slaughtered pig, the average being 27 units.

How does your pig farm stand in electrical efficiency?

All too often we disregard our electrical bill as a fixed cost, one that we are stuck with and one we have little or no control over. Electrical costs have risen by almost 29% over the past three years and most commentators say 'we ain't seen nothing yet'

How would you cope if your pig farm was rationed to 20 units of electricity per pig produced or 2,000 units per farrowing crate on the farm! Work it out before January 1st 2007, when the next price rise of 19.4% kicks in!

The Carbon Trust in the United Kingdom published data on typical power consumption on pig farms in the UK. The data is presented in Table 1

Table 1. Electrical usage in each section of pig production

Production stage	*Typical per pig produced*	*Best practice per pig produced*	*Main influence*
Farrowing	8kWh	4kWh	Covered creep / heat pads
Weaning	9kWh	3kWh	Insulation / ventilation control
Finishing	10kWh	6kWh	Efficient fan selection / inlet design
Feeding system	3kWh	1kWh	Dry feed more efficient
Manure handling	6kWh	2kWh	High efficiency in pumps, separators
TOTAL	**36kWh**	**16kWh**	

Source Carbon Trust UK 2005

The Teagasc electrical usage survey results are presented in Table 2

Table 2 Electrical consumption on eight Irish integrated sow herds

Farm size Sow herd	*Production pigs/sow/year*	*ESB bill €*	*Vat@13.5% €*	*€ per pig*	*Units / pig (kWh)*	*Cent / kWh*
624	22.8	42,170	5,693	3.38	26	13
420	22.5	39,230	5,296	4.71	37	12.8
370	22.5	18,134	2,448	2.47	19	13
540	25.1	55,165	7,448	**4.71**	35	13
600	23	44,422	5,997	3.65	27.5	13.3
532	23	29,485	3,980	2.73	20.5	13.4
315	22	13,590	1,835	**2.23**	17	13
1,300	22.6	72,931	9,846	2.82	21	13.3
Tot. : 4701	Avg. : 23	315,127	42,543	Avg. : 3.30	Avg. : 27	Avg. : 13.1

Source Teagasc 2006

Check out your own situation.

1 Monitor energy usage

(a) Organize your ESB bills at office level
(b) Systematically record the pig farm electrical meter weekly or monthly

2 Benchmark for comparison

(a) Compare usage with other periods
(b) Compare with fellow producers
(c) Check with your Teagasc adviser visa v other pig farms of similar pig output

Understanding your electrical bill

Type of supply MAX DEMAND LOW VOLTAGE - COMMERCIAL **[3 Phase]**

Components of a typical electrical bill

1 Charge for MAXIMUM IMPORT CAPACITY
€23.88 / KVA / YEAR

77 KVA for bill period in days [59 days example] €297.22

2 Charge for DEMAND CHARGE
€40.20 / KW / YEAR [winter]

€33.60 / KW / YEAR [summer]

57 KW for 59 days at winter rate €370.39

3 Charge for Metered readings as in Table 3

Table 3 Meter readings

Present	*Previous*	*Actual*	*Multiplier*20*	*Rate in cents*	*Total €*
Day units					
65163	63218	1945	38,900		
			19296 *	14.22 c [high]	€2,743.89
			19604 *	10.82 c [low]	€2,121.15
Night units					
37103	35982	1121	22420		
			22420	6.11 c [standard]	€1,369.86
Wattless					
41353	40071	1282	25640		
				Free	
			5200	0.638 c [standard]	€33.18

Notes:

*High day rate calculated:

[[No. KW x 350] / 61] x 59(bill days) = units at high day rate

[[57x350] / 61] x 59 = 19296 @ 14.22c = €2,743.89

*Low day rate calculated:

Total day units minus high rate units

38900 – 19296 = 19604 @ 10.82c = €2,121.15

* Wattless calculated:

Total Wattless minus 1/3 [Day + Night units]

25640 – 1/3 [38900 + 22420]

25640 – 20440 = 5200 @ 0.638c = €33.18

4 Standing Charge

59 bill days @ €860.22 per year [365 days] = €139.05

5 Charge for Public Service Obligations Levy

MIC < 30kVA = €5.10 per two months

MIC =>30kVA = €0.44 per Kva per month

[77kVA] for 2 months @ €0.44 per Kva = €67.76

6 Charge for Value added tax [VAT] @ 13.5% = €964.34

7 Charge for Arrears !!!!!

Total electrical bill **€8,106.73**

Applying the bill to production levels

Units consumed [period in days]	61,320
Cost per unit	13.2c
Pigs sold during the period	2,230
Units per pig sold	27.5

Cost per pig sold ***€3.63***

Target cost per pig **€2.64**

Potential savings to the farm **€13,657**

If on the average Irish herd of 500 sows the usage was reduced from 37 to 20 units per pig the savings amount to €24,497, each unit reduction being worth €1,410. At a return of 5% on investments, this would justify an investment of €500,000 in the reduction of waste energy.

In Table 3 we examine some of the farm factors leading to higher or lower usage.

Table 3 Factors relating to electrical usage on surveyed farms

Farm size	**Units / pig (kWh)**	Creep box / under floor heat	Natural vent finishers	Mechanical ventilation growers / finishers	Wet /dry feeding growers /finishing	Computerized wet fed growers / finishers	Good electrical maintenance
315	**17**	Y	Y	N	Y	N	M
370	**19**	Y	N	Y	Y	N	Y
532	**20.5**	Y	Y	N	N	Y	Y
1,300	**21**	Y	N	Y	N	Y	Y
624	**26**	Y	N	Y	Y	N	Y
600	**27.5**	Y	N	Y	N	Y	N
540	**35**	Y	**N**	**Y**	N	**Y**	Y
420	**37**	Y	**N**	**Y**	N	**Y**	N

Source Teagasc 2006

Areas requiring closer examination on your farm.

Farrowing rooms

Approximately 20 – 25% of electricity usage on the farm is consumed here. Our survey reveals little opportunity to improve the heating systems in the farrowing area. All eight farms had controlled under floor heating. We might look at shredded paper to supplement the heat source at farrowing rather than the infra red bulb. If your average gestation period is 115 days, should you heat up the creep area on day 113 of gestation? Poor temperature control can lead to unnecessary overheating of pads resulting in wasted electrical heat and wasted ventilation energy. This applies particularly in week two and onwards after farrowing.

Weaner rooms

First stage [6 – 17 kg]

An extra one kilo body weight at weaning can reduce energy consumption by 8% in the weaner stage.

One quarter of the energy usage on the pig farm is consumed in this area. Flat deck housing is used on most Irish pig farms. In Table 6 the energy consumption for 120 pigs housed at $0.22m^2$ ($2.33ft^2$) per pig is given. The heat was provided by four 1.5 Kw electric heaters and the ventilation by two 355 mm fans (14inch). Typical usage of 10 Kwh can be expected, with the breakdown of 7.5 units for heating, 2 units for light and 0.8 units for ventilation.

Table 6 Weaner house energy consumption: typical and best practice

Energy consumption (Kw)	*Typical*	*Best practice*	*Potential saving %*
Heat	7.5	3	60%
Light	2	1	50%
Ventilation	0.8	0.6	25%

Best practice annual usage should require heating - 3 units, light - 1 unit and ventilation - 0.6 units/pig or an annual saving of 5.7 units per pig sold. This (on the average Irish herd) is worth €8,276. Watch for ventilation working against your heating system. The ventilation may control house temperature at a massive cost to your electrical consumption if the two systems are out of sync with each other.

A lag time may occur before the temperature sensor shuts off the 'call' for heat, this problem can be compounded by the fan cutting in to remove the excess heat provided. Air quality will be fine but at a cost to energy usage.

Can we make cost effective improvements to reduce heat input?

Can fan and ventilation inlet/outlet efficiency be improved?

Grower – Finisher rooms

One third of the electrical energy is consumed in this area. Ventilation and feeding systems often go head to head for energy usage here; lighting systems come in a poor third in usage. Where the ventilation system chosen is ACNV and the feeding system is liquid then power consumption leans heavily towards the feeding system. Where the ventilation system is fan powered with restricted inlets and the feeding system is augered wet / dry, the consumption pattern may be reversed.

General electrical consumption, common to all area on the pig farm

Fans

The 'Yuppie' terminology springs to mind, **24/7**. Fans are '***ever ready'*** to consume electricity, sometimes at no advantage to the pig. How often have we seen fans at fully speed in a dry sow house in mid winter, or first stage weaner houses with fans at full speed and heaters glowing? Remember that when fans are set, either manually or on a curve, they will carry out that function, be it correct or incorrect until the settings are changed.

When choosing a fan – check

- Fan size versus stock type and numbers
- Inlet size versus fan capacity
- Fan efficiency: How much air moved versus power consumed? M^3 per hour / kW
- Fan efficiency at selected 'back pressure' (usually 30Pa);
- Fan efficiency at increasing 'back pressure'
- Ventilation Efficiency Ratio VER [M^3 per second / Kw] at 50Pa
- Location of fan: Wall mounted v's Chimney
- Wind breaks or hoods to ensure optimum air flow
- Distance of fan from control panel. Optimum less than 30m
- Higher gauge cable results in less line losses.
- Quality and settings of controller

Table 6 Values of VER at back pressures of 50Pa

Fan Diameter, mm	*VER Best*	*VER Worst*	*Reduced efficiency %*
350	3.4	2.3	32
450	4.1	2.0	51
630	4.5	3.5	22

NAC 1990

Lighting

A typical 500 sow integrated pig farm has 5,000M^2 floor area to illuminate, approx 10M^2 per sow and progeny. Lighting power consumption accounts for 10 – 15% of electricity supplied onto the farm, 2 to 4 kWh per pig produced.

The standard incandescent (Tungsten) bulb is 5% efficient at converting energy to light and has an expected life of 5,000 hours versus a fluorescent at 20,000 hours. They are now museum pieces, long gone by their 'sell by date'. Cheap to buy and better than a torch!

The compact fluorescents have been heavily promoted in recent years. They provide good energy efficiency and are easily fitted into the incandescent bulb holder. They are expensive to buy and have a relative short expected life of 10,000 hours. They are unreliable in terms of light output when dimmed below 50%.

The new energy efficient standard is the T-8 fluorescent tube with dimmable electronic ballast, mounted in weatherproof housing (plastic) with gasketed diffuser. These units are four times as efficient as regular incandescents and last 24 times longer.

Table 7 Relative life and efficiencies of various light sources

Lamp Type	*Lamp Size (W)*	*Efficiency (Lumens/Kw)*	*Typical Lamp Hours*	*Energy usage (kWh/pig)*
Incandescent [Tungsten]	25 – 200	11 – 20	5,000	2 – 4
Compact Fluorescent	5 – 50	50 – 80	10,000	0.4 – 0.8
Fluorescent T-8 Strip	32 - 120	88	20,000	0.4 – 0.8

ASAE IET 433-4 Lighting EP,2005

For efficiency, chose the T-8 (1 INCH) tube instead of the T-12 (11/2 INCH). Electronic control will further reduce energy usage by 20% and extend lamp life by 50%.

It's your choice,

(A) Disregard all the above if you don't care about your own pig farms electrical costs

Or

(B) Get your 2006 bills in order and discuss savings potential with your Teagasc Enterprise Adviser.

Optimum energy efficiency **'will'** benefit your pig farming enterprise:

in the following areas:-

- Bank balance
- Your pig performance
- Your working environment
- Your job satisfaction
- Your global environment

Global Pigmeat Production – How Good Are Our Competitors?

Mike Ellis, Department of Animal Sciences, University of Illinois

Background

One of the most overused quotations is the one from Charles Dickens that goes "It was the best of times; it was the worst of times. It was the spring of delight; it was the winter of despair. We had everything before us; we had nothing before us." Although it is obviously not the case, Dickens could have been describing the situation that confronts everyone that is involved with the swine industry today. To say that the industry is dynamic would be an understatement and every person involved in whatever capacity is struggling to appreciate the changes and to understand how to adapt to them. At the national level, over the last decade we have seen industries in decline that arguably were once world leaders, such as that of the UK, and new major industries have emerged in non-traditional areas, such as in Brazil. At the more local level, regions that have been major producers of pigs, such as the Midwest of the US, are experiencing problems maintaining competitiveness; it is a startling realization that having access to cheap feedstuffs for pigs is no longer a panacea for a prosperous industry.

It is very difficult for an existing industry or for any established producer within that industry to remain competitive in the longer term. The rapid speed of change in technology development and in business models is such that existing approaches are quickly outdated and replaced with more efficient technologies and systems. Producers must be continually updating facilities and equipment and production practices to remain competitive. This is often difficult in a sector where profitability and return on investment is historically relatively low.

In Illinois over the last decade or so we have seen some sobering examples of the dynamic nature of this industry. A substantial number of our relatively large producers that a decade ago would have been considered among the best in the state have gone out of business. In their place, new larger systems of production have emerged that have adopted business models and production systems that have allowed them to develop low cost, very competitive businesses. One of the major reasons why these systems have been able to grow quickly is their extensive reliance on contract finishing. Contracting with another farmer to rear the pigs from weaning to slaughter has many potential advantages the major one of which is that it reduces the capital (in the form of buildings and land) that is needed to expand production.

In the US, and increasingly elsewhere, we have seen major restructuring within the industry with, particularly, the emergence of large-scale production companies. Many of these are vertically integrated, controlling all aspects of production through to slaughter and meat processing. Currently, the largest producer in the US controls more than 20% of US production and nearly 40% of the pigs are produced by just 10 production companies. Many of these companies are expanding into other countries and regions of the world.

On the face of it, there are many reasons to be pessimistic about the future of swine production, particularly for smaller independent producers. However, not all is doom and gloom and there will be many of opportunities for those that remain committed to the industry and are able to adapt quickly to the rapid changes that we will undoubtedly see in all aspects of our industry and in the political, economic, and social environment that it has to operate in.

Future Prospects for Swine Production

Globally, the demand for pork is increasing and this trend is predicted to continue for the foreseeable future. Projections indicate that by the year 2020 on a world basis the consumption of pork will increase by as much as 3kg/person per year. Given the projected increase in the size of the world population over the same time period, this increase in demand, if it does occur, will result in a substantial increase in the numbers of pigs needed to supply this extra pork. Interestingly, most of the extra demand for pork will occur in the developing world, largely in Asia and Central and South America, where improving living standards will result in a concomitant increase in meat consumption. In developed countries, such as those in Western Europe and the US, pork consumption levels per capita are expected to be relatively static. Although there will be some population increase in these area leading to increased demand for pork, this will be relatively modest. Thus, the major opportunity for expansion for swine industries in the developed world is directly related to their ability to export pork.

Relative Competitiveness

In a very general sense, it is possible to identify the major strengths and weaknesses of swine industries in various countries. However, there a few published studies that have attempted to detail the relative economic performance of these industries. Recently, PIC has carried out a comparison of production costs and prices for pigs in the major swine producing countries across the world and the results of this comparison for selected countries is presented in Table 1. Obvious caution is needed when interpreting this type of information and one is reminded of the saying "lies, damn lies, and statistics'. Comparisons such as this one are fraught with problems, particularly in relation to the exchange rates used to convert from the local currency to US dollars. Rates of exchange can fluctuate widely and can have a major impact on such cost comparisons across countries. However, this type of information can be used in a general sense to assess an industries economic strengths and weaknesses. The countries presented in Table 1 were chosen to represent the range in terms of production costs and this range is considerable; there was a three-fold difference between the countries with the lowest (Argentina) and the highest production costs (Japan). There was also a three-fold difference in feed costs between the lowest and the highest and, perhaps surprisingly, a four-fold difference in non-feed costs.

Broadly speaking, these countries could be divided into high, medium, and low cost industries. The highest cost industries (total cost > ~$1.50) include Japan, United Kingdom, South Korea, and Ireland, the medium cost industries (total costs ~$1 to $1.20) include Denmark, Spain, Poland, Canada, and Mexico, and the lowest cost industries (total costs <$1) include China, Chile, USA, Brazil, and Argentina. Unfortunately, Ireland appears to be in the higher cost bracket!

Table 1. Production costs and market price in selected countries February 2006 (PIC, unpublished)

Country	Production costs ($US/kg live weight)			Market price ($US/kg live weight)
	Feed	Non-feed	Total	
Japan	0.88	1.29	2.17	2.28
United Kingdom	0.62	1.16	1.78	1.77
South Korea	0.87	0.74	1.61	2.23
Ireland	0.69	0.80	1.49	1.65
Denmark	0.52	0.65	1.17	1.48
Spain	0.65	0.51	1.16	1.21
Poland	0.80	0.33	1.13	1.78
Canada	0.32	0.82	1.14	1.50
Mexico	0.63	0.44	1.07	1.38
China	0.59	0.30	0.89	0.89
Chile	0.40	0.44	0.84	1.21
USA	0.39	0.38	0.77	0.96
Brazil	0.44	0.31	0.75	0.98
Argentina	0.32	0.31	0.63	0.96

One country that will have a huge influence on global swine production, both directly and indirectly, is China. Over half the pigs produced in the world are in China and the numbers are increasing. Living standards are increasing dramatically and with that there is an increase in meat consumption, including pork. China is obviously a huge market and there will be opportunities for other industries to export pork to that country. The Chinese are committed to producing as much of the pork they need within China. They will need to import an increasing quantity of feed ingredients, particularly corn and soybeans, for the extra production and that will influence world prices for ingredients.

Future Prospects for Swine Production

Given that the numbers of pigs produced worldwide will need to increase to meet the increased demand for pork in the developing world, the obvious critical questions include where will these extra pigs be produced, who is going to produce them, and what technologies will be used?

Historically pigs were produced and slaughtered and processed close to the centers of population and to a large extent that is still the case today. However, the export trade in pork has increased dramatically in recent years and distribution networks have developed that allow large quantities of product to be shipped around the world relatively cheaply. For example, the major multinational supermarkets, such as Wallmart, and the international fast food chains, such as McDonalds, commonly source their materials from the lowest-cost sources wherever in the world that might be.

These changes will favor an expansion of production in areas that are low cost, such as Brazil, Argentina, and the countries of Eastern Europe, with product being shipped globally from these centers. As an aside, it is interesting that swine production in Argentina has not increased over recent years to the same extent that it has in Brazil. On the face of it, both countries have similar potential to increase production, having vast areas of fertile land on which to grow cereals and oilseeds. However, pork consumption in Argentina is relatively low and it is difficult to develop a large swine industry based solely on exports without a significant domestic market to absorb the product that doesn't meet the requirements for the export market.

Factors Influencing the Future Competitiveness of Swine Industries

Political and Social Climate: A colleague of mine is very fond of saying that pigs will be produced wherever the people want them to be produced and there is a significant element of truth in this statement. Successful pork production depends to a large extent on a favorable political and social environment in which to operate. Unfortunately, the political influence of agriculture including the swine industry is declining in many countries, including the US, and the social acceptance of the industry is on the wane.

Barriers to Free Trade in Pork: Many domestic industries have been protected from outside competition by, for example, tariffs on cheaper imports. As long as these barriers remain in place, high-cost domestic producers can survive. Globally, however, there is an increase in free-trade agreements which will result in tariffs on agricultural goods being reduced or even eliminated. Swine producers in many countries will need to produce pork at a price that will be competitive with other industries globally. One barrier to free trade in pork that will continue to protect some industries is that relating to disease. There are many areas of the world were some critical diseases are endemic which will eliminate any potential for such areas to export pork.

Production Efficiency and Cost: Swine industries lose sight of the need to continually improve production efficiency and reduce costs at their peril. A classic example of where this happened would be in the UK industry. Arguably, in the period from the 1960s through to the 1980s, the UK industry was the leader of developments in swine science and swine technology. It was also one of the lowest cost producers during this period. Today, as illustrated in Table 1, it is now one of the highest cost producers and the industry is substantially smaller than it was 30 years ago. Although there were many factors involved in this demise, the major one undoubtedly was that the industry stopped focusing on reducing production costs and got hung up on other issues.

Technology Development and Application: The rapid development, evaluation, and application of new technologies are essential to maintaining production efficiency.

Research and Education Systems: A well-organized, appropriately-funded research and education system is essential for the development of successful industries. Historically, research and education in agriculture was largely funded by governments. However, in recent times government funding of agricultural research has been dramatically reduced, particularly in the applied areas related to improving production efficiency. In the future, funding of applied research will need to come from industry and its important that strong partnerships are formed between industry and the research and academic communities to organize and facilitate technology development and educational programs.

Competitive Slaughter Sector: Maintaining an efficient, low-cost slaughter and meat processing sector is central to future competitiveness for any industry. Arguably, one of the competitive advantages of the US industry is its large-scale, volume-throughput packing plants which have very low costs for slaughter and meat processing.

Sustainable Production Systems: "Sustainable" is an often misused word that has commonly been associated with extensive, low-input systems of production. However, it is my view that intensive systems can be (and often are) sustainable. The issues associated with intensive, housed livestock production are environmental sustainability, particularly manure disposal, and emissions of dusts and gases from the facilities. In the case of the former, areas that can use manure to fertilize growing crops will have a competitive advantage. There is a large amount of research currently underway to develop cost-effective approaches to minimizing emission from swine facilities.

Available Markets for Pork: Here I would like to draw the distinction between "commodity" and "niche" markets. The former demands large volumes of low cost products whilst the later requires small volumes of products with some special attribute (s). Advocates for niche marketing view it as an absolute alternative to producing for the commodity market. They propose that producing for niche markets is the best way for small producers to remain competitive and in business. The argument that is often put forward to support this view is that niche markets pay higher prices; smaller producers with a high-cost structure can stay in business because the higher returns will compensate for their higher costs. I do not subscribe to such an argument. Certainly there will be opportunities at the local level for some producers to capture niche markets, however, it is my view that they will still need to be lowest cost producers to stay competitive in the long term. One factor that is often overlooked is that niche markets actually depend on having a strong local commodity market to sell the products that don't fit into the "niche". The successful production systems of the future will need to produce at a low enough cost to be able to survive with commodity market prices whilst remaining flexible in their approach to exploit other marketing opportunities. There are many examples worldwide of highly successful systems that have adopted such an approach. There is a very competitive and sizeable swine industry in the middle of the desert in Sonora in northern Mexico that exports a substantial volume of its product to the high-priced Japanese market and sells a lot of product into the commodity market in Mexico.

Size and Scale: For as long as anyone can remember, structural changes in agriculture have resulted in fewer, larger farms. In the US swine industry, this change has been taken to the extreme with one company currently producing over 20% of the 100 million pigs produced annually. Many industries are still based on small independent producers and there is a great debate over the future for these operations. In the absence of any legislation limiting the size of companies, there is no doubt that economic forces will continue to drive the increase in size of pig production companies. So what of the smaller producer? I believe that there is a major central role for the smaller producer in the modern swine industry but not as an independent but rather as a part of a larger system. In fact, all of the larger systems are based on a very large number of relatively small producers, often working on contract to the larger operation. The small producer losses some independence but gains all of the benefits of being associated with a large company, a major one of which is a substantial reduction in financial risk. Generally speaking, contract producers supply buildings and labor, and land for manure disposal and in return get a guaranteed payment for their services which is independent of any fluctuation in market prices.

Talented Young People: The life blood of any industry is a steady supply of talented, well-educated young people that can move the industry forward into the next era. Unfortunately, the supply of such people that want to work in the swine industry is declining dramatically in many countries. In large part this is due to a reduction in the number of people working in agriculture and, consequently, a reduction in the number of sons and daughters from farming backgrounds that want to work in the industry. In addition, there are many alternative careers available to young people today. Attracting young people of the appropriate caliber into any swine industry will be a big factor determining its future competitiveness.

Teagasc Pig Research programme 2005 - 2006

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
Following a successful series of experiments to determine the optimum concentration of lysine in diets for pigs in defined weight ranges (15 to 30kg; 20 to 40kg; 40 to 60kg; 60 to 80kg; 80 to 100kg, we have recently commenced a series of trials to determine the optimum concentrations of threonine in the diet. Later we plan to examine the optimum concentration of methionine. A better balance of dietary amino acids improves efficiency of growth and minimises nitrogen excretion in manure.
Project leader: Karen O'Connell (Moorepark)

2. Effect of low phosphorus diets on bone strength
This project id funded principally by the Department of Agriculture and Food. The background is that as dietary P has been reduced and phytase supplementation has become the norm there is evidence that problems of bone breakages in slaughter pigs and breeding sows. This project will study bone development in pigs and the effect of diet.
Project leader: Brendan Lynch (Moorepark) and John O'Doherty (UCD);
Student: William Ryan, MRCVS

5. Assessment of on-farm salmonella control measures
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 was most effective. This project has been completed and an end of project report is in preparation.
Project leaders: Brendan Lynch (Moorepark), Nola Leonard (Vet College, UCD) and John Egan (Dept. of Agriculture, Backweston)
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 were slaughtered at different stages of pregnancy and samples of muscle collected from the foetuses.

Pigs from most sows were monitored from birth to slaughter with measurement of growth rate feed efficiency and carcass traits.
Project leader: Peadar Lawlor (Moorepark) and Neil Stickland (Royal Vet College, London)
Student:

7. PIGSYS herd performance analysis

A project is in progress which has 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 changes to management on pig unit output, costs and profitability.

Detailed management data from c. 80 herds has been collected and the data is being analysed. This project is part funded from the Pig research levy and by six feed manufacturing companies.

Project leader: Karen O'Connell (Moorepark)

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 weight without actual weighing of animals.

At present breeding gilts on two farms (Moorepark and one large commercial herds) are being assessed at first mating (backfat, body size) with a view to monitoring their lifetime performance. Only a small number of sows have farrowed so far.

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

Project leaders: Peadar Lawlor (Moorepark) and Karen O'Connell (Moorepark)

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. Studies with sows on electronic feed stations have been completed in Hillsborough and studies with sows in groups of four and in stalls are at present being carried out in Moorepark.

This project is part funded from the Pig Research Levy.

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

Student: Charlotte Stewart

11.Processing of pig manure

This study is funded by the Department of Agriculture Research Stimulus Fund and the Pig Research Levy. Manure is being separated into solid and liquid fractions and the characteristics of both fractions are being studied. The study will also address:

- The effect of diet on the distribution of N and P in the two fractions
- Response of winter wheat to solid and liquid fractions
- Water use on pig farms and
- The economics of processing/handling manure

Project leaders: Brendan Lynch (Moorepark), John O'Doherty (UCD) and Tom McCabe (UCD)

Student: Sinead Treanor

Progress Report to the Teagasc Pig Industry Advisory Committee May 4, 2006

1. This committee

The terms of appointment of the chairman and members of this committee end with this meeting. On behalf of Teagasc I wish to express my thanks to all of you for your input of the past three years. A new committee will be convened in the autumn.

2. Pig Growth rate study

Amii Cahill BAgrSc. submitted her thesis in November 2005 and she was awarded the MAgrSc degree. An End-of-Project report has been published on the Teagasc website (http://www.teagasc.ie/research/reports/pigs/index.htm).

3. Amino acid nutrition of pigs

A summary article on responses to lysine was published in the December issue of the Pig Newsletter.

4. Salmonella control

This project is due to terminate in May 2006. A workshop on this and related Teagasc/UCD/DAF projects was held in DAF, Backweston on April 26.

5. Examination of PIGSYS herd performance records

Collection of management data (housing system, feeding system, water supply, breeding policy) on the PIGSYS herds has been completed and analysis is in progress

6. Sow feeding

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. The graduate student working on this project resigned in January 2006 and a replacement is being sought.

A related study of sow feeding and management on commercial farms was due to start in January 2006. This was delayed due to the Nitrates issue. The part of the project involving monitoring of backfat in gilts at breeding is underway.

7. Pig welfare

A project on the provision of manipulable material to pregnant sows in the diet (high fibre ingredients) or separately (straw or equivalent) is continuing in Hillsborough and Moorepark. This study is led by Laura Boyle with Ms Charlotte Stewart as the Walsh Fellow and Dr. Niamh O'Connell (Hillsborough) as the academic supervisor.

A project examining methods of measurement of pig welfare concluded and a thesis was submitted to the University of Limerick in September by Ms Sara Llamas Moya for which she was awarded a PhD degree. An End of Project Report has been prepared and will be on the Teagasc website shortly.

8. Manure processing

A project processing of pig manure with the emphasis on the feasibility of separation of manure into solid (rich in P) and liquid (rich in N) started in February. The project is funded by DAF and will look at the effect of diet on manure separation and the economics of various manure handling options.

9. Advisory service

A new appointee will take up duty as a Pig Development Officer in early June. He will be based in the Midlands.

Ciaran Carroll spent a week at North Carolina State University studying training methods for pig unit staff and other aspects of North American production especially manure processing/management.

Seamas Clarke attended the Agromek show in Denmark in January and will visit Iowa State University in June to study developments in manure management.

Michael Martin attended the Banff Pork Seminar in Canada in January and also visited pig farms in Alberta.

Brendan Lynch presented a paper at the Australasian Pig Science Association meeting in New Zealand in November and visited pig farms in NZ.

10. Odour control study

A desk study of odour production from pig units and methods of control was carried out under the Pig Research Levy in 2004. A summary leaflet for producers was issued with the October newsletter.

11. Annual Pig Conference

The 13th annual Teagasc Pig Conference is planned for October 18 to 20 in Moorepark, Kilkenny and Longford.

12. Liaison with other agencies

Statutory Instrument SI 788 of 2005 giving effect to the Nitrates Action Plan was published in December. The subsequent "debate" required a significant amount of staff time. Michael Martin and Brendan Lynch were involved in preparation of the Teagasc submission to DAF in March.

A new revised Bord Bia Pigmeat Quality Assurance programme is being launched this autumn. Michael Martin was heavily involved in finalising the document.

DAF inspectors who will be supervising the Sow Housing scheme were given a training course by Michael Martin.

13. Producer workshops

Producer workshops on manure management are planned for the autumn. Two pilot workshops for non-national staff on pig units are planned for later this year.

A series of workshops on the Bord Bia Pigmeat Quality Assurance programme is being discussed with An Bord Bia.

14. A development plan for the pig industry

The Teagasc Pig Group has initiated a discussion on the formulation of a development plan for the pig industry. The opening document will be sent to producers and other stakeholders as a "special issue" Newsletter. Written submissions are requested by June 15.

Brendan Lynch,
May 4, 2006.

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

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Notes