# A review of factors influencing litter size in Irish sows

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Many factors influence litter size. These include genetics, gilt management, lactation length, parity distribution, disease, stress and boar fertility. In the past 20 years, litter size in Irish sows has increased by only one pig. Born alive figures now average at 11.2 pigs per litter. In this regard, Ireland is falling behind our European competitors who have made significant advances over this time. Denmark, for example, has an average figure of 12.7 pigs born alive per litter and France an average of 12.5. The single area that could be improved immediately is sow feeding. It is important that sows are fed correctly throughout pregnancy. If over-fed during pregnancy, sows will have depressed appetite during lactation. If underfed in pregnancy, sows will be too thin at farrowing. The correct way to feed a pregnant sow is to match her feed allocation to her requirement for maintenance, body growth and growth of her developing foetuses. During lactation, sows should be given as much feed as they can eat to prevent excessive loss of body condition. Liquid-feed curves should be such that lactating sows are provided with a minimum mean daily feed supply of 6.2kg. A small proportion of sows will eat more and this could be given as supplementary dry feed. Where dry feeding is practised in the farrowing house, it is difficult to hand-feed sows to match their appetite. Ideally *ad libitum* wet/dry feeders should be used. From weaning to service, sows should once again be fed *ad libitum*. If liquid feeding, this means giving at least 60MJ DE (digestible energy) per day during this period. If dry feeding, at least 4kg of lactation diet should be fed daily. The effort spent perfecting sow feeding management on units should yield high dividends in the form of increased pigs born alive per litter.

**Key words:**   litter, size, Ireland, sows

## Introduction

In the past 20 years, litter size in Irish sows has increased by almost one pig. However, most of this increase had occurred by 1996. Since then, litter size has increased by only 0.40 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 in total born between the top 25% and bottom 25% performing herds (**Table 2**). However, even the top quartile is falling behind our European competitors (**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 in Ireland. Genetics is obviously an important factor in this regard (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 some of 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 last 20 years (PIGSYS report 2006)

| 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 select EU countries in 2004 (BPEX data, 2005)

| Country | Number born alive |
|---------|-------------------|
| Denmark | 12.7 |
| France | 12.5 |
| Sweden | 12.1 |
| Netherlands | 11.9 |
| Ireland* | 11.2 |

*PIGSYS data, 2005*

## Genetics

As a result of heterosis, litter size of crossbred sows is on average 0.25 to 0.5 pigs greater than that of purebred sows (Aherne, 2002). Literature estimates of heritability

of litter size range between 0 and 0.76 with an average of 0.10 (Rothschild and Bidanel, 1998). A policy of selecting gilts from prolific sows, and serving them with boars from a prolific dam line, will gradually increase litter size over time because litter size and its component traits (ovulation rate, embryonic survival and uterine capacity) respond to selection (Johnson *et al.*, 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 between ovulation rate and number of foetuses with numbers of stillborn and mummified pigs and because birth weight has decreased as litter size has increased (Johnson *et al.*, 1999).

One of the most important determinants of litter size is failure of the developing foetus to survive (Spötter and Distl, 2006). 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. 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 increased uterine capacity and, in particular, selection for reduced placental size and increased placental efficiency may also lead to increases in litter size (Ford *et al.*, 2002; Wu *et al.*, 2006)

## Gilt selection and management

There are more gilts served and farrowed than sows of any other parity. Therefore, if gilt litter size is low, the average born alive 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 be carried out 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 (Tummaruk *et al.*, 2001).
- An increase in growth rate from birth to 100kg body weight of 100g/day results in an increase in litter size (both total born and born alive) of between 0.3 and 0.4 piglets, 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 have increased litter size in parity two as well as a shorter weaning to oestrus interval and a higher farrowing rate (Tummaruk *et al.*, 2001).
- As age at first mating increases, so too does 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).

The essentials of gilt management and nutrition have been reviewed previously by Carroll and Lawlor (1996) and Young (2003).

## Sow feeding
### Feed quality
Certain 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 and feed storage areas are kept clean, fresh and free of moulds.

### Gestation
Moderate energy intake (31 MJ DE/day) compared to low energy intake (18 MJ DE/day), in the first three days after mating, may reduce litter size in gilts but not in sows (Kongsted, 2005). Tokach *et al.* (1999) recommended limiting sow feed intake (28 MJ DE/day) in the first 12 days 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 four weeks of pregnancy (Kongsted, 2005), especially where sows are in a very poor body condition (Tokach *et al.*, 1999). Where sow body 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 of gestation.

Day 75 to day 100 of gestation is the critical period for mammary development and Tokach *et al.* (1999) recommend that excess feed intake 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 of gestation.

The period from day 100 to day 112 of gestation is also critical in that this is a period wherein rapid foetal growth takes place. Feed intake should be increased by 1-2kg during this period to prevent sows from losing weight. Failure to increase feed intake during this period results in sows entering a catabolic state at farrowing. This catabolic state contributes to gorging and sows "going off feed" during lactation (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 recommended gestation feed curves for sows and gilts.

*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 (Eissen *et al.*, 2003; Thaker and Bilkei, 2005). In the study by Thaker and Bilkei (2005), it is evident that weight loss during lactation should not be greater than 5% (approx. 9kg) for first parity sows and 10% (approx. 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 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 in these young sows which impacts negatively on their fertility. Subsequent ovulation rate is reduced by lactation weight loss (Zak *et al.* 1997).

In the sow, only extremes of either under or over-nutrition have been reported to influence milk yield (NRC, 1998). The number of piglets suckling the sow has the greatest positive influence on total production of milk (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 sucking the sow and their growth rate will determine this) compared with that provided by the feed (NRC, 1998).

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

*Computerised liquid feeding*
At Moorepark Research Centre, the authors are currently looking at ways to increase feed intake during lactation in order to minimise weight loss. **Appendix 2** shows three feed curves that have been looked at. Curve 1 is the baseline curve, curve 2 is curve 1 plus 15% and curve 3 is curve 2 plus 15%. The suitability of the three curves is examined in **Table 4**. Curve 1 provides, on average, 74.3MJ DE/day (5.2kg; 14.2MJ/kg DE diet) and is easily consumed but results in a lactation weight loss of between 23 and 33kg (depending on sow weight; **Table 4**) over a 26-day lactation. Curve 2 provides, on average, 85.5MJ DE/day (6kg; 14.2MJ/kg DE diet), leads 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; 14.2MJ/kg DE diet) 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' (i.e., their feed levels temporarily restricted) on a regular basis.

It is suggested that curves similar to either curve 2 or 3 be used. If curve 2 is adopted, then it should be fed as two splits (morning and evening) and personnel should be prepared to provide supplementary dry feed at midday to

Table 4: Energy requirement of sows during lactation and sow weight loss during lactation (kg over 26 days) associated with three different lactation feed curves (see Appendix 2).

| Sow weight (kg) | Energy requirement during lactation | | | | Curve 1 | | Curve 2 | | Curve 3 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 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) = $((110 \times BW^{0.75}) / 1000) \times 4.1853$ (NRC, 1998) where BW is body weight.
2 DE for milk (MJ DE /day) = $((((6.83 \times ADG \times pigs) - (125 \times pigs)) \times 4.1853) / 1000) / 0.96$ (NRC, 1998) where ADG is the daily gain of sucking pigs (assumed here as 250g/day) and pigs is the number of piglets sucking per sow (assumed here as 10).
3 $(Total\ energy\ requirement\ during\ lactation - Energy\ fed) / ((5 \times 4.1853 \times 0.88) / 0.96) = weight\ loss$ (Noblet et al., 1990).

sows that will consume more. If curve 3 is used, it should be fed as three splits (morning, midday and evening), personnel should be prepared to monitor troughs (one hour after each 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 not getting sufficient feed. The voluntary food intake of individual sows differs greatly and is influenced by a number of factors including ambient temperature, genotype, parity, sow health, lactation stage and litter size (O'Grady *et al.*, 1985; Farmer *et al.*, 2001) and it is the responsibility of the stockperson to ensure that these very individual feed requirements are satisfied. This will involve some additional work but the return to labour in this area will be very worthwhile with improvements resulting in subsequent weaning to service interval, farrowing rate and litter size coupled with increased litter weight at weaning. Another very obvious, though often overlooked, consideration where liquid feeding is carried out, is the trough capacity. The trough must be capable of taking the high levels of feed and water that the sow will require by the second week of lactation. A typical water to feed ratio for lactating sows is 4.1kg water:1kg feed DM or 3.6kg water:1kg fresh weight feed. At maximum feed (curve 3; **Appendix 2**) 9.8kg fresh weight of feed would be fed per day. Feeding three splits per day would require a trough capacity of 19 litres (15 litres plus 25%). Feeding two splits per day would necessitate fitting a trough with a minimum capacity of 28 litres (22.5 litres plus 25%). The additional 25% capacity is recommended to prevent overflows when sows are feeding.

*Dry feeding*
Where sows are hand-fed dry feed in the farrowing house, it is extremely difficult to match the sow's *ad libitum* feed requirement. Peterson *et al.* (2004) found a 7% improvement in feed intake when lactating sows were given *ad libitum* access to dry feed using a self-feeder. In addition, lactating sows provided with wet feed tend to eat more 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 fed wet.

A recent study by Peng *et al.* (2006) compared an *ad libitum* wet/dry feeder to hand-feeding. Feed intake for the two systems were similar up to day 14 of lactation 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 6kg body weight over a 21-day lactation. Piglet weight at weaning was increased and variation in individual pig 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.


Figure 1: The majority of Irish herds wean at about 28 days.

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

*Weaning to service*
Tummaruk *et al.* (2000) found that subsequent litter size decreased by about one pig when weaning to service interval increased from four to 10 days. This is another reason why feed intake during lactation should be maximised as 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* after weaning.

## Lactation length/weaning age
The majority of Irish herds wean at about 28 days (**Figure 1**). 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) is responsible for a subsequent increase in number born alive of up to 0.09 pigs (Clark and Leman, 1987).

### Parity distribution

The annual sow replacement rate in Ireland is 52.2% (46.2% culling rate and 6% mortality; PIGSYS, 2005). Based on an average 2.28 litters per sow per year (PIGSYS, 2005), 22.9% of litters born have to be from gilts in order 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 from Irish herds. To combat this deficiency, it is suggested that strict selection procedures (conformation and structural soundness, feet and leg soundness, reproductive soundness) for gilts on entry to the herd are adopted (Stalder *et al.*, 2004; Lawlor, 2005; Stalder and Bass, 2005a; Stalder and Bass, 2005b).

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 38.8%. It is also important that a high proportion of this culling be 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 after parity seven since number born dead tends to increase with older parities and number born alive tends to decline. Allied to this is the reduction in milking ability as the sow ages.

### Diseases

Clinical parvovirus is recognised when a herd suffers an outbreak of SMEDI (stillbirth, mummification, embryonic death and infertility). The clinical signs include a low total number born and a high number born dead/mummified leaving a very low number born alive. However, sows infected with parvovirus in early pregnancy can cause a reduction in litter size without the presence of mummies. A comprehensive parvovirus vaccination programme is recommended and generally adhered to in Ireland though not elsewhere where there are large numbers of sows kept outdoors and where only gilts may be vaccinated. Gilts and sows should be vaccinated three weeks before service. Leptospirosis, PRRS (porcine reproductive and respiratory syndrome) and, occasionally, enterovirus may also reduce litter size (Aherne, 2002).

### Movement/stress

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

### Boar fertility

If boars are either over- or under-worked, a reduction in litter size is likely (Ashenhurst, 1983; **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 differences among boars. Artificial insemination accounts for as much as 80% of total services on a high proportion of the large sow herds in Ireland. This means that fewer boars are now kept on these units. However, there will always be a need for some boars (boar power) in these herds for oestrus stimulation and detection and perhaps for gilt matings (Hughes *et al.*, 1990). The recommended maximum sow to boar ratio is 20:1, 50:1 and 67:1 where natural mating accounts for 100% of services, where AI is practised on a 100-sow unit and where AI is practised on a 1000-sow unit, respectively (Lawlor, 1998).

Table 6: 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 |

### Timing of service

Timing of mating/AI is very important (Hunter, 1983). Sows generally ovulate sometime during the last half of their oestrus period and it is critical that sperm are in the reproductive tract before ovulation occurs. If fertilisation does not occur within four hours of ovulation, a sharp reduction in litter size will result (Hunter, 1983; **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. Sows should be served when first

detected on heat and again 24 hours later as sperm is likely to survive for 24 hours in the sow's reproductive tract.

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

| Age of eggs at fertilisation (hours) | Percentage of 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 |

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 where very little semen flow-back occurs, that a higher conception rate will occur (Steverink *et al.*, 1998; 'Simultaneously optimizing farrowing rate and litter size', 2000).

## Other considerations

- Monitor litter size from natural service and AI. If AI has poorer litter size than natural service, there is likely to be a problem with timing and/or technique and this area should be revised.
- Semen for AI is normally purchased onto Irish units. Ensure that it is handled and stored appropriately to maintain quality (semen should be stored at 17 ºC in a climate box and rotated every 12 hours to prevent separation of the sperm from the diluent).
- 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 18-20ºC. Each degree Celsius 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 by way of a warm creep area or heat pads). This will encourage sow appetite.

## Summary

The average litter size on Irish sow herds is 1.5 pigs less than that of the average for the Danish national herd. This paper has discussed the factors limiting litter size in Ireland, including; genetics, gilt selection and management, sow feeding, lactation length, parity distribution, diseases, movement/stress, boar fertility, timing of service and other considerations. Sow feeding has been identified as the factor where the most immediate improvements could be made. It is important that pregnant sows are fed to closely match their requirement for maintenance, growth and growth of the developing foetus. During lactation, sows should be given as much feed as they can eat to prevent excessive loss of body condition. Where liquid-feeding is practised, this is best achieved by providing a minimum mean daily feed supply of 6.2kg of lactation diet on the liquid feed curve and giving supplementary dry feed where

sows will eat more. Where dry feeding is practised in the farrowing house, installing *ad libitum* wet dry feeders to promote intake is advised. From weaning to service, sows should also be provided with *ad libitum* feed access. The time and effort spent perfecting sow feeding management is likely to be highly cost effective.

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# Appendix 1

**Table 1.1: 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 approx. 3.5% for each 10kg in sow weight above 180kg.
[3] Increase curve at day 13 – 45 by 6.2 MJ/day for each additional 10kg in body weight gain required during gestation.

**Table 1.2: 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 approx 4% for each 10kg in sow weight above 140kg.
[3] Increase curve at day 13-45 by 6.2 MJ/day for each additional 10kg 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 per day should be fed where effective temperature drops 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

**Table 2.1: Lactation feed curves (MJ DE) used in sow feed studies at Teagasc, Moorepark**

| 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 |
| 23 | 98.0 | 112.7 | 129.6 |
| 24 | 98.0 | 112.7 | 129.6 |
| 25 | 98.0 | 112.7 | 129.6 |
| 26 | 98.0 | 112.7 | 129.6 |
| 27 | 98.0 | 112.7 | 129.6 |
| 28 | 98.0 | 112.7 | 129.6 |
|  |  |  |  |
| **26 days**[1] |  |  |  |
| Total feed (MJ DE) | 1932.5 | 2222.4 | 2555.7 |
| Mean daily feed (MJ DE) | 74.3 | 85.5 | 98.3 |
| Total feed (kg) | 136.1 | 156.5 | 180.0 |
| Mean daily feed (kg) | 5.2 | 6.0 | 6.9 |

[1] Feed intake is calculated for a 26-day lactation which is the mean lactation on Irish herds.