Pig Development Department

Pig Farmers' Conference, 2017

Conference Proceedings

Cavan Crystal Hotel, 17th October, 2017
Horse & Jockey Hotel, 18th October, 2017

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Agriculture and Food Development Authority

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A closer look at preweaning mortality- Keeping your 'born alive' alive

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1. Background

The period from birth until weaning is one of the most dangerous in a pig's life. Pre-weaning mortality in Ireland was 10.8% in 2016, meaning that more than one in 10 pigs born alive died before it was weaned. Although this figure is better than in most other European countries, it represents considerable wastage, both financially and ethically. With the on-going increase in numbers born alive, there is a risk that that this figure will increase.

To truly understand piglet mortality it is useful to understand the biology of the pig, and how it evolved. The pig is a polytocous species i.e. it produces many offspring at a single birth. The reproductive strategy of such species represents an evolutionary "safety net" so that in the event of some offspring dying, there are still many surviving litter mates. The ancestors of today's domestic pig were exposed to a highly variable and challenging environment. In a good season, with plentiful food and good weather, a sow could rear most of her piglets. However, in a poor season low viability piglets would die as soon as possible such that available resources would be diverted to the strongest littermates. This is consistent with natural selection or 'survival of the fittest' and means that in trying to address the problem of pre-weaning mortality we are in effect battling against evolution!

The good news is that the wide variation in pre-weaning mortality rates (ranges from 6 to +15% on Irish farms) indicates that there is room for significant progress to be made. Excellent record keeping is the first step in trying to address the problem. If you are not keeping detailed records on why piglets are dying and the age at which you're losing them as well as keeping detailed records of sow performance there's no point in reading on. If you are, and find that your pre-weaning mortality is over 10% then you need to take an urgent look at ways to reduce it.

2. Causes

There are three main reasons why piglets die prior to weaning: still-birth, crushing and poor viability/starvation. Lesser causes include disease in the sow and the piglets (e.g. scour), defects (e.g. cleft palate, splayleg) and savaging.

2.1 Still births

Apart from piglets that did not survive to term (mummies) the majority of still births are piglets that die either just before farrowing, during or immediately after birth and they usually appear fresh and normal. These account for about 30% of piglet mortality. 'True stillborn pigs' are those that died during farrowing and that never breathed. If you open their chest the lungs will have a dark plum colour, showing none of the pink areas associated with breathing. Pigs that attempt to breathe during farrowing will show evidence of mucous obstructing the wind pipe. Pigs that died immediately after being born will have characteristic pink areas in their lungs associated with breathing. It is important not to immediately assume that all piglets found dead behind the sow are stillbirths; they may have died of chilling and low blood sugar after being born and simply never made it away from behind the sow. A good target level for stillbirths is 3 to 5 % of total pigs born. If the level reaches beyond 7% it is worthwhile carrying out an investigation by records and post-mortem examinations.

2.2 Crushing

This is the main cause of pre-weaning mortality accounting for about 45% of live born piglet deaths. Crushing deaths generally occur when the sow changes posture, particularly when lying down from standing or rolling over on top of piglets. But it can also be caused by the sow treading on piglets. Crushing usually occurs during the first 3 days after birth, with around half occurring during the first 24h. The piglets that are often considered most at risk are the smaller ones, but large piglets are also crushed; about 70% of crushing mortality happens to healthy viable piglets. This is in spite of the widespread use of farrowing crates which were invented to protect piglets from crushing by restricting the sows movement.

Given the amount of crushing that occurs in farrowing crate systems it is clear that there are other factors influencing a piglets likelihood of being crushed.

2.3 Poor viability/starvation

Post-mortem examination of piglets that die show that 30% have no milk in their stomach. Starvation (characterised by low blood sugar levels) is likely the primary cause of death in such piglets although some may actually have been crushed by the sow. Piglets are born with very poor energy reserves meaning that they rapidly become weak if they do not consume enough colostrum after birth. Such piglets are vulnerable to cold stress and crushing and have little protection against infection due to minimal intake of maternal antibodies from colostrum. This is exacerbated in low viability piglets (birth weights <1kg). Indeed piglets that are born light are also more vulnerable to starvation later on in lactation, as they may not be able to compete against larger litter-mates.

2.4 Disease, defects and savaging

Disease

Although the majority of pre-weaning losses are due to non-infectious causes which are strongly associated with management practices, deaths due to disease do occur. Diseases affecting pre-weaning mortality can occur in the sow or her piglets.

Postpartum dysgalactia syndrome (PDD)

This disorder refers to inadequate colostrum and milk production, and occurs in some sows in the period immediately after birth, usually lasting up to 72hrs after birth of the 1st piglet. The main signs are piglet growth retardation and high mortality. Unfortunately, it is difficult to identify sows with this problem until the piglets start to be compromised. However, observing the piglets' behaviour can help; high levels of fighting, and staying close to the sow are signs of inadequate milk.

Diarrhoea

Diarrhoea (scour) is a common problem generally caused by bacteria (though in some cases it is viral i.e. rotavirus) in the pen. This type of diarrhoea is generally characterised by slow onset and spread, and a gradual increase in severity over time. However a sudden onset of diarrhoea with a rapid spread could be a sign of a viral cause. The age at which pigs are first affected with diarrhoea is also an indicator; in addition to appearing during the first few days of life, diarrhoea from E. coli, PDD and coccidiosis is commonly seen at 3wks of age. Usually when diarrhoea occurs in pre-weaned pigs, the entire litter is affected due to low antibody levels. As well as the evidence of scouring the pen, another sign of diarrhoea is dehydration (the skin remains tented after being pinched between thumb and finger).

Arthritis

Infectious arthritis is a relatively common problem in pre-weaned pigs. Mortality due to arthritis is highest in the winter with most affected pigs dying by 3wks of age.

Bacterial meningitis

Piglets acquire infection with the bacteria causing meningitis during farrowing from contact with the sow, her faeces, and the environment. The mortality rate is very high, but if identified and treated early, pigs can recover fully. While ill, pigs should be removed from the group, put in a warm, dry environment, and treated with injectable antibiotics and electrolytes (as recommended by your vet).

Defects

Birth defects or congenital malformations include cleft palate and splay leg. The former pigs should be euthanized at birth. Splay leg is characterised by severe limb abduction (spread) and an inability to walk due to underdeveloped muscle fibres of the limbs. It generally affects the hind limbs of 0.4% of new born piglets and results in 50% mortality in affected animals due to starvation. Although many splay leg piglets die, those that survive past the first week of life will recover completely.

Savaging

Savaging mainly occurs when first-litter sows attack their piglets. Apprehension and stress related to their first confinement in crates, their first experience of farrowing, fear of their piglets and the associated hormonal changes are all implicated. However, savaging may become a habit in some sows so it is important to record it and monitor closely at the next farrowing.

3. Influencing factors

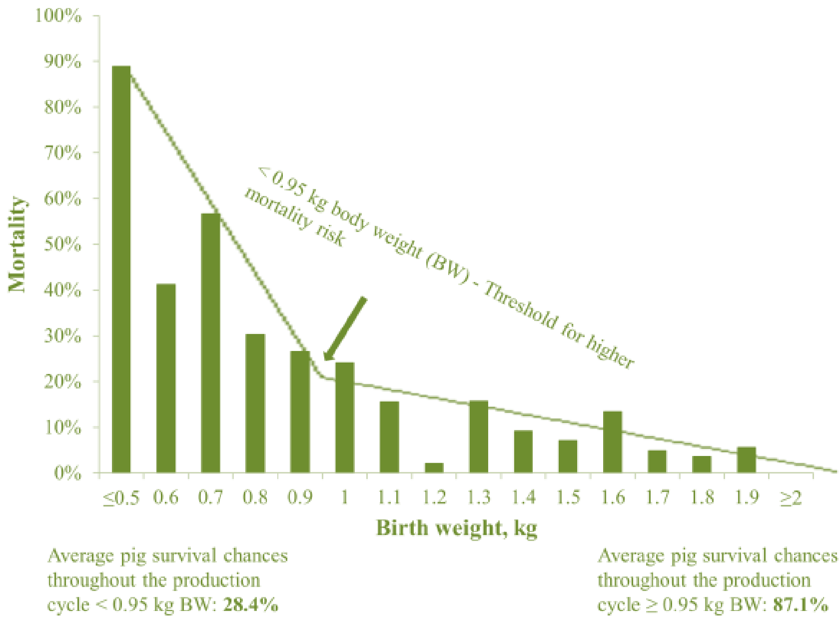
Influencing or risk factors for piglet pre-weaning mortality are a combination of factors related to the animals themselves (i.e. sow and piglet factors), the environment and management

3.1 Animal factors

Litter size

For piglets, the biological consequences of large litter size can be divided into outcomes that are related to a crowded gestation environment and outcomes that are related to experiencing post-natal life in a large litter. As litter size increases the percentage of very light pigs born also increases. Moreover, as well as being associated with more smaller piglets on average, large litters also result in an increase in within litter birth weight variation. The result is an increase in the number of very large and very small piglets. The reason for this is poorly understood, but in essence it is due to overcrowding in the uterus such that piglets in different positions have different access to resources. Moreover, as sows get older, litters tend to be more uneven in weight and so the frequency of low viability piglets increases further. Pigs with a low birthweight have lower energy reserves, are more sensitive to low temperatures, have lower vitality, and are therefore more likely to delay their first suckle. They also have a reduced ability to compete with littermates at the udder, so are at a disadvantage at the time of feeding, leading to reduced colostrum and milk consumption. Moreover, heavier pigs have a greater ability to access the best teats and to stimulate them to induce greater milk flow. Recent Teagasc research found that pigs with a birth weight of <0.95 kg have an 80% chance of dying before weaning (Figure 1). This raises the controversial suggestion that such piglets should be euthanized at birth in order to minimise suffering and the time and financial input associated with trying to keep such piglets alive.

Figure 1. *Mortality rate in piglets of different birthweights and average chance of surviving according to birthweight*



Farrowing duration

Another consequence of large litters is that farrowing is prolonged. As farrowing duration increases, there is a higher risk of piglets being deprived of oxygen before they are born (hypoxia). Indeed 70% of born dead occur in the final quarter of farrowing. This is why litter size is unfavourably associated with stillbirth prevalence and the production of low viability piglets. Hypoxia reduces piglet viability after birth, increasing the risk of starvation and crushing. This is especially the case for piglets with a high birth-weight, particularly if they are born towards the end of farrowing. A long farrowing in combination with a large litter size means that some piglets will be born late reducing their chances of accessing colostrum. Colostrum antibody concentration decreases dramatically from 6hrs after the 1st piglet is born, so a late born piglet born will have less opportunity to consume it.

Sow parity/size

Gilts are still immature and developing, and thus they have to partition nutrients between both themselves and their developing piglets, which can contribute to them producing piglets of low birth weights. They also produce lesser quality colostrum and less milk than older parity sows, which is also likely related to their increased mortality risk. Older sows have more stillbirths. Mortality can be >12% from parity 8 sows. Furthermore, birthweight variation increases in older sows as does the proportion of low viability piglets. Older sows also have larger girths such that teat placement can be poor making it more difficult for piglets to suckle or indeed making them too big for the crates, creating manoeuvring difficulties and placing piglets at increased risk of crushing.

Mothering ability/sow behaviour

There is huge variation between sows in their ability to respond to piglet distress calls and many sows do not stand up in response to piglet distress at being crushed. One of the reasons cited for the variable success of farrowing crates in preventing piglets from being crushed is that generations of close confinement in crates during farrowing means that we inadvertently selected sows with poorer "anti-piglet crushing" behaviour. Hence it is possible that some sows are less capable than others of providing good maternal care, particularly if they have large litters, so keeping a note of how many piglets are crushed over multiple lactations could help to identify sows that are at high risk for crushing. (See Teagasc Newsletter, Oct 2015 for more detail). Highly fearful sows can be more prone to savaging and prolonged farrowings. Conversely sows that readily interact with humans are less likely to savage their piglets.

Genetics

There are many genetic influences on pre-weaning mortality. For example, there is a genetic aspect to savaging, and thus maternal line gilts born to mothers with a history of savaging should not be retained in the herd. Also the number of teats a sow has is genetically determined and contributes to pre-weaning mortality. Only 5% of the sow population have 16 teats.

Lameness

Sow lameness is also a critical risk factor for crushing; lame sows are less able to control lying behaviour than sound sows, causing up to 15% more crushing. Overgrown hooves are also more likely to inhibit the normal lying-down behaviour sequence; sows with overgrown claws have difficulty standing up to feed and while standing during feeding, demonstrated by more slips and weight shifts, and ending feeding prematurely in order to lie down. The importance of high levels of feed intake during lactation for subsequent reproductive performance, milk production and therefore litter performance and piglet mortality rates are widely acknowledged. Thus management practices to reduce lameness and promote good hoof health will not only improve the welfare of the sow, but optimise her ability to wean a higher number of piglets.

Disease status

Certain sow diseases can influence the survivability of her piglets. Indeed both bacterial and viral diseases are more likely in neonatal piglets that are born to infected sows.

3.2 Environmental factors

Environmental factors that influence pre-weaning mortality include pen design (crate type/positioning, dimensions, positioning of heat mats/lamps), temperature (thermal environment), resources (water, bedding, nesting material), flooring (type and condition).

Thermal environment

Heat pads

Unlike many other mammals, piglets have very little body fat at birth (1-2%) and thus have limited ability to regulate body temperature. Hence a major stressor to new born piglets is adaptation to the new thermal environment. Thus piglets need a supplementary heat source after birth in order to avoid cold stress. Heat pads encourage piglets to stay away from the sow when they're not feeding. Small piglets are particularly susceptible to cold, so may be more likely to lie near the udder, and get crushed by the sow when she lies down. Anecdotally many Irish pig units run their heat pads too hot which is as harmful as cold heat pads.

Room temperature

The farrowing house should be dry and draught free with the rooms kept at 20^{0}C until just before the birth of the first piglet in that batch of sows, then increased and maintained at 24^{0}C until all piglets are over 48 hours old. After this, the temperature should be reduced to no more than 22^{0}C. The creep area should be maintained at ~30^{0}C during and after farrowing, with the heat pad itself at approximately $28\text{-}30^{o}$C.

Pen design/dimensions

Sufficient space must be provided behind the sow or gilt in the farrowing pen to allow natural or assisted farrowing. Installing farrowing crates so that the rear of the sow is facing the passageway facilitates easy handling and observation during farrowing. Moreover, given increases in litter size larger pens may reduce the risk of piglets being crushed, and optimise their feeding. Pens where piglets are unable to nurse comfortably can result in piglets becoming crushed after nursing, or not being able to obtain milk at each nursing bout. Small farrowing pens mean that piglets often rush to the space underneath the sow when she stands up. We have observed sows to stand on piglets in such instances.

Provision of resources

Nesting material

Sows start to perform nesting behaviour about a day before farrowing, and it peaks 6 – 12 hours before farrowing onset. Its original purpose was to provide a safe warm environment for the new-born piglets, and to encourage bonding between the mother and her offspring. Even in the relatively barren environment of a farrowing crate, the sow is still highly motivated to attempt to build a nest. Instead of being able to create a nest from rooting the ground and carrying branches, grass etc. as she would in a natural environment, her behaviour instead takes the form of pawing, and chewing on the bars and feeding trough. Providing her with some sort of nesting material, such as wood, straw, or even some old bags that she can tear up stimulates more protective behaviour of the sow towards her young. In fact, research has shown that sows that perform more nest building behaviour in the 12 – 6 hours before birth are less likely to crush piglets during the first 4 days after farrowing. Work done in Denmark found that provision of enrichment reduced crushing by rolling; 60% of sows without nest materials crushed piglets by rolling, compared to 0–14% of sows with access to sand and/or straw. Provision of some form of nest building material reduces the duration of farrowing, which in turn reduces the problem of still births, oxygen deprivation and 'slow' piglets. Provision of nesting material during farrowing also seems to strengthen the sow–piglet bond evidenced by increases in the response of crated gilts to the separation from piglets.

Water

Piglets will drink water even on the first day after birth, particularly if milk supply is limited. Under low milk intake conditions, water intake via bowl drinkers will help prevent dehydration and promote survival.

Bedding/paper

Having a good supply of shredded paper as a drying material in the pen is useful, but it should not be located directly behind the sow as it could hinder small piglets from getting up and locating the udder.

Flooring

It is difficult to meet the flooring requirements of the sow and her piglets in the farrowing crate. This is mostly because of the enormous disparity in size between sows and their piglets. For example efforts to maintain hygiene in the farrowing pen mean that slatted floors are required (at least behind the sow) but these pose risks for piglets tiny feet and limbs. Furthermore, sows may be too hot on plastic floors though these are generally less injurious to piglets. In a survey conducted by Amy Quinn, the majority of Irish farms use plastic slats in the piglet area (51%) and metal slats in the sow area (57%) as per recommendation. Moorepark research found that metal slats or slatted steel in the piglet area is associated with an increased risk of foot and limb lesions for piglets, so its use in this way is discouraged. However, metal slats used in the sow area of the crate still pose a risk to piglets particularly as their feet can become trapped between the slats injuring them and placing them at risk of crushing if trapped underneath the sow. Indeed, this is likely a significant contributor to crushing of older, generally strong piglets. Use of plastic-coated woven wire in the sow area may also encourage piglets to lie there as they perceive it as comfortable thereby placing them at risk of crushing.

The frequency of rolling by sows is affected by floor properties, and fast rolling is more risky for the piglets than slower rolling. Frequency of rolling from the side to the udder is reduced on concrete floors compared with plastic floors. Having some concrete under the sow, for instance from her mid-section forward, could thus reduce rolling. Another benefit of having concrete under the sow is that it is a smooth surface, so the piglets can’t get caught in any gaps increasing their chances of being able to get away.

3.3 Management factors

Management factors which can affect pre-weaning mortality include hygiene, preparation of the sow for farrowing, induction, fostering and processing.

Hygiene

It is essential to maintain the highest level of hygiene in the farrowing house due to the vulnerability of piglets to pathogens. It is best practice to operate farrowing rooms on an 'all in all out' basis, with all rooms being power washed, then disinfected and allowed to dry out before moving the next batch of sows in to farrow. Drying powder should be sprinkled in the farrowing pens prior to farrowing to facilitate quick drying of the piglets (this helps them to keep warm) and to ensure that the pens are not harbouring bacteria. Good hygiene practices in the farrowing room also includes reducing stepping into pens, use of disposable over-boots in the case of an outbreak, and biosecurity protocols for entering rooms (e.g. disinfection of boots, changing gloves etc.).

Preparation of the sow for farrowing

Late introduction to the farrowing crate can affect mortality rates. Sows that are introduced late to farrowing pens show more changes between standing and lying during nest building than sows introduced early, which is an indication of stress. This can be a particular problem for gilts. Research from Denmark found that gilts that were moved to crates immediately before farrowing had longer birth intervals and more stillborn piglets, than if they were moved in earlier. These results indicate that the adjustment to the crate could be difficult for them, as now that all animals are group housed while pregnant it is the first time being confined for many of them. Moving them earlier (about 10 days in that study) could ease their adaptation to the crate prior to the stressful experience of farrowing for the first time. Thus easing the transition into the crates should help reduce the stress level of the mother, and improve her ability to perform good mothering behaviour.

Induction

Induction refers to the management practice of injecting sows with hormones to stimulate farrowing. This is usually done for management reasons, so that sows farrow during the time when staff are available to monitor the sows and care for piglets. Sows should never be induced more than 1 day prior to their due date (calculated using the herd average for gestation duration), so for this reason it is very important that the breeding dates for each sow are recorded and available at the pen side. There is variation in pregnancy length; the majority of sows farrow between 113 – 115 days, but some are up to 117 days. Accurate records will allow you to get an idea of the herd average gestation length when sows farrow naturally on your farm, and help in deciding whether it is too early to induce. Inducing too early means that piglets are underdeveloped at birth, therefore reducing litter birth weights, increasing stillborns and the risk of scour. Piglets born early are not as well able to get up and suckle, so have reduced colostrum intake. If you are concerned about piglets getting too big inside the sow – don't be. Piglets grow very little during the last week before farrowing, and instead are getting ready to adapt to life outside the sow. This includes lung and other organ development, so there is actually a greater risk of problems by inducing too early, rather than letting the sow farrow later. Farrowing induction may also result in a higher prevalence of splay legs.

Farrowing supervision

Given the proportion of piglet deaths which occur around farrowing, supervision around this time can play a major role in reducing pre-weaning mortality. This involves handling sows that have a prolonged farrowing and identifying piglets that may be in need of additional attention. Struggling piglets can be helped to find the udder or placed in a safe and warm place until they are better able to move around and compete for a teat. Such piglets can also be provided with colostrum via a syringe. Split suckling can also be practiced so that piglets which have consumed colostrum are separated from the sow giving the later born piglets an opportunity to consume colostrum.

On the other hand too much disruption and/or loud noises can upset sows so that farrowing is delayed or piglets are put at an increased risk of being savaged. Hence the farrowing room should be an area of calm and peace, as much as possible. A noisy farrowing room may also mean that piglets miss the call of the sow to nursing. Moreover, sows may not respond to their own piglets distress calls if they are being crushed if the room is too noisy. Minimising the number of staff that enter the farrowing rooms, and carrying out as many management practises as possible on a single occasion can help to lower noise levels.

Pain relief

Farrowing is a painful process for sows and is exacerbated by larger litters. Research shows that administration of paracetamol to farrowing sows helps to mitigate such pain with potential advantages for piglet mortality. Administration of analgesics could be considered for sick or injured sows to relieve pain and thereby reduce the risk of savaging.

Processing

Once piglets are born the navel provides the first route for potential pathogens to enter the body. Hence navels should be sprayed with iodine as soon as possible. Most forms of piglet processing also create a route through which bacteria can enter the body and lead to arthritis or septicaemia etc. This is why there is a lower incidence of polyarthritis in pigs from herds that do not have their pigs' teeth clipped or tails docked. If tail docking is necessary it should always be carried out within the first 3 days, using a cauterising blade, again to ensure the smallest wound possible and should then be sprayed with a disinfectant. In line with pig welfare legislation, tail docking should not be conducted routinely unless efforts have been made to address problems with tail biting on the farm by other means (e.g. environmental enrichment). Grinding of teeth rather than clipping will reduce the risk of mouth infections. Different instruments should be used for the teeth and the tails at processing. Instruments should be disinfected between piglets. Signs of infection may include lameness, particularly between 10 and 18 days of age. Early treatment with antibiotics will reduce the duration of illness and mortality.

Fostering

Cross fostering (CF)

CF refers to moving piglets between sows to match the number of piglets to teats. It should strictly be carried out between litters that are 12 to 24h old. The rationale for this is that it gives piglets enough time to consume colostrum from their mother before being CF and because the teat order is not fully established they will find it easier to acquire a teat on their foster mother. The recommendations are that larger piglets should be moved as they are best able to cope with the stress of moving to a new litter and that after this, ideally piglets should not be moved again.

Unfortunately our experience working on commercial farms is that piglets are CF long after the recommended period (i.e. late CF) or worse still that the same piglets might be repeatedly cross-fostered (continuous CF) throughout lactation. In a recent study we found that nearly 30% of all piglets born alive were CF at some point pre-weaning. This is extremely worrying given that we found increased risks of pre-weaning mortality in all CF piglets. Of these 40% were CF on the first week of lactation while almost 60% were CF late (i.e. 2nd and 3rd weeks of lactation). Those CF in the 1st week of lactation were CF to reduce variation in litter size and involved normal birthweight piglets. Indeed 12.2% of piglets born alive were CF to equalise litter size in the Teagasc study. Late CF mainly involved low birthweight piglets. Interestingly such piglets were 5kg lighter at slaughter than similar birthweight piglets which were not CF.

The reason for these findings is that late and especially continuous CF is extremely stressful for piglets. It disturbs their behaviour, and involves continuous exposure to pathogens and fighting. As the teat order is well established in litters receiving late or continuously CF piglets, fostered piglets have to fight more to access a teat resulting in insufficient milk intake mostly due to irregular suckling. Additionally, adopted pigs engage in a higher number of fights unrelated to nursing and spend a lot of time wandering around the farrowing pen wasting energy. Ideally CF piglets should be tagged so they can be tracked in the farrowing house and ensure they are not CF again.

Nurse sows

Nurse sows are used to deal with large litters on farms where litter size consistently exceeds the number of teats. Surplus piglets are transferred from large litters (i.e. > 14 piglets) to a sow whose litter was just weaned. As there is no competition from the biological piglets of the nurse sow this strategy has benefits for the fostered piglets, and there is less risk of rejection from the nurse sow. There are two nurse sow strategies 1) "one-step" strategy: a single nurse sow rears a new litter after weaning her own piglets and thus, stays for up to 7 weeks in the farrowing crate (i.e. 3wks with her own piglets and 4 with the new litter) and 2) "cascade" strategy whereby one nurse sow weans her own litter and then receives younger piglets from another nurse sow who in turn receives younger again piglets, and so on until there is a sow free for surplus new born piglets.

When selecting new-born piglets to move to a nurse sow, the largest piglets should be selected. However another strategy is to move all small weak piglets to a single nurse sow, enabling the stockperson to keep a closer eye on them. This may also make it easier for them to compete, as they don't have larger litter mates to contend with. In this case a sow (normally a gilt) with a 'perfect' udder and easy to reach teats is ideal. This also means that these piglets can stay with the foster mother for a week longer if needed. Finally, using nurse sows appropriately so that there is only one piglet for each milk producing teat is essential – extra piglets should not be moved onto a sow, even if there is an extra teat, if that teat hasn't been used for a day or more.

Nutrition of the sow and piglets

There are several options on how to feed sows so that they produce and sustain piglets that are more viable and less likely to be crushed or succumb to a disease (e.g. no over feeding during gestation). But the most important is to maximise feed intake during lactation particularly by increasing feeding frequency. Ensuring a high water flow-rate (3 litre/min) is also very important as is ensuring the feed is of the best quality possible and rich in energy.

Pelleting and liquid feeding can help increase lactation feed intake. Recent work at Moorepark found that providing supplementary milk during the first 10 days after birth resulted in higher weaning weights but a cost benefit analysis is required before this can be recommended.

4. Take home messages

- Keep **and use** accurate records (NBA, NBD, no. weaned, causes of death)
- Provide nesting material to sows and drying material (paper) to piglets
- **Supervise farrowings** – both mother and all young are extremely vulnerable at this time
- Identify and **care for 'at risk' piglets** at birth (dry, supplement with colostrum, split suckle)
- Ensure piglets have continuous access to **fresh water from birth**
- Minimise cross fostering of piglets between litters outside of 12-24hrs of age and **then only do it once**
- Consider using nurse sows and supplementary milk sources
- Minimise processing of piglets and keep farrowing rooms quiet
- **Minimise inductions** and then only on full term sows
- **To minimise risk of suffering and death in low birthweight piglets (<1kg) leave them with their birth mother OR consider euthanising them at birth**

Redesigning my farm, what are my options?

Michael McKeon & Emer McCrum, Teagasc Moorepark & Ballyhaise

In the period 2010-2016 margins in Irish pig production were tight (43 c/kg Margin over Feed) which resulted in many pig units only undertaking essential capital expenditure (e.g. loose sow housing). However during this period the number of pigs produced per sow and average sale weights also increased considerably. The lack of capital investment allied to increased output has now resulted in reduced pig space leading to sub-optimal housing/stocking rates on some farms which is restricting the genetic performance potential of the pigs.

Thankfully profit margins over the last 12-18 months increased substantially (59c/kg MOF) so that pig producers can now examine future capital investment projects on their units. What are the investment priorities/ options for pig producers?

This paper examines the options available to a 600 sow unit that was originally built in the 1990's.

What do we have?

It is a 600 sow integrated pig unit originally built in 1997. The unit was designed to produce/sell 23 pigs per sow, at a sale weight of 100 kgs - at the time national average output was 21.5 pigs/sow/yr and 96kg liveweight. Current sale weight is 105 kgs, achieved by reducing space to sub-optimum stocking rates as a consequence of the greater number of pigs on the unit. Capital investment since 1997 involved minimal refurbishment (plastic slats, feeders etc.) with the exception of new loose dry sow housing (from 4 week post service to five days pre-farrowing) to comply with changes in legislation.

What is the target?

The ideal would be to purchase and develop a separate site/unit and move all finishers to this site. This would reduce disease pressure/recirculation of pathogens and therefore reduce antibiotic usage with better growth performance and feed conversion. Unfortunately, while the last 18 months were profitable, the unit may not be in a strong enough financial position to do this at the moment.

The next best option is to maximise efficiencies in the current unit thereby generating more profit potential and a stronger financial platform to enable future sow herd expansion. The first step in improving efficiencies for this unit is to have sufficient accommodation for the increased pigflow on the unit. How much space is required to give the optimum floor space to all pigs, sell 28 pigs/sow/year and achieve a sale weight of 117 kgs?

***Table 1**. Comparison of pigflow; 1997 versus 2017 – full data in Appendix*

Output		1997		2017
Litters farrowed /wk		27.1		27.5
Born alive /wk		301.8		384.5
Pigs weaned /wk		277.3		343.7
Pigs transferred /wk		271.2		334.5
Pigs sold/wk		265.4		326.6
Pigs sold/sow/yr		23.0		28.3

The comparison reveals a shortfall of 591 weaner places and either 797 finisher places (if using two stage finisher housing) or 1,831 places if using single stage finisher housing whereby all finishers are allowed 1m^2 (10.75 ft^2) each. The capital investment necessary (weaner+finisher) varies between €386,000 and €697,050 depending on whether using 1 or 2 stage finisher housing.

While sufficient accommodation is the priority for this unit there are further design/pigflow options that should be considered in each of the production stages. These are briefly described under the main pig unit housing areas.

Housing Design options

Gilt housing:

Should additional gilt housing be designed to provide a higher space allowance to reduce stress and improve limb health, thereby improve gilt longevity? In Ireland we have very high rates of culling young animals.

Dry Sow Housing:

Service stalls replacement

Some E.U. countries are now banning the confinement of sows in stalls from **one** week after service. Should this unit could consider building extra dry sow accommodation to allow all dry sows to be loose housed from service to farrowing? This would require an additional three weeks loose sow accommodation, which equates to 98 places (at 95% occupancy) at an estimated cost of €78,400 -€800/place for a new build.

Gilt Gestation Diet

Should the unit consider a separate diet with higher mineral and vitamin levels can be fed to pregnant gilts throughout their pregnancy? Teagasc research suggests that a separate gestation gilt diet gives the young animal higher retention rates, stronger bones and therefore a longer longevity within the herd. A separate gilt gestation diet could require changes in current feed lines/additional bins.

Farrowing House:

Genetic advancements in pig breeding have seen an increase in the number of pigs produced per sow year on year, primarily through increasing born alive. These larger litters are increasing pressure on the farrowing facilities which were initially designed to cater for smaller numbers born. When the total number of live piglets exceeds the number of functional teats (usually more than 14 piglets) some form of management intervention is required. Interventions such as the use of artificial rearing systems or nurse sows become necessary when large litter sizes are being consistently produced.

Rescue Decks

Rescue decks are slatted, heated and lit enclosures designed to sit above the farrowing crates, or in a separate room, and house either surplus or low viability piglets. Pigs are housed in groups of up to 12 and are initially fed artificial milk with water and when older, creep feed. Manufacturers recommend one deck for every 10 to 20 farrowing crates, depending on the born alive. The financial considerations of rescue decks are the initial investment of €500-€600 per box plus the running costs associated with rearing piglets on milk replacer (€1,500-€2,000 / tonne) and the additional labour requirement. It is important to note that rescue decks are not a substitute for poor nutritional management of lactating sows. Before considering rescue decks, lactation diets should be examined and intakes optimised in order to maximise the sows milking ability.

Nurse Sows

Another solution to cope with the challenges of large litters and to take the strain off the dam is to use a nurse sow. There are two main strategies which can be used: a one step and a cascade system. Firstly, it is important to note that is it essential piglets have received colostrum from the dam before they are moved to a nurse sow. Secondly, as nurse sows remain at peak lactation for longer than normal, there is a risk that the sow may have poorer body condition which could have a negative impact on her subsequent service.

One step management involves weaning piglets which are at least 21 days old from a chosen nurse sow and then fostering on surplus piglets from freshly farrowed when the piglets are at least 24 hours old. The nurse sow will then rear this second litter until weaning and the sow will return to the dry sow house for service.

The cascade system involves the use of two lactating sows. Firstly, a sow at +21 days is weaned (Nurse 1). Next, another second step nurse sow (Nurse 2) whose piglets are 4 to 7 days old is selected. These 4 to 7 day old piglets are fostered onto Nurse 1 and Nurse 2 is then given any surplus, newly farrowed piglets.

The nurse sow system is an effective management tool which can be employed on a unit with relative ease. The biggest consideration to take into account is the additional space that nurse sows and their piglets will require. There are two options: we can house nurse sows in the main farrowing room or design a separate building which will house solely nurse sows. If we take for example a room with 18 farrowing places per week, an allowance needs to be made for an extra 2 farrowing places in that room to accommodate the nurse sows i.e. the room needs to hold 20 farrowing places and all will be weaned at the same time. If we decide that a separate room would suit the system better, a small farrowing house could accommodate 8 farrowing places. This house could be split into 4 separate rooms with two farrowing places/room thus giving two nurse sows per week. Splitting the house will prevent piglets of different ages coming into contact or sharing an air space. The extra farrowing places can also be used to accommodate a cull sow and small pigs on the point of weaning who may benefit from an extra week suckling.

Balanced floor/Rising Crates

The balanced floor is a flooring system for farrowing pens that reduces the risk of piglets being overlaid by the sow, particularly during the first few days after birth when the pigs are most vulnerable. The capital investment is approximately €1,400 per crate plus €300 labour for assembly costs. The crates also require a minimum clearance of 0.3M (1ft) above the slurry level which is an important consideration if retro-fitting into shallow tanks. As the biggest risk period for overlays is in the first 7 to 10 days of the piglet’s life, there is no real benefit to fitting balanced crates throughout the farrowing room. Instead, having two weeks accommodation with rising floors then moving the sow and litter onto conventional crates is a more economical option. However the additional labour this involved should be considered. There is also a risk that future E.U. legislation may require lactating sows to be loose for a period of days/weeks. In this scenario a minimum farrowing pen size would be required therefore it is difficult to know what balanced floor area would be needed.

Free farrowing crates

So far Norway, Sweden and Switzerland have banned farrowing crates and the use of conventional crates is emerging as the next major item on the pig welfare agenda. Should the unit preempt a potential ban on farrowing crates and explore alternatives? Research in this area is ongoing and there are many different types of free farrowing crates on the market but two important points to note; a) mortality may not always be higher with free farrowing systems, b) certain free farrowing crates have been designed which retain the dimensions of the conventional pen but with an adjustable crate. Capital investment is in the region of €4,000 per sow place and if considering free farrowing, there may have to be a shift in breeding and selection for sows with good mothering ability that suit free farrowing systems.

Weaner Houses

The higher output per sow and resultant lower birth/weaning weights places an extra burden on stockmanship when the piglets are weaned. The housing and feed system therefore needs to be optimum to ensure the growth lag after weaning is minimized.

Acidification system for water:

The weaning period provides a window of opportunity for digestive diseases/bacterial infections e.g. E. coli, salmonella etc. The acidification of the piglets stomach (PH 4-4.5) prevents a barrier against these infections and therefore improves nutrient digestibility and performance. Acidification can be undertaken either through the water or through the feed. Successful acidification of feed is difficult to successfully achieve with young pigs and therefore it may be easier to through the water system – doesn't affect feed intakes.

Milk replacer bowls:

Piglets are used to drinking sows milk in the farrowing house but when they are weaned this milk source obviously disappears. While starter/creeps contain have a high percentage of milk powder they are presented in a dry form. The milk bowls are provided in each pen to encourage the piglets to consume higher levels of the milk product then when presented in a dry pellet. The benefit is that getting fluids into the piglet immediately after weaning reduces dehydration, villi degradation and the lactic acid reduces intestinal infection. The risk with this system are, like rescue decks, that it needs to be kept meticulously clean and that the financial cost of providing liquid milk to piglets can become very expensive unless very tightly managed. Milk replacer bowls can also be used in the farrowing room but the running costs can be very high.

Heat Canopy

A heated/unheated canopy allows a small area under the canopy to be kept at a higher temperature (30^{o}C) and the remainder of the room be operated at a much lower temperature (e.g. 24C) thereby reducing the cost of heating a large airspace. They are a relatively inexpensive system and if properly operated can generate considerable savings over the lifetime of the building (~ 45% lower heating costs). While canopy's are commonly used in Irish weaner houses, in many cases they are not operated correctly as; a) the whole room continues to be run at a high temperature, b) the canopy is too small for the number of pigs in the pen or c) the canopy is incorrectly positioned/sealed and losses too much heat to the room and therefore can't maintain the higher temperature.

Housing deck/balcony

A housing deck provides a balcony structure within the pen and a ramp that allows pigs to easily access the higher area. All of the pig manure produced on the balcony is collected underneath and directed into the tank below the room. This system increases the effective floor area for pigs and effectively allows a lying/resting area with in the pen. As it is built within the existing house it is a cost-effective way to gain extra space allowance per pig. However in most cases, as the system is retro-fitted into an existing house, the ventilation system may not be designed for an increase in the number of pigs within the house. The balcony can cause issues with air movement within the house (dead air pockets), and a higher number of pigs can affect the rate of air turnover/temperature control, the level of respiratory disease and therefore the balconies should be used to increase space allowance per pig rather than the number of pigs per room.

Finisher Houses

The house design and feed supply is important in the finisher section as 50-60% of all feed usage and manure production occurs in this section.

Trowbridge housing

Trowbridge houses have been used on Irish pig units for the past 50 years. However the older versions performed poorly as they were only partially slatted, very narrow and low, with little head space at the rear. This design often generated conditions that were too cold in the winter and too hot in the summer and they became unpopular among producers. Producers should reconsider using this design for new finisher housing. The updated design for trowbridges are fully slatted (ideally sow slats for greater comfort), with a large bright airy space through greater roof height. The advent of more compact feeders (wet-dry feeders or probe feeding) has resulted in more clearly defined lying and activity areas for the pigs which results in less pig stress/aggression. Automated flap temperature control allied to 'drop-out' vents in the rear wall, ensure that the house temperature is now accurately controlled. As each pen has its own separate air space the circulation of pathogens causing respiratory disease might be reduced. These houses are very cost efficient having low running costs (no fans) and requiring less initial capital investment making them attractive from a financial perspective.

Manure volume

The recent cessation of the 'nitrates allowance' for pig phosphorus usage will result in a proportion of pig manure being transported further for landspread. The more pig manure that is produced the further it has to be transported. The biggest effect on manure production is the fattener feeding system and any new build needs to seriously consider the manure volume that the feed system will produce. The common wet-dry feeder has an estimated water:feed usage 2.2:1 while many finisher wet-feed systems could have a ratio in excess of 3:1. This is a difference of **1,800 M^3** (**400,000 gls**) per year for a 600 sow unit. A unit with an existing wet feed system is unlikely to change to a dry feed system but they should investigate how low can the water:feed ratio be reduced. For very long lines it may require rerouting some of the system to a satellite tank or evaluating the use of a larger pump – assess the pipe line strength as well.

Environmental Enrichment

Tail biting is a health, welfare and production issues in pig farming. Docking of pigs' tails is used as a control mechanism although routine docking is prohibited in the EU. Research has shown that manipulable environmental enrichment may reduce the amount and severity of tail biting, and is a legal requirement. In March 2016, the European Commission issued a recommendation that enrichment materials should be edible, chewable, investigable and manipulable. In slatted systems, materials such as wood, ropes and compressed straw conform to these characteristics whereas objects such as floor toys, hanging toys and chains do not meet the requirements. According to Teagasc research, wood was the most commonly used manipulable material on Irish farms with a hardwood such as beech provided to pens throughout the farm costing €202 per year for a 500 sow unit. Compressed straw in wall mounted holders was found to be unfeasible due to high usage rates and expense - an estimated running cost of €20,000 per year per 500 sow unit.

Reduction in sow numbers

Another option is to look at the possibility of reducing sow numbers to match the grower-finisher space available on the unit. As the born alive has increased since the unit was built, we no longer need the same number of sows to produce the optimum volume of pigs through the system. The first step is to identify the farm's production potential relative to its capacity. This involves identifying the capacity of the grower accommodation and working back to the source of pig flow and setting production targets to meet the space available. By reducing the sow herd the weekly pigflow produced matches the accommodation available, which has a positive impact on stocking rate, feeder space and weaning to sale performance. Even though there are fewer pigs on the unit, there is now no overstocking, the pigs will grow more efficiently and have a higher weight at sale (closer to the target of 117kg). In this scenario, we won't require any investment in more space as the unit is at the optimum stocking rate from fewer sows. However this option needs to be carefully analyzed as although the pigmeat output **per sow** will be higher, the overall pigmeat output **for the pigunit** may be lower so cost efficiencies may be negatively affected.

Energy efficiency

On most units, the biggest consumers of energy are heating, lighting, ventilation and feed delivery. According to the 2016 Teagasc National Herd Report, the average cost for heat, power and light came in at 4.2 c/kg. However, energy bills are not fixed costs on farms. Measuring, recording and benchmarking energy use across the farm is the first step to improving energy efficiency and protecting the business from unnecessary expense.

Air to heat pumps:

Air to heat pumps can be used as an efficient method of heating the heat pads in farrowing rooms. The pumps work by extracting the heat from ambient air and using it to heat water to temperatures of 55°C via heat exchange systems. The pumps can also be used to heat houses, but the capital cost of a system to meet the requirements can be very high and therefore some designs incorporate a 'top up' heater for those occasions when maximum heating is required .The process requires energy to drive it (typically to run the compressor) but for each unit of energy required to drive the process, more units of energy are captured and delivered. The initial capital investment can be high, but there is an SEAI grant available which when availed of can reduce the payback to three years.

Lighting:

Good lighting should be a priority on any unit and there are a range of options available, each of which differs in longevity and energy usage. LED's have emerged on top in terms of their efficiency and while the capital cost is higher than alternative options, the lights have energy savings of 80-90% and last far longer than conventional lighting. Light switches should be clearly labelled so employees can select the correct lights required.

Insulation:

The provision of heat in pig buildings is very wasteful if there is a poor level of insulation in the building. Insulation in older buildings should be checked to ensure there is no compression, slipping or rodent damage to the material –can use infra-red cameras. For new insulation, composite panels containing polyurethane insulation can be used. There panels can be bought with plastic coated steel cladding for durability and cleanliness. Alternatively mass concrete/block walls can be constructed and lined with plastic pumped panels. Improving the insulation in pig houses could greatly improve feed production costs by reducing the feed conversion efficiencies. Check all insulation for its fire rating standard before making a final decision

Solar panels:

Solar Photovoltaic (PV) works on the principle that energy from the sun, in the form of solar radiation, is converted to electricity. The angle and orientation of the solar PV panels is very important and generally an installation requires a large southerly facing roof. Trees, chimneys and other buildings should be avoided to minimise any shading effect. The installation of panels on agricultural structures is considered exempt from planning and medium sized construction on a farm roof top would require 350-400m² of roof space which could generate 41,500 kWh of electricity. Once the panels are in place, the maintenance and operating costs are small, with the panels requiring cleaning roughly every 10 years. Panel output should be expected to fall at a rate of 1% per year and the financial return is mainly tied up with the amount of energy generated, three quarters of which will be generated from April to September.

Conclusion

Our 1990’s unit was built and designed around different performance parameters than we are dealing with today. This paper also covered a number of different options in the areas of accommodation, energy efficiency and general management of the unit that should be considered when reinvesting in the future.

As previously stated, sufficient space for each pig is the priority to ensure optimum performance, health and welfare. When considering the options discussed in this paper, it is vital to remember the importance of space allowances per pig and also our overall end goal- to reduce the cost per kg of pigmeat and increase your output of pigmeat per sow.

Appendix

Original

Sows	600		**Output/Litter**		
weaner	in	7	BA		11.13
	out	36.3	PW Mort %	8.1	10.23
	Gain	29.3	Wean Mort %	2.2	10.00
	ADG	450	Fin Mort%	2.15	9.79
	days	65.1	Num weaner places		2580
	weeks	9.3	Weaner Places / sow		4.30
Finisher	in	36.3			
	out	100			
	Gain	63.7			
	ADG	722			
	days	88.2	Num Finisher places		3419
	weeks	12.60	Finisher Places / sow		5.70
Space Req.@7.5ft		25641			

Weekly Output

Litters farr	BA	Weaned	Transferred	Sold	sold/s/yr
27.1	301.8	277.3	271.2	265.4	23.0

New Unit

Sows	600		**Output/Litter**		
weaner	in	7	BA		14
	out	38	PW Mort %	10.6	12.52
	Gain	31	Wean Mort %	2.68	12.18
	ADG	480	Fin Mort%	2.36	11.89
	days	64.6	Number Weaner Places		3171
	weeks	9.2	Weaner Places / sow		5.29
Finisher	in	38			
	out	117.4			
	Gain	79.4			
	ADG	900	Num old Finisher Places		2385
	days	88.2	Num Finisher places		4216
	weeks	12.6			
Space req @10.75		45319	Finisher Places / sow		7.03

Weekly Output

Litts farrowed	BA	Weaned	Transferred	Sold	sold/s/yr
27.5	384.5	343.7	334.5	326.6	28.3

Extra Space req.	Weaner	**591**	
	Finisher	***797***	If using 2 stage finisher system
		1831	If using 1 stage system at 10.75 ft2

Is your pig business adequately insured?

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Insurance Cover

Adequate insurance cover is very important to protect your business if an accident or tragedy occurs on the farm. Insurance policies are often scrutinised after an unfortunate event occurred to see if there is adequate cover, rather than making sure in advance that the cover is sufficient. It is important to understand what your insurance policy covers at the time you take it out.

The purpose of this paper is to offer some guidelines to allow you check whether your insurance cover is adequate or not.

How often do you check your insurance cover?

Areas of Insurance Cover for Pig Farms

There are three main areas that should be covered when you insure your pig farm: 1. Building cover,

2. Stock cover,
3. Loss of profits or Consequential loss.

Along with these you should have cover for public liability and employer's liability, personal accident and also wages/salary cover. Each area should be discussed with your insurance company each year as you renew your policy to ensure that your cover is suitable for your business.

If there is a mill on the farm this should also be adequately insured.

Insuring Farm Buildings

Remember that when you insure a farm building you are really insuring the replacement of the farm building should it be damaged or destroyed. Therefore your cover should be for the replacement of a new building rather than the estimated value of the existing building. Say if you have a pig finisher house with 1000 places and it was built ten years ago. You value it at a current value of €100,000 today. The current cost of a new finisher house is €300 (excluding VAT) per finisher place – so the replacement cost of the building is 1000 by €300 – so the building should be insured for a value of €300,000. This valuation should be done for all your buildings on the pig farm.

If you only insure the building for its current value you may only get 33% of the cost of replacing it (i.e. €100,000/€300,000 multiplied by 100). This will not replace the building if the building was destroyed.

You must be clear as to the perils that you require insurance for, e.g. fire, storm damage, lightning, explosion, suffocation etc.

The insurance company may refuse to insure certain buildings (if they feel they are very old and have never been upgraded). In this case the farmer should try over a period of time to put a reserve of money aside to upgrade and refurbish such houses.

Insuring Stock Values

When insuring the stock on a pig farm their value must be estimated. This will vary depending on the pig sale value and the feed cost on your farm. There is also the replacement cost for your breeding herd which is a lot higher than the value obtained for culled sows from the herd and this is often under-estimated.

Gilt Value

Gilts (F1s) from breeding companies usually command a premium of €100 to €120 (depending on numbers, transport distance and weights etc.) above the slaughter pig price. If you purchase a 115 kg F1 gilt when pig prices are 165 c/kg deadweight (DW) the gilt will cost 115 by 76% (assumed kill-out) by €1.65, plus a premium of €110 giving a total cost of

€254 (87.4 by €1.65, plus €110.00). This gilt value does not include the cost of pure-bred females if you were re-establishing a new breeding herd.

Sow Value

What is the replacement value of a sow? The 115kg gilt has to be reared to 140-150 kg liveweight (LW) before being mated and then will have to be fed for 115 days until she farrows i.e. achieve the value of a sow in an operational pig herd. The feed cost for the gilt up to the time of farrowing will be €110/head increasing the cost to €364. An allowance should also be made for a drop-out rate of 15 to 20% of gilts that do not make it. Based on a fall-out of 20% the cost is now €437 per gilt. If an allowance is made to cover the labour and housing cost per gilt it is easy to see that each sow is worth a minimum of €500 if she is to be replaced as a breeding animal in a herd. This has not allowed for the extra cost of pure-bred stock which will add more to the replacement sow value.

The value of piglets, weaners and finishers will vary with the pig sale price, feed performance and feed costs (€/tonne). Assuming a sale weight of 110kg LW and a 76% kill-out allows a valuation for these pigs as shown in the table below. This values the pigs at a sale value minus the feed cost with an allowance for the other variable costs associated with bringing the pig up to sale weight.

Table 1. *Value of a Piglet, Weaner and Finisher based on three sale prices:*

	Sale Price in c/kg DW		
c/kg DW	**165**	**155**	**145**
Piglet value	€40	€32	€25
Weaner value	€62	€54	€46
Finisher value	€103	€95	€86

Assumes a finisher FCE of 2.7 and a weaner FCE of 1.8. Transfer to finisher at 35kg LW. Creep/starter diet @ €880/t, Link @ €600/t, Weaner €340/t, Finisher €265/t, Dry sow €250/t, Lac sow €290/t.

The decision then is what value you should assume for the stock. The average sale price for pigs from 2012 to 2016 was 161 c/kg DW. The average price in 2017 (January to August) was 165 c/kg DW.

For insurance cover of stock you need to decide what perils are you to insure against. Cover should also be sought to cover the value of pigs being transported from the farm (pigs in transit). This should be discussed with your insurance company.

Loss of Profits or Consequential Loss

The cost of profit loss or consequential loss is usually defined as the gross profit that is lost as a consequence of some tragic event that may be insured. Read your policy or ask your insurance company for an explanation of how the cover is defined and what that means. As pig prices and feed prices fluctuate the gross profit will also change from year to year. The gross profit is something your accountant can tell you very quickly and a three year average is a reasonable figure to use. The next decision is what length of cover you may require. If you have a fire on your farm and need to depopulate the herd, the time that you are out of production could well be a year, but if you run into planning issues or other problems this could even be longer. **It is important to know when the consequential loss is triggered.** It is usually the date of the incident. The period of cover needs to be considered – a year may suffice but if there is a fire it could take longer than a year to be fully operational again.

Public Liability Cover

Farmers can be legally liable for claims from the public due to injury, disease or damage to property. Public liability insurance indemnifies the insured up to a certain value to cover claims plus legal costs and expenses. Pig farmers must ensure that they are not negligent and must take all reasonable precautions to prevent accidents on their premises.

Employers Liability Cover

This insurance covers the insured in respect of his or her liability at law for damages in the event of bodily injury or disease to any person under a contract of service, or apprenticeship with the insured, where the injury or disease arises out of or as a result of the business of farming. Cover may be extended to include members of the pig producers family.

Conclusion:

Good farm insurance can take a lot of pressure off if an unfortunate event occurs on your farm. Unfortunately a lot of people say that "it will never happen to their farm" and perhaps do not give this the time and attention that it deserves.

It could happen to you, and you need good farm insurance cover if your business is to survive.

EXAMPLE:

1000 sow Integrated pig Farm with average herd performance. This example is for illustrative purposes only. Talk to your own insurance company for your specific farm cover.

Table 2. *Building Costs for an average 1000 sow integrated unit*

Type of accommodation	No. of Places	Cost €/place	Total Cost €
Farrowing	228	3200	729,600
Dry Sow	822	850	698,700
Gilt	120	450	54,000
Boar	4	500	2,000
Weaner	5100	250	1,275,000
Finisher	6350	300	1,905,000
		TOTAL	**4,664,300**

This valuation does not include office, canteen, and shower and storage areas etc.

Table 3 *Stock Value and numbers*

Category of pig	Number	Cost €/head	Total Value €
Sows	1000	500	500,000
Gilts	120	400	48,000
Boars	4	500	2,000
***Piglets**	2300	32.28	74,244
***Weaners**	4850	54.28	263,258
***Finishers**	6050	94.55	572,028
		TOTAL	**1,459,530**

*Value is based on a sale price of €1.55/kg DW.

Consequential Loss (Business Interruption):

The gross profit is the price paid minus the feed and other variable costs (such as heat, power and light, veterinary costs and other variable costs). Consequential Loss is the gross profit that would not be produced if the business was interrupted for some reason. It is the profit needed to cover the fixed costs on the farm. Your accountant will quickly give you the gross profit for the previous three years if you request it. The gross profit per sow could range from €600 to €900 depending on the output per sow – you should take a three year average to see what gross profit is applicable to your farm. Remember that 12 months cover may not be adequate. In the example below an annual net profit of €800,000 was used but the farm sought 24 months cover for business interruption.

Table 4. *Example of insurance cover and premium cost for a 1000 sow integrated unit using the figures above:*

1000 Sow Unit-Insurance Cover	**Estimated Sum Insured**
Buildings (Basic property perils including storm)	€4,664,300
Stock (Basic perils including storm)	€1,459,530
Stock debris removal @ 10% of stock sum insured	€145,000
Fire Brigade Charges	€50,000
Business Interruption – 24 months	€1,600,000
Employers Liability – estimated 8 employees	€200,000
Public Liability and Product Liability	For a 1000 Sow Unit
Estimated premium band excluding Government Levy*	**€25,300 to €31,850**

*The current government levy is 5%.
Cover for stock suffocation based on a first loss basis would cost approx. €2000 extra.
To allow cover for goods in transit of €50,000 would add approx. €170 to the premium.

The reason there is a "band" in the above example is that there are "rating factors" to assess the risk in each specific case. The building construction, the property age, the maintenance and repair (and records of same) will be important considerations from the insurance companies' perspective. The clients' history will also be considered. The risk assessment that the insurance company carries out is ever evolving and the factors cited above will include many other factors. This is why it is important to engage with an insurance company to understand their risk survey and work to reducing the risk on your farm as much as possible.

Zinc oxide ban must lead to improved post-weaning management

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1. Introduction

Up to now, the licence in most of the EU allowed the use of zinc oxide (ZnO) as a medicinal product at 3.1 kg/t feed to provide 2500 ppm Zn (pharmacological level/medicinal level) for 14 days to treat post-weaning diarrhoea. Beyond this 14 day period, the maximum Zn level allowable in pig feed is 150 ppm Zn. On June 19th 2017 the Standing Committee on Veterinary Products supported an earlier European Medicines Agency decision from December 2016 to withdraw all marketing authorisations for ZnO containing veterinary medicines. Their reason being that the benefits of ZnO for preventing diarrhoea in pigs did not outweigh the risks posed to the environment. The EU will ban the use of ZnO after a 5 year transition period. Many of us fought this ban, as ZnO is very effective in treating post-weaning diarrhoea. However, the decision has now been made and we must look on this ban as a new opportunity. It could be said that the use of medicinal levels of ZnO, though effective, was simply a 'band-aid' for suboptimal post-weaning management. There will be no one off the shelf replacement for ZnO, rather our approach must be multi-faceted. Our focus needs to be on improving post-weaning management of pigs so that pig health is improved. In many cases this will simply mean that we must strictly adhere to good management practices where this is not currently the case but there may also be a place for certain alternative feed additives.

2. Improved hygiene and biosecurity

2.1. Improved hygiene

Pigs should only be moved into pens that have been thoroughly washed, disinfected and allowed to dry. The sanitation regime is extremely important as different disinfectants and routines can yield very different results. Walia et al. (2017) evaluated different cleaning/disinfection steps to determine the most effective sanitation protocol. Washing followed by disinfection with a chlorocresol product, followed by a period of time when the facility was allowed to dry out thoroughly resulted in the most effective elimination of Salmonella and Entrobacteraceae (indicator of hygiene standard; Table 1).

Table 1. *The effect of different cleaning and disinfection protocols on Enterobacteriaceae counts and on the probability of detecting Salmonella in pens in a commercial pig abattoir (Walia et al., 2017)*

Cleaning and disinfection protocols	Mean *Enterobacteriaceae* count ($\log_{10}$ CFU/cm^2)	Probability of detecting Salmonella (%)
Before Power Wash	5.29	Not applicable
After Power Wash	4.12	87.9
After Quaternary Ammonium Compound (QAC) Disinfectant	3.26	34.0
After Chorocresol Disinfectant	< Limit of Detection	14.2
After Detergent	2.30	45.8
After Detergent + QAC Disinfectant	3.53	17.1
After Detergent + Chlorocresol Disinfectant	< Limit of Detection	2.2
After QAC + Drying	1.23	3.8
After Chlorocresol + Drying	< Limit of Detection	1.2

2.2. Biosecurity

External biosecurity is essential to keep all unwanted diseases out of the unit. Even if good procedures are in place on a unit in this regard, it is often the case that internal biosecurity is poor on many Irish units. Many units think that they are operating all-in /all-out when in fact they are not. This system means:

- Keeping animals of the same age together in groups.
- Animals from different groups are not mixed.
- When a group moves forward, the room is completely emptied, washed, disinfected and allowed dry before introducing new pigs.

The health status of pigs will be improved over time if strict all-in /all-out is implemented on farms for each stage of production.

3. Reduced crude protein diets

Low protein diets improve piglet health, post-weaning, by reducing the incidence of diarrhoea (Wellock et al., 2008; Heo et al., 2009). Reducing crude protein (CP) in the diet prevents an excess of undigested protein reaching the large intestine, where it contributes to the growth of pathogenic bacteria, such as *E. Coli* and the production of harmful compounds which negatively affect gut permeability.

The requirements of weaned pigs for amino acids are high for growth but also to counteract health challenges, therefore low CP diets must be supplemented with synthetic amino acids. Bellego and Noblet (2002) showed that reducing CP in post-weaning diets from 20.4 to 16.9% with adequate synthetic amino acid supplementation was an effective approach to limit diarrhoea in pigs weaned at 28 days, without affecting weight gain and protein deposition.

In Ireland Pierce et al. (2006) found that pigs fed 18.5% CP diet from day 12 to 40 post-weaning (weaning age 21days) had similar growth to pigs fed a 21% CP diet. Each diet was supplemented with synthetic amino acids, however, reduced growth was found when the CP content of the diet was reduced to 16%. As the diets were not supplemented with amino acids beyond lysine, methionine, threonine and tryptophan a deficiency in some essential amino acid(s) or non-essential nitrogen may have caused the poorer growth of the pigs fed the 16% CP diet.

4.Wean heavier (healthier) pigs

4.1. Weaning age

Typically in Ireland pigs are weaned at ~26 days of age. Earlier weaning could increase sow productivity due to increased litters per sow per year. However, this can lead to greater health/mortality problems, and feed costs will increase as pigs are introduced to more expensive diets earlier. In Moorepark, Leliveld et al. (2013) investigated the effect of weaning age (3, 4 and 5 weeks) on the growth performance of pigs up to 10 weeks of age. With each one week increase in weaning age, feed intake and growth rate increased and feed conversion improved in the first 2 weeks after weaning. When growth performance was measured to the same chronological age (10 weeks of age) feed intake and growth rate increased with each week increment in weaning age. Five week weaned pigs also had improved feed conversion efficiency compared to those weaned at 3 or 4 weeks. Previously it was shown that each 1 day increase in weaning age contributes ~500 g of an increase in weight at 28 days post-weaning (Lawlor et al., 2003). Older pigs adapt more rapidly to solid diets as their gastrointestinal tract is more developed.

Mortality between weaning and 10 weeks of age, and faecal *E. coli* counts at 10 days post-weaning were higher in 3 week weaned pigs compared to those weaned at 4 weeks (Leliveld et al., 2013; Table 2). Additionally, more undigested feed is found in the gut of early weaned pigs compared to those weaned later leading to the growth of pathogenic bacteria in the intestine and diarrhoea.

Table 2. *Effect of weaning age on growth performance (Leliveld et al., 2013)*

	Weaning age (wks)			
	3	**4**	**5**	**s.e.**[1]
Mortality (%)	14[a]	1[b]	4[ab]	
Weight at weaning (kg)	6.5[a]	7.8[b]	10.0[c]	**0.34**
Weight 2 weeks post-weaning (kg)	9.5[a]	11.6[b]	15.5[c]	**0.41**
Weight at 10 weeks of age (kg)	24.4	24.7	26.7	**1.01**
Average Daily Gain (g)[2]	363[a]	402[b]	476[c]	**17.6**
Average Daily Feed Intake (g)[2]	560[a]	621[b]	680[c]	**26.1**
Feed Conversion Ratio[2]	**1.57**[a]	**1.55**[a]	**1.43**[b]	**0.045**

[1]s.e. = standard error. [a-c] Means within a row with different superscripts differ significantly. [2]Performance data given for the period from weaning to 10 weeks of age

4.2. Weaning weight

High feed intake and growth rate in the period immediately following weaning is essential if growth rates from weaning to sale are to be maximised. The key to achieving this is to wean heavier pigs. However, a heavy pig at weaning can originate because it was inherently heavier at birth or because, it received preferential management and nutrition during the suckling period. Increasing nutrition and management by creep feeding, offering milk replacer to suckling pigs and reducing litter size were effective in increasing weaning weight by 0.5 kg per pig. However, boosting weaning weight in this manner did not influence post-weaning performance and the weight advantage created at weaning disappeared by 14 days post-weaning (Lawlor et al., 2002).

Conversely, pigs that were heavier at weaning because they were heavier at birth had higher intake and daily gain in the first 4 weeks post-weaning and their weight advantage had increased by 60 % at 26 days post-weaning. The differential in weight between heavy and light pigs at weaning (1.3 kg) could be traced back to a 170 g difference in birth weight between the two groups. Similar results are reported extensively and the benefit from a heavy weaning weight is evident up to slaughter weight. This highlights the importance of achieving heavy birth weights. Pre-weaning management, although important cannot correct for low birth weights. The importance of birth weight in this regard is most likely because lighter pigs at birth have fewer muscle fibres which results in lower lean gain deposition rates and poorer FCE (Dwyer, et al., 1993). It is also important to note that, unless a high nutrient density diet is fed post-weaning, the benefits that arise from having a heavy pig at birth and at weaning are lost (Lawlor et al., 2002).

5 Vaccination Programme

Increased use of an improved vaccination programme for sows and piglets should be used to increase the immunity of pigs around weaning. Sows are vaccinated to provide immunity to piglets via colostrum/milk.

Below is an example vaccination plan for a Pig Unit:

- *Erysipelothrix rhusiopathiae* + Parvovirus
    - Gilts at selection and after 4 weeks
    - Gilts and sows on entry to farrowing house (bi-annual)
- Escherichia coli + Clostridium perfringens
    - Gilts: 6 and 3 weeks pre-farrowing
    - Sows: 3 weeks pre-farrowing
- Porcine circovirus type 2 + *Mycoplasma hyopneumoniae*:
    - Pigs at 3 weeks of age
- Oedema disease: shigatoxin
    - Pigs at 4 days of age. Immunity from d 21 after vaccination

6 Promoting increased and earlier water and feed intake after weaning

Weaning is one of the most stressful events in the pig's life. This abrupt change in environment and diet results in fear and anxiety which reduces the pig's motivation to eat. Many weaned pigs do not have contact with solid feed during the first hours (sometimes even days), which negatively affects intestinal integrity and nutrient absorption, promoting proliferation of pathogens and diarrhoea. Thus, promoting increased feed intake early post-weaning is important. Increasing intake and growth during the first week post-weaning results in increased pig weight at day 56 post-weaning and particularly so for light weaned pigs (Tokach et al., 1992).

Creep feed offered during lactation may help piglets to develop feeding behaviour and also develop their gastrointestinal tract structure and enzymatic activity. Consumption of creep feed during the suckling period is frequently low, but piglets that eat creep feed have shown greater post-weaning daily feed intake than non-eaters, which results in increased post-weaning growth rates (Sulabo et al., 2010). In addition, offering milk replacer, liquid feed (in a dish) and palatable starter diets with a high lactose content (Lawlor, 2013) as well as using a sufficient number of suitable feeders that provide easy access to fresh feed are likely to encourage feed intake.

It is vitally important to encourage piglets to maintain fluid intake post-weaning. It can take more than a week after weaning for the pig to restore its daily fluid intake to the equivalent of that on the day prior to weaning. According to Fowler and Gill (1989) a suckling pig has equivalent water consumption prior to weaning of ~680ml; however, water intake is only ~290ml in the first day post-weaning and averages ~442ml in the first week after weaning. It is only in the second week post-weaning that water intake averages ~770ml/pig. Encouraging water intake will promote feed intake. Appropriate sizing, number, positioning and hygiene of water drinkers is essential to ensure adequate hydration and feed intake. Equally important is ensuring the chemical and microbiological quality of the water supply used.

7 Use of feed additives

Feed additives are non-nutritive products used in pig diets to improve animal health, production efficiency and performance. Organic acids, prebiotics, probiotics, plant extracts as well as others, can be good alternatives to antibiotics and zinc oxide. Not all feed additives behave or provide the same beneficial response and choosing a product wil depend on the farm’s specific circumstances.

7.1. Acids

Early weaned pigs produce insufficient levels of gastric acid which can result in a high stomach pH. As a result, the digestion of nutrients, especially protein is reduced. Moreover, high pH is favourable for the proliferation of diarrhoea-causing micro-organisms in the weaned pig. The use of organic acids has been suggested as a means of lowering gastric pH in weaned pigs and has been reported to improve growth performance. The benefits that arise from feeding organic acids include an inhibitory effect on pathogenic bacteria, increased amino acid and energy digestibility and an increase in nitrogen retention. The response to organic acids was previously found to be greatest in diets with low levels of dairy products. Dairy products contain lactose which can be fermented to lactic acid thus reducing gut pH. In addition, milk proteins are much more easily digested than vegetable proteins in the immature gut. The response to diet acidification might be expected to be reduced when provided in post-weaning diets to pigs that were provided with creep feed prior to weaning as creep feeding of suckling pigs is thought to benefit post-weaning pig performance by stimulating gastric acid production and enzyme secretion.

Unexpectedly, Lawlor et al. (2005a; Table 3) found that the response to a dietary acid was not influenced by the level of dairy product in the diet or whether pigs had or had not been creep fed while suckling the sow. Feed intake in one experiment was increased by ~32% in week 1 and by 11% over the first 3 weeks after weaning due to the dietary addition of fumaric acid. This increase in feed intake translated into a ~20% increase in growth rate in the first 3 weeks post-weaning. However, the response to diet acidification was not always consistent between experiments with a response to fumaric acid seen in 2 of the 3 experiments reported and the magnitude of the response varied greatly between the two experiments where a positive response was found. Similar results were found in later work (Lawlor et al., 2006). It was thought that microbial challenge during the post-weaning period has a major influence on the response to acid supplementation.

Table 3. *Effect of pre-weaning creep feeding on response of weaned pigs to dietary fumaric acid (Lawlor et al 2005a)*

					s.e.d.	F-test
Creep	**No**	**No**	**Yes**	**Yes**		**FA**
Fumaric acid (FA; g/kg)	**0**	**20**	**0**	**20**		
Pig weight (kg)						
Weaning	6.1	6.1	6.2	6.0	0.31	
Final	12.1	12.9	11.9	13.6	0.67	**
Feed intake (g/day)						
Week 1	194	233	180	260	19.0	***
Overall	466	500	466	535	30.3	*
Daily gain (g/day)						
Overall	289	320	273	358	23.6	**

There was no significant effect of C and no C x FA interaction.

An alternative approach to diet acidification, which can yield similar benefits, is to formulate post-weaning diets to have a low acid binding capacity. Acid binding capacity can be defined as the amount of acid required to lower the pH of 1kg of feed to (a) pH 4.0 (ABC-4) and (b) pH 3.0 (ABC-3) (Lawlor et al 2005b). The lower the acid-binding capacity of the feed, the lower will be the amount of gastric acid that is required to lower its pH. This creates an acidic environment in the stomach, which is beneficial to pig health and digestion. Lawlor et al. (2005b) published a data set of acid-binding capacity values for a wide range of feed ingredients. There is great variation between ingredients with regard to acid-binding capacity values. For this reason, complete post-weaning diets can be formulated to have a low acid-binding capacity by selection of ingredients from this dataset with low acid-binding capacity and by using the acid-binding capacity value for each ingredient in the diet formulation matrix. Such diets can be used when a high gastric pH is likely to be a problem (e.g., at weaning) and as an effective alternative to diet acidification. When such diets were formulated by reducing calcium and phosphorus content in the diet formulation, feed intake in the first week after weaning was increased by 17% (Lawlor et al., 2006). This is the time where we need to increase feed intake as it has such an influence on subsequent growth performance.

7.2. Probiotics

Probiotics are 'live microorganisms which when administered in adequate amounts confer a health benefit on the host' (FAO/WHO, 2001). They offer potential as an alternative to antibiotics and zinc oxide for pigs, both as a means of controlling enteric pathogens and improving growth performance. Their possible modes of action include modulation of the immune system, competitive exclusion of pathogens in the gut, antimicrobial production, neutralising toxins and preventing the adhesion of harmful bacteria to the mucosal surface of the gut.

Prieto et al. (2014) evaluated the safety and efficacy of a marine-derived *Bacillus pumilus* strain for use as an in-feed probiotic in newly weaned pigs. The *B. pumilus* used was pre-screened and selected for its ability to inhibit pathogenic *E. coli* (Prieto et al., 2013). The

Bacillus strain was administered to weaned pigs fed a non-medicated diet and compared to a negative control treatment without antibiotic or pharmacological levels of zinc oxide (non-medicated treatment) and a positive control treatment containing apramycin and pharmacological levels of zinc oxide (medicated treatment). The study herd was at the time experiencing oedema disease during the post-weaning period. The *B. pumilus* strain decreased ileal *E. coli* counts in a manner similar to the medicated treatment but without the reduction in growth performance (Table 4) and possible liver toxicity found with the medicated treatment (Prieto et al., 2014). Work on this probiotic strain is now being continued in Moorepark and is funded by Enterprise Ireland.

Table 4. *Effect of feeding non-medicated, medicated or B. pumilus treatments for 22 days on post-weaning pig growth performance*[1,2] *(Prieto et al., 2014)*

	Non-medicated	**Medicated**	***B. pumilus***	**s.e.**	**P value**
Day 0 BW[3] (kg)	8.7	8.6	8.8	0.26	0.38
Day 22 BW (kg)	18.1	17.6	18.7	0.35	0.07
ADFI[4] (g/d)	471	458	475	12.6	0.53
ADG[5] (g/d)	427	405	455	15.7	0.07
FCR[6]	1.11^{ab}	1.14^{a}	1.05^{b}	0.023	0.04

[1]Mean values with their standard errors. [2]Within a row, values without a common superscript are significantly different ($P < 0.05$). [3]BW = body weight. [4]ADFI = average daily feed intake, weaning to day 22 post-weaning.[5]ADG = average daily gain, weaning to day 22 post-weaning. [6]FCR = feed conversion ratio (ADFI/ADG), weaning to day 22 post-weaning.

7.3. Prebiotics

Prebiotics, like probiotics, are used as a strategy to influence the composition of the gastro-intestinal microflora towards a more favorable balance, by reducing the amount of harmful/pathogenic species and promoting the growth of species thought to have beneficial effects on host health (O'Sullivan et al., 2010). A prebiotic is "a selectively fermented ingredient that allows specific changes, both in the composition and/or activity of the gastrointestinal microbiota that confers benefits upon the host's wellbeing and health". Prebiotics are resistant to digestion in the upper gut (i.e. resistant to acid and enzymes), a selective substrate for the growth of beneficial bacteria and able to induce intestinal or systemic effects that are beneficial to host health. To date only inulin, oligofructose, galactooligosaccharides and lactulose are considered true prebiotics; however, other potential sources of prebiotics such as seaweed-derived compounds are currently being explored (O'Sullivan et al., 2010).

7.4. Phytogenics

Phytogenics are plant-derived products used in feed to improve pig performance. Phytogenics include herbs, spices, essential oils, and oleoresins. Oregano and thyme have received particular interest due to their antimicrobial properties. Besides having antimicrobial activity, these products potentially provide antioxidative effects, enhance palatability, improve gut function, and/or promote growth. Li et al. (2012) observed that weight gain, feed conversion and faecal consistency of weaned pigs fed a blend of essential oils (thymol and cynnamaldehyde) were essentially equal to that of pigs fed antibiotics. Essential oils also affected immune response and antioxidant capacity.

7.5. Others

Other additives with potential to help improve gut health and pig growth post-weaning and not discussed above include enzymes, clay minerals, egg yolk antibodies, medium chain fatty acids as well as others.

8 Reduce Stressors at weaning

Pigs are less prone to disease if they are not stressed. The following are some common areas that need to be considered.

8.1. Feed

Ensure that feed is palatable, balanced, low in protein and provided clean and fresh to the pig. Anything that helps improve earlier feed consumption after weaning should be considered (e.g. milk feeding, gruel feeding etc.).

8.2. Water

Pigs will not eat if they are not drinking and weaned pigs frequently do not drink for a considerable period after weaning. When did we stop providing supplemental water (in addition to bowels and nipples) to our pigs for the first few days after weaning (cubes, turkey drinkers etc.)? This practice should be restored.

8.3. Floor space and Feeder space

Overcrowding piglets is a stressor and stressed pigs will succumb to infection more quickly than those that are not stressed. Provide $0.2m^2$/pig to weaned pigs. Additionally feeder space allowance is important with pigs of all ages but it is even more important with newly weaned pigs as they have limited, if any, experience of eating solid feed. Provide supplemental circular troughs for the first week post weaning to encourage early and higher feed consumption.

8.4. Heavy and uniform weaning weights

Having pigs weaned at heavy and uniform weaning weights will make post-weaning management so much easier. Particular attention must be paid to increasing piglet weight and uniformity of weight at birth, maximising sow lactation feed intake to fuel increased milk yield and creep feeding prior to weaning to increase weaning weight and earlier adjustment to solid feed post-weaning.

8.5. Controlled Environment

Poorly controlled temperature and ventilation are stressors to be avoided. Ensure that controllers are accurate and set at the correct temperatures. Avoid fluctuations in temperature between day and night. Use a max/min thermometer in each room to monitor temperature fluctuations. Ventilation rate needs to be sufficient to prevent the build-up of gasses but should not be so high that draughts become a problem.

8.6. Stockmanship

Weaned pigs should not be stressed by poor/rough handling or excessive noise.

9 Summary

Here we have listed strategies to improve post-weaning management and thereby improve piglet growth and feed efficiency. These same strategies will consequentially reduce the incidence of post-weaning diarrhoea. However, a single intervention on its own is unlikely to be an effective substitute for zinc oxide, rather a multifaceted approach including improved pre-weaning and post-weaning health, nutritional and stress management will be necessary. It is essential that we strive to improve pre -and post-weaning management to successfully overcome problems posed by the ban of zinc oxide. Much of this involves doing correctly what we already know should be done!

References available on request from the authors.

Phase and budget feeding programmes for finishing pigs

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Introduction

Nutrient requirements of growing-finishing pigs gradually decrease as the pig becomes heavier. Therefore many producers in the US phase feed several diets from 20 to 130 kg in order to minimize over- and under-feeding of nutrients. Phase feeding has long been thought to be economical justified and especially reduce nitrogen and phosphorus excretion. Yet feeding several diets for finishing pigs presents logistical problems such as stretching feed mill capacity when manufacturing several different diets and their appropriate delivery at the right time. To help with the logistical issues of feed delivery and when to change diets in a phase feeding program, budget feeding is one method to simplify the process. By combining the two management practices, we believe an economical balance can be achieved while still reducing the impact on the environment.

Phase Feeding

Phase feeding can be defined as feeding several diets for short periods of time compared with feeding one diet for a long period. It is widely held that by phase feeding we can avoid times when diets are formulated below the pig's nutrient requirements, and thus possibly reducing growth performance, as well as reducing over-feeding of nutrients which will negatively impact the environment. To test this hypothesis, we recently evaluated 4 different dietary feeding regimens to look at the impact of different lysine levels as well as phase feeding (Menegat et al., 2017). In this study we compared a feeding regimen designed to "maximize" pig growth and feed efficiency (Table 1). The second treatment was designed to be a "best cost" program designed to maybe not be the most aggressive in maximizing growth performance, but providing the greatest profitability. The third treatment was a combination of the best cost nutrient levels early in the growing period, but then finishing at the maximum nutrient concentrations. All three of these feeding regimens were fed in 4 dietary phases. The last regimen was a 2 phase feeding program with lysine levels slightly below requirement estimates early, but slightly above requirements in late finishing.

Overall (d 0 to 117), pigs fed the 2-phase feeding program had greater average daily gain compared to pigs fed the standard feeding regimen with other regimens intermediate. There was no evidence for differences in F/G (FCE) among pigs fed any of the 4 dietary regimens. For the economic analysis, the standard feeding regimen had the lowest feed cost per pig and feed cost per kg of gain; however, although not statistically different, numerically had the lowest income over feed costs.

The surprising question in this study was why wasn't the 4 phase feeding programs more cost efficient that the 2 phase feeding program? It would appear from the intermediate weight periods that although pigs fed the 2 phase program were below their lysine requirements early, there was compensatory gain in these pigs during late finishing when lysine levels were adequate to arguable slightly over their requirement. These findings are in agreement with previous data (Main et al., 2008) where pigs fed slightly below their lysine requirements early in the growing phase had compensatory gain as long as lysine levels were adequate in late finishing. It appears that in finishing pigs we can get away with slightly lower lysine levels in diets fed during the early grower phase, but as long as we are adequate in late finishing, pigs grow at a similar overall level. Therefore, feeding lysine levels for maximum growth and efficiency in either a 2- or 4-phase feeding program results in the similar growth performance and feed cost. A broad range of lysine specifications within the levels tested herein can be utilized in grow-finish diets without compromising income over feed cost.

A Single Phase Finishing Program

To extrapolate the results of our study to a single phase feeding program, we then used the same feed intake and growth performance as the 2 phase program, and estimated the income over feed cost in a single phase feeding program feeding 0.92% standardized ileal digestible lysine for the entire finishing period. Again we made the assumption that performance would be slightly lower in the early phases when we were below the pig's lysine requirements, but then counted on compensatory gain in the later phases when we were at or arguable above the pig's lysine requirement. Even though we assumed equal growth performance as the 2-phase program, the single phase feeding program was approximately $3.00 USD less profitable than either the 2 phase or 4 phase programs. This was largely due to over-feeding lysine in late finishing. It is our conclusion based on the extrapolation of these data that 1, 2, or 4 dietary phases can be used with similar growth performance; however, because of over feeding in late finishing, a single phase program will be the least economical.

Feed Budgeting

To implement a phase feeding program, be it 2 to 6 phases, rather than guess pig weights and corresponding diet changes, we recommend a feed budget should be used. Budget feeding uses a known feed efficiency (taken from close-out records) to estimate the amount of feed needed by the pig to grow from one weight to another. Again, this is used to simplify the phase feeding program as farmers are not visually evaluating pig weights (which can sometimes be misleading) in order to change diets. Feed budgets can also be monitored at the feed mill, based on how many tons of feed has been delivered to the barn and making diet changes when the amount of each diet is used before going to the next diet. A feed budgeting program can be found at our website: KSUSwine.org, and can be customized to individual farms based on the number of diets to be fed, weight ranges, and feed efficiency. Two examples of feed budgets are provided.

Conclusions

While nutrient requirements change over time with improved genetics and production practices, the basics of formulating to a farm’s specific conditions still apply. There are several options for phase and budget feeding farmers may decide to use. It also appears that a wide range of lysine concentrations can be selected with maintaining good pig growth and feed conversion. However, feeding several diets over the finishing period compared to one, appears to be a more economical option along with reducing nutrient excretion in the environment.

***Example** feed budget feeding 3 phases from 25 to 110 kg at a 2.80:1 feed conversion.*

Mixed Sex Feed Budget		
Closeout Feed Efficiency		
Initial wt	Final wt	F/G
25	110	2.8
Initial wt	Final wt	kg/pig
25	50	61
50	80	83
80	110	100

***Example** feed budget feeding 5 phases from 25 to 115 kg at a 2.70:1 feed conversion.*

Mixed Sex Feed Budget		
Closeout Feed Efficiency		
Initial wt	Final wt	F/G
25	115	2.7
Initial wt	Final wt	kg/pig
25	40	36
40	60	49
60	80	56
80	100	64
100	115	53

Table 2. *Effect of phase feeding strategies using different lysine specifications on growth performance, carcass characteristics, and economics of grow-finishing pigs (M.B. Menegat et al., 2017)*[1,2,3]

Item	MAX	STD	STD/MAX	2-PHASE	1-PHASE*	Probability, *P* <
BW, kg						
d 0	27.9	27.9	27.9	27.9	27.9	0.998
d 25	49.4^{a}	49.0^{ab}	48.4^{bc}	48.0^{c}	48.0^{c}	0.002
d 53	73.8	72.7	72.5	73.4	73.4	0.208
d 81	100.1^{ab}	98.3^{b}	99.5^{ab}	100.9^{a}	100.9^{a}	0.029
d 117	129.7	127.1	129.4	129.8	129.8	0.109
d 0 to 25						
ADG, kg	0.86^{a}	0.84^{a}	0.83^{ab}	0.80^{b}	0.80^{b}	0.001
ADFI, kg	1.65^{a}	1.65^{a}	1.63^{a}	1.57^{b}	1.57^{b}	0.001
F/G (FCE)	1.93^{b}	1.95^{ab}	1.99^{a}	1.96^{ab}	1.96^{ab}	0.063
d 25 to 53						
ADG, kg	0.87^{ab}	0.85^{b}	0.85^{b}	0.90^{a}	0.90^{a}	0.005
ADFI, kg	2.12	2.09	2.09	2.07	2.07	0.364
F/G (FCE)	2.44^{a}	2.47^{a}	2.45^{a}	2.29^{b}	2.29^{b}	< 0.001
d 53 to 81						
ADG, kg	0.93^{bc}	0.91^{c}	0.95^{ab}	0.97^{a}	0.97^{a}	0.001
ADFI, kg	2.58	2.53	2.57	2.62	2.62	0.192
F/G (FCE)	2.79^{a}	2.78^{ab}	2.70^{bc}	2.68^{c}	2.68^{c}	0.003
d 81 to 117						
ADG, kg	0.85	0.83	0.85	0.84	0.84	0.463
ADFI, kg	2.69^{ab}	2.63^{b}	2.72^{ab}	2.75^{a}	2.75^{a}	0.051
F/G	3.16	3.20	3.20	3.28	3.28	0.296

d 0 to 117										
ADG, kg	0.88^{ab}		0.85^{b}		0.87^{ab}		0.88^{a}		0.88^{a}	0.048
ADFI, kg	2.29		2.26		2.28		2.29		2.29	0.514
F/G (FCE)	2.62		2.64		2.63		2.60		2.60	0.193
Economics, USD										
Feed cost per pig[4]	47.99^{b}		45.38^{c}		47.05^{b}		48.23^{b}		51.04^{a}	< 0.001
Feed cost per kg gain[5]	0.468^{b}		0.454^{c}		0.463^{b}		0.470^{b}		0.496^{a}	0.001
Revenue[6]	113.07		110.80		112.77		113.65		113.65	0.183
IOFC[7]	65.08^{ab}		65.42^{ab}		65.72^{a}		65.43^{ab}		62.62^{b}	0.039

[1] A total of 1,188 pigs (PIC 359 × 1050; initially 27.9 kg BW) were used with 27 pigs per pen and 11 pens per treatment.

[2] Dietary treatments were: MAX, a 4-phase feeding program with lysine levels for maximum growth; STD, a standard 4-phase feeding program for optimal IOFC; STD/MAX, a 4-phase feeding program based on standard lysine levels in early finishing and for maximum growth in late finishing; and 2-PHASE, a 2-phase feeding program.

[3] Means with different superscripts are significantly different ($P < 0.05$) in the row.

[4] Corn was valued at $3.30/bu ($118/ton), soybean meal at $290/ton, DDGS at $94/ton, and L-lysine at $0.75/lb.

[5] Feed cost per lb gain = feed cost per pig ÷ overall gain per pig.

[6] Revenue = (HCW × $0.70) − (d 0 BW × 0.75 × $0.70).

[7] Income over feed cost = revenue − feed cost.

* Projected economics for a 1-phase feeding program with 0.96% SID lysine levels from d 0 to 117, assuming same growth performance and carcass characteristics of 2-PHASE feeding program

Table 1. *Description of feeding phases and lysine levels of experimental diets*[1,2]

Phase	1				2				3				4			
Duration, d	0 to 25				25 to 53				53 to 81				81 to 117			
Weight range, kg	30 to 50				50 to 70				70 to 100				100 to 127			
	MAX	STD	STD/ MAX	2-Phase	MAX	STD	STD/ MAX	2-Phase	MAX	STD	STD/ MAX	2-Phase	MAX	STD	STD/ MAX	2-Phase
SID Lys, %	1.13	1.02	1.02	0.96	0.96	0.87	0.87	0.96	0.82	0.76	0.82	0.96	0.77	0.67	0.77	0.77
SID Lys:ME, g/Mcal	3.42	3.08	3.08	2.89	2.89	2.62	2.62	2.89	2.46	2.28	2.46	2.89	2.29	1.99	2.29	2.29
SID Lys:NE, g/Mcal	4.61	4.12	4.12	3.84	3.84	3.46	3.46	3.84	3.24	2.98	3.24	3.84	3.00	2.59	3.00	3.00

Above table based on Mcal values for further information or clarification contact your Advisor.

1 Dietary treatments were: MAX, a 4-phase feeding program with lysine levels for maximum growth; STD, a standard 4-phase feeding program for optimal IOFC; STD/MAX, a 4-phase feeding program based on standard lysine levels in early finishing and for maximum growth in late finishing; and 2-PHASE, a 2-phase feeding program.

2 The equations used for lysine requirement estimates for finishing gilts in g/Mcal NE were: $0.00006 \times BW^2$, lb - $0.0291 \times BW$, lb + 6.6894 for maximum growth (PIC, 2016); and $-0.00000015 \times BW^3$, lb + $0.00010 \times BW^2$, lb - $0.0304 \times BW$, lb + 6.0435 for optimal IOFC (adapted from Tokach et al., 2012).

Effects of feeding practices and energy and protein formulation on Irish pig performance

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Since 2015, Teagasc Pig Development Department has been running two parallel projects on general management of feeding and nutrition in Irish pig farms. Here we present some of the results and ideas for future improvements in productive efficiency in Irish pig farms.

Feeding Practices

The feeding practices of 60 farms were studied in combination with performance data from the eProfit Monitor. Table 1 shows the average and range of data for the farms studied.

Table 1. *Performance data for 60 farms from the e-Profit Monitor (year 2015) included in the study.*

Performance	mean	min	max
AVERAGE HERD SIZE	722	114	2525
AGE AT SALE days	173	149	215
DAILY FEED INTAKE g	1694	1404	1910
AVERAGE DAILY GAIN g	703	538	808
CREEP FEED PER WEANER kg	2.8	0	6.7
LINK FEED PER WEANER kg	6.5	0	23.2
WEANER FEED PER WEANER Kg	47.8	15.2	71.2
FEED PER WEANER Kg	57.2	27.6	82.6
AVERAGE LIVE WGT SOLD kg	106.9	94.8	121.2
AVERAGE DEAD WGT SOLD kg	81.6	72.4	92.9

The feeding practices studied in the farms were the type and number of diets used in the feeding program, the form of these diets (meal or pellet), how the diet was provided to the animals (wet or dry) and if those diets were purchased or the farm was home milling. An important factor that was not included is the type of feeder and drinkers used in each farm.

A standard feeding program in Ireland would include 1 or 2 creep and link feeds in first stage weaners, followed by 1 or 2 weaner feeds and then 1 to 3 finisher feeds. However, this is highly variable between farms. As it can be seen in table 1, many farms use an excesive amount of weaner diet. This has been pointed out in the past as one of the main reasons why the cost of feeding programs in Ireland are higher than in other countries. In many cases this is because only one feed can be provided to the animals in one building and the next feed is not fed until pigs move to the next stage.

Some farms (22%) fed pigs in 1st stage only with creep and link and no weaner feed is used until second stage. These are normally small farms. Creep and link are normally used as dry pellet or meal. Weaner feed is used dry in 65% of case in first stage and 60% in second stage. The daily intake is around 40g lower in farms feeding pellets than on those using meal for weaners, which reduces FCR. This may be indicating higher wastage of feed instead of higher intake. The kill out is slightly higher in those fed pellet vs. those fed meal.

In finisher, 63% of farms use only one diet. In farms using 2 or 3 finisher diets, daily intake was almost 100g higher and daily gain was 30 grams higher. However, FCR was around 2.4 no matter the number of diets used. The percentage of farms feeding wet feed in the finisher stage is higher (49%) than for weaner stage. Wet feeding is clearly associated to feed provided as meal. However, when finisher diets are used dry there is still an important amount of farms using meal for both home millers and those purchasing feed. This may result in more wastage of feed.

There were a total of 42% home millers in the farms studied and no apparent difference on performance was observed between home millers and those purchasing feed.

In terms of composition of the diets, creep and link are, in most cases, commercial diets very high in protein and often medicated. A reduction in the levels of protein for this feeds may help to reduce the need for medication. Weaner diets are between 18 and 20 % of CP with high variability in total lysine levels going from as low as 0.9 up to 1.7. Finisher diets vary between 16 and 19 CP and 0.85 and 1.1 digestible lysine. Energy levels in the diets are often not reported which make difficult to assess and compare them.

Energy, protein and lysine

Based on the information collected from diets used in commercial farms, 3 experiments were designed to show the effects of levels of net energy, crude protein and digestible lysine in diets similar to those used in Irish farms.

In the first experiment, 4 diets (table 2) were used to combine high and low levels of protein and energy keeping the levels of lysine constant. Pigs were followed for 30 kg to slaughter. Growth was not affected by the level of energy or protein. Average daily feed intake was lower for pigs on diets high in energy (2013 g/d) than with low energy (2234 g/d). As a result, FCR for the pigs on the diet with high energy was lower than for those with low energy (2.16 vs 2.34). Depending on the price of the ingredients and pigs it might be of interest to move from diets high in energy to diets with lower energy. Lean meat percentage was affected by both protein and energy. Higher energy resulted in lower lean meat percentage (58.5 vs 57.8%) and high protein resulted in higher lean meat percentage (58.5 vs 57.8%).

Table 2. *Diets used in experiment 1 comparing levels of crude protein (CP High, HP; CP Low, LP) and levels of net energy (NE High HE; NE Low LE) but keeping digestible lysine (SID Lys) constant.*

	HP HE	HP LE	LP HE	LP LE
NE KJ/kg	**10**	**9.1**	**10**	**9.1**
CP %	**19**	**19**	**15**	**15**
SID Lys %	**0.9**	**0.9**	**0.9**	**0.9**
Barley	46.0	63.6	46.0	63.4
Wheat	19.5	5.0	19.5	5.0
Soya Hi-Pro	26.2	25.5	16.8	16.1
Wheat pollard	3.4	3.3	12.1	12.9
Soya oil	3.3	0.0	3.4	0.0

Productive performance

	HP HE	HP LE	LP HE	LP LE
ADFI g/d	2088	2219	2119	2249
ADG g/d	985	979	1004	978
FCR	2.16	2.32	2.16	2.35
LeanMeat	58.2	58.7	57.3	58.2

12 pens of 2 pigs were used for each diet.

In experiment 2, 4 diets were used *(table 3)* to combine high and low levels of protein and energy. However this time the levels of digestible lysine were lowered when the levels of protein were lowered. Pigs were followed for 32 kg to slaughter. In this case, both energy and lysine level were important for productive performance. As expected, higher levels of energy or lysine results in better FCR, with a reduction of 0.1 (from 2.3

to 2.2). Although the best FCR was achieved with diets high in energy and protein, the diet showing the best growth was the diet high in lysine but with lower protein. This diet promoted a higher intake of nutrients than the one with higher energy. When comparing these diets we have to consider 2 factors affecting intake and growth. First, the lower level of energy will promote higher intakes of the pigs, although can increase the price. Second, the level of lysine used is not that important. Instead, we should look at the ratio of lysine (SID lysine) per KJ of net energy. This ratio is higher in the case of the diet with high lysine and low energy.

Table 3. *Diets used in experiment 2 comparing levels of digestible lysine (SID Lys) and crude protein (High, HL; Low, LL) and levels of net energy (High HE; Low LE).*

	HL HE	LL LE	LL HE	HL LE
NE KJ/kg	**10**	**9.5**	**10**	**9.5**
CP %	**16.4**	**14.8**	**14.9**	**16.7**
SID Lys %	**1.1**	**0.85**	**0.85**	**1.1**
Wheat	33.6	31.3	36.2	31.9
Barley	30.0	34.5	30.0	30.4
Soya Hi-Pro	20.1	12.2	12.2	20.2
Wheat pollard	10.9	18.7	16.4	14.1
Soya oil	3.0	1.0	2.9	1.0
Lysine HCl 78.8	0.44	0.34	0.35	0.42

Productive performance

	HL HE	LL LE	LL HE	HL LE
ADFI g/d	2523	2592	2641	2733
ADG g/d	1164	1113	1155	1209
FCR	2.17	2.34	2.29	2.25

30 pigs were used per diet in automatic feeders registering individual intake.

Finally a third experiment was carried out using 2 diets form the second experiment, the one high in both protein and energy (high spec) and the one low in protein and energy (low spec). In this experiment, 6 batches of pigs were progressively switched from the high spec diet to the low spec diet. On group was all the finishing stage in the high spec diet, another group was all the finishing stage on the low spec diet and 4 other groups were switched from the high spec diet to the low spec diet at 2, 4, 6 or 8 weeks of the finishing period (table 4).

Table 4. *Diets and feeding programs used in experiment 3. Diets used were high (H) or low (L) in both digestible lysine and net energy. The different groups of pigs were switched from diet H t diet L at different ages.*

Group	Weeks in finisher stage					ADFI g/d	ADG g/d	FCR
	1-2	3-4	5-6	7-8	9-10			
1	**H**	**H**	**H**	**H**	**H**	2123	1021	2.15
2	**H**	**H**	**H**	**H**	L	2138	1018	2.14
3	**H**	**H**	**H**	L	L	2144	1006	2.16
4	**H**	**H**	L	L	L	2080	1001	2.15
5	**H**	L	L	L	L	2140	986	2.17
6	L	L	L	L	L	2172	1003	2.18

8 pens of 10 pigs were used for each diet.

No differences were found in this experiment for the different feeding programs. High spec diets were expected to perform better however in this case the results were similar in both cases. Other effects like sex and initial weight of the animals were clearly shown in the trial what means that these pigs did actually had similar performance on the 2 diets with a slightly worse FCR for those in low spec diets for 8 weeks or longer.

Conclusions

Feeding practices in Irish farms are very heterogeneous to the point that many farms are unique. This makes comparisons between different practices difficult. In general weaner feed is fed to the pigs for too long and when feeding dry feed it seems to be a better result by using pellet instead of meal. No differences were observed between home millers and those purchasing feed or between those using wet vs. dry feed.

Formulation of pig diets has to be based on net energy and digestible lysine. The level of crude protein is not relevant for performance once digestible lysine is at the right levels. The ratio digestible lysine / KJ of net energy should be the most important figure to look at. A level of lysine alone is not a good indicator of expected results as it is modified by the levels of energy.

Feeding programmes for gestating and lactating sows

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Introduction

Adoption of new technology has allowed for dramatic improvements in sow productivity over the last 20 years. Litter size has been steadily increasing in the USA averaging an increase of 0.15 pigs born alive per year over the past 20 years (PigChamp Records Benchmarking; http://www.pigchamp.com/). Much of these improvements have been driven by genetics, but to manage the high producing sow requires excellent stockmanship and a solid nutrition program. The relationship between stockmanship and nutrition is important because one cannot achieve excellent sow productivity without the herdsperson providing the right diet (and particularly the right amounts) at the right time. There are no magical ingredients or additives that will affect reproductive or milk production, it all depends on providing adequate amounts of energy (feed intake), and the proper amount of amino acids, vitamins and minerals.

Gestation

When designing a feeding program for gestating sows, overall goals for the nutrition program include: 1) prepare sows to be in proper body condition at farrowing (approximately 17 to 19 mm last rib fat depth); 2) maximize reproductive performance (farrowing rate and litter size); and 3) meet the daily nutrient requirements at the lowest cost possible (measured as diet cost × feed allowance per sow per day).

After breeding, sows and gilts in good body condition should be fed 4.5 to 5.5 Mcal (18.84 to 23.03 MJ) NE per day, based on weight and body condition. This amount should be the level they will be fed throughout gestation. Thin sows should be set at the level required to return them to the desired body condition, hopefully within the first 30 to 40 days of gestation. However, depending on how much sows have milked down, this might require increased feed amounts for the entire gestation period.

Problems with over-feeding during gestation

One of the most detrimental effects of having gestating sows over-conditioned is the negative effects on subsequent lactation feed intake (Young et al., 2005). In this study, sows with greater than 21 mm back fat depth ate significantly less feed during lactation, and as a result lost more backfat than thin or ideal conditioned sows. The low lactation feed intake and greater backfat loss of over-conditioned sows also resulted in approximately 1 less pig born than thin of ideal sows in the subsequent farrowing. This emphasizes the need for fixing gestation feed allowances to prevent over-conditioned sows.

Gestation Feed Costs

The next step in a gestation feeding program is to meet the daily nutrient requirements at the lowest possible cost. However, adding a low cost byproduct ingredient, while perhaps reducing diet cost, might not be such a bargain if the ingredient is very low in energy and there is an offsetting increase in feed intake necessary. This is illustrated in the example below. Diet A represents a wheat- barley-based diet which would cost approximately $162.00 USD/ton vs Diet B where a bargain ingredient such as soy hulls, for this example, could be added to reduce diet cost by approximately $2.00 USD per ton. However, we need to consider the differences in energy content between the 2 diets. While it reduces diet cost per ton of feed, the added soy hull diet also results in a lower energy content than the original wheat- and barley-based diet. Therefore more of the added soy hull diet needs to be fed to provide a similar energy intake by the sow as the wheat- barley-based diet. As a result, the increased feed intake offsets the lower diet cost and actually to provide the same energy intake, will cost approximately $0.04 per day or approximately $4.50 per gestation period between the 2 programs.

Table 2. *Example gestation diets*

	Gestation	**Gestation**
Ingredient	Diet A	Diet B
Wheat	42.6	33.0
Barley	42.6	33.0
Soybean meal	11.3	10.6
Soybean hulls	---	20.0
Limestone	1.5	1.2
Monocalcium P	0.9	1.1
Salt	0.5	0.5
Vitamins and minerals	0.7	0.7
TOTAL	100.0	100.0
SID Lysine, %	0.56	0.56
NE, kcal/kg	2,280	2,002
CP, %	16.3	15.6
Ca, %	0.82	0.82
Available P, %	0.47	0.47
Cost/ton (USD)	$162.31	$160.27
Feed budget, kg/sow	2.00	2.25
NE Intake, Mcal/day (MJ/day)	4.55 (18.84)	4.55 (18.84)
Feed cost, $/sow (USD)	$0.36	$0.40

Increasing Feed Amounts during Late Gestation

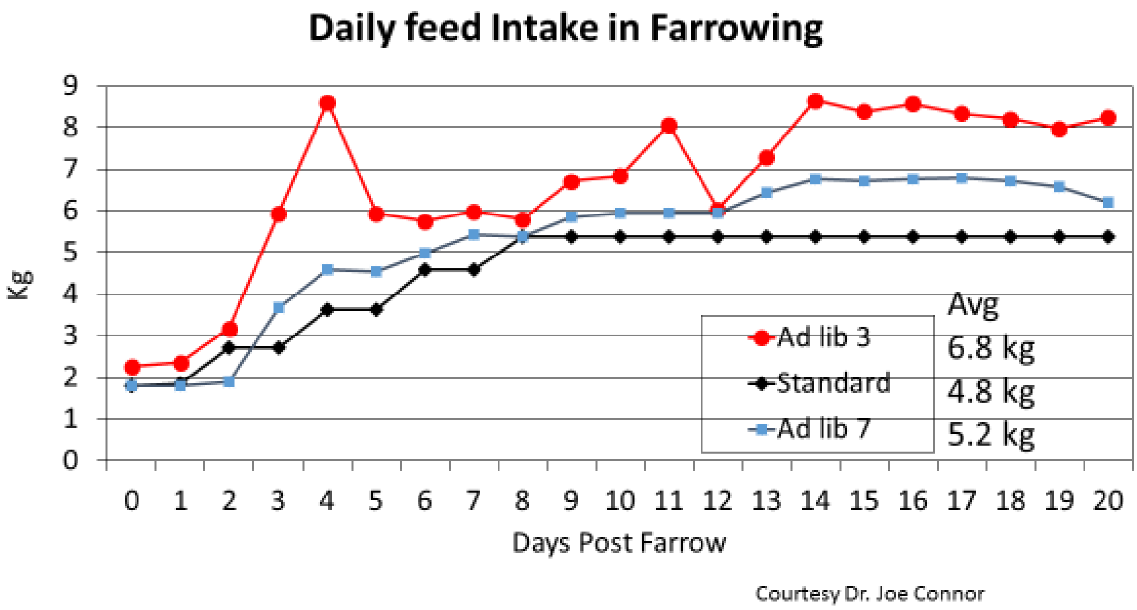
The increase in fetal growth during the last third of gestation has led many nutritionists recommend to producers to increase feed allowance or "bump feed" the last 3 weeks before farrowing. "Bump feeding" during late gestation is generally defined as increasing daily feed intake by about 1 kg from day 90 of gestation to farrowing. The goal is to provide the gestating sow the extra energy needed in late gestation to satisfy the exponential growth of the conceptus.

Recently Goncalves et al. (2016) examined whether increasing energy intake (4.5 vs 6.75 Mcal NE per day) before farrowing would increase pig birth weight in high performing sows (> 14.5 NBA). Results indicated that a 1 kg increase in feed intake from day 90 to farrowing resulted in a modest increase in birth weight of pigs by approximately 30 g (1.326 vs. 1.356 kg, respectively). It also increased sow weight gain during this period by 7 kg. However, one negative consequence of the study was an increase in stillborn pigs observed in sows that were bump fed (4.3 vs. 6.5% stillborn pigs per litter) but not gilts (3.4 vs 3.4% stillborn pigs per litter). Considering the negative effect on stillborn rate, (perhaps as a result of the added weight gain) and the potentially negative effects on sow lactation feed intake, it is our recommendation to only bump feed gilts and thin sows in poor body condition and not bump feed gestating sows in good body condition.

Lactation

Aside from over-conditioned sows in gestation, the second problem affecting feed intake is people. People tend to either intentionally or unintentionally limit feed intake. This can be a result not feeding multiple times during the day, or more likely, the long held belief that sows must be gradually brought up on feed over time so as not to have them go off feed later in mid-lactation. This philosophy is wrong. Sows need to be brought up on feed as quickly as possible and have feed in front of them at all times. To demonstrate this point, 3 methods of lactation feeding were evaluated (Figure 1). The first was a standard limit-fed program where the objective of the feeding program was established so that sows would not go off-feed during early lactation as a result of over-feeding early. The second and third regimens were to gradually bring the sows up on feed with an aggressive feeding program over either the first 3 or 7 days immediately after farrowing followed by ad libitum feeding the rest of lactation. Results demonstrate that with ad libitum feeding, feed intake is variable and that there are indeed spikes in feed intake followed by days of low feed intake. However, overall sows offered feed ad libitum had greater feed intake overall than those on the restricted program.

***Figure 1**. Effects of ad libitum feeding on overall lactation feed intake.*



***Pictures 1 and 2**. Examples of ad libitum lactation feeders.*

In the US swine industry there is a rapid move towards ad libitum sow feeders (Examples in pictures 1 and 2). While sow feed intake will vary from day to day during lactation, ad libitum feeders, either purchased or home-made, are the best way to keep feed in front of sows during lactation.

Summary

In summary, the modern sow appears to be nothing but remarkable. However, over-feeding during gestation or underfeeding during lactation can have dire consequences on reproductive and litter performance. Proper amounts of a good quality gestation diet followed by ad libitum feed intake during lactation can result in excellent productivity. Lastly, there are no “special” feed ingredients that will cover up for poor stockmanship.

References are available upon request

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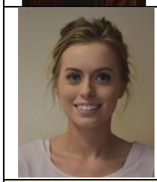	**Emer McCrum,** Teagasc, Ballyhaise, Co. Cavan Tel: 049-4338640| Mob: 087-7940974 Email: emer.mccrum@teagasc.ie
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Notes