Maximising sow longevity

by Dr Terry L. Ward and Dr Mark E. Wilson, Zinpro Corporation, 10400 Viking Drive, Suite 240 Eden Prairie, Minnesota 55344, USA.

Removal of non-productive sows along with the introduction of replacements is an essential part of maintaining herd productivity at a constant level. In commercial production 40-50% of the sows are removed prior to third and fourth parities. Increasing longevity or decreasing sow attrition is an important consideration in commercial pork production because of the cost of gilt replacement. Benefits from such a programme will improve litter size and life time productivity of sows, and result in fewer non-productive days.

In addition, acquired immunity is improved and biosecurity risks are reduced, the salvage value of sows is higher, and production flows are stabilised. All of these effects mean there will be fewer concerns on welfare issues for the herd.

The Faust et al (1993) simulation model has shown that production systems with lower rates of culling are more profitable than farms with higher rates of culling.

To help stabilise the culling rate, an optimum parity distribution of the sow herd has been suggested by several researchers for the first few parities (Table 1).

Maximum productivity

Maximum productivity within a herd is generally parities three through to five. There is a significant loss of potential herd output, measured in pigs per sow per year, when young parity animals are culled at a high rate. Stalder et al (2003) estimated that a gilt must produce three or four litters to pay for the cost of replacement of an older sow.

Other authors claim that economically optimal sow productive lifetime for sows is the fifth farrowing. Balogh et al (2007) quantified via an economic model how the production period of a sow influences average cost of the piglets and they calculated fifth farrowing is the minimum cost per pig placed.

High incidence of involuntary culling of the younger parities, such as reproductive failure and feet and leg problems and accelerated death loss, are costly to the individual producer and the pork industry as a whole.

Sows leave the herd through death or culling. The issue is how do we stabilise the culling procedure such that the producer has more voluntary control over culling and emphasis is on culling the parities six and up and minimise the retention of old sows past their prime.

Reasons for culling

Farrowing number per sow needs to be stressed and the factors that cause involuntary culling of the young parity sows needs better understanding. Correcting flow and performance of the herd when a bimodal distribution of the parity structure occurs is a difficult and expensive fix in commercial production. Surveys have been done on the reasons for sow removal. These surveys can give us an overview of the trends or factors that need focus and attention to see if we can reduce the impact of culling young sows from the herd. Table 2 gives a summary of some reasons for culling in sow herds.

A recent study suggests caution in using these numbers as absolute causes of culling as their data suggested that 23% of the culling reasons were judged as recorded inaccurately.

However, these listed surveys and many others show trends and areas of emphasis that need to be investigated to see if we can develop management schemes to help prevent early sow removal and improve sow longevity in the herd.

A trend in these surveys was that young sows (under parity three) were largely culled due to feet and leg problems and reproductive failure, while parity six sows and older were mainly due to age and performance. There was a trend for larger farms to have a slightly higher rate of sow removal and death loss compared to smaller farms.

Interestingly, the survey by Friendship et al (1986) found that most farm owners claimed an increase in culls during late summer and fall; however, the statistical results of the actual data showed no differences in season.

The focus needs to be on the causes of involuntary culling of the young sows and to determine if there are any management responses we can do to help eliminate the problem. The predominant reasons that young sows are culled are reproductive failure and feet, leg and locomotion issues. If we evaluate the areas that may impact these two most dominate reasons for culling they include nutrition, genetics, facilities and environment and gilt development, to name a few.

Reproductive failure

Reproductive failure is reported as the most common reason sows are culled from farms. Furthermore, reproductive failure is the major factor for early culling of young sows from commercial production.

There are many factors which may impact reproductive failure. Some of these factors are semen quality, environment, management, proper oestrus detection, adequate records, gilt development, flow and management, age, lactation length, genetics, mycotoxins, health, gestation and lactation feeding. Personnel impact adoption and implementation of technologies to control reproductive failure and reduce culling of younger animals.

This article focuses on nutritional reproductive interactions and helps explain why young sows with low feed intakes in lactation are at risk for culling.

Table 1. Ideal parity distribution recommendations. Values by parity within a row indicate the percentage of females that should be in each classification for an ideal distribution (Table adapted from Stalder et al, 2004).

	Parity		
Study	0	1	2
Straw, 1984	20	18	17
Parsons et al, 1990	30	23	19
Muirhead and Alexander, 1997	17	15	14
Morrison et al, 2002	19.1	16.5	16.9

Lactating sows

Australian researchers were some of the first to demonstrate the linear relationship between daily feed intake during lactation and increased time required for sows to express oestrus after weaning. Younger first litter gilts were more sensitive to negative effects of reduced feed intake during lactation than older gilts and multiparous sows.

Lactating sows are often fed ad libitum to optimise milk production and maintain body condition. How-ever, voluntary feed intake of hyperprolific sows can be insufficient, especially in young sows, to meet their high nutrient requirements due to milk production, maintenance and growth.

Lactation is one of the most energetically expensive and challenging activities that a female can undertake. The people in the breeding barn should consider the personnel feeding the sows in lactation as one of the most influential for the success of their job.

Reproductive sows are restrictively fed during gestation to avoid becoming overweight.

Overweight sows generally have a poor feed intake during the first week to 10 days of lactation and actually lose more weight than properly conditioned sows.

There is a linear decrease in feed intake in lactation with an increase in feed consumption during gestation from 1.8-2.7kg. However, a fibrous diet fed in gestation to help prepare females for ad libitum feed supply in lactation may be a significant tool to improve feed consumption. The role of an early experience of a bulky diet fed during pregnancy impacted development of a feeding behaviour during the first reproductive cycle.

Continued on page 8

Continued from page 7

For each additional kg increase in ADFI during lactation, an additional 0.11 pigs were born at the subsequent farrowing. Logistic regression analyses revealed that increases in average daily feed intake (ADFI) reduced the probability of having an occurrence of reproductive failure on commercial farms. Producers can improve the performance of their breeding herds and reduce rates of reproductive problems through nutritional management designed to optimise feed intake and feed intake pattern. A higher daily feed intake in the sow reduced body weight loss, improved litter weight gain and reduced the probability of a prolonged wean to oestrus interval by 42% for each kg increase in ADFI.

Poor performance

When young sows have poor daily feed consumption in lactation, a practical outcome of extended wean to oestrus intervals is to cull for presumed reproductive failure.

Although younger females are often culled for poor reproductive performance, the repeatability of poor reproductive performance of younger sows is actually lower than what is often suggested.

The reproductive effects of inadequate lactation feed intake seems to be mediated, at least in part, through LH secretion, and embryo mortality. A low feed intake during lactation involves mobilisation of body tissues and can lead to an excessive loss of body weight, reducing sow longevity and reproductive performance.

Sows with a body condition score (BCS) of one have a higher frequency of acyclic ovaries than sows with a BCS of four. It is reasonable that some of the body weight loss was due to increased protein loss from these sows. Clowes et al. reported body protein mass loss greater than 9-12% rapidly reduced ovarian function. Protein restriction throughout lactation alters circulating concentrations of somatrophic hormones and insulin at the end of lactation and negatively impacts postweaning ovulation rate.

Caution must be used when checking for the presence of ovaries that appear acyclic among sows culled within one day of weaning has been reported to be relatively high (97%). Heinonen et al (1998) found 6.2% grossly cystic ovaries.

Real-time ultrasound may be a tool to help pork producers reduce the number of non-productive days by identifying and subsequently culling females with ovarian cysts. Cystic ovaries can be readily identified by using real-time transcutaneous ultrasound due to their immense size. Castagna et al (2004) using real-time transcutaneous ultrasound examination in gilts and sows found 2.4% cystic ovaries.

This field study reported that the rate of return to oestrus was greater in sows with cystic ovaries than sows with normal ovaries. This suggests that cystic ovaries may be more likely to be culled for reproductive failure.

Results from Germany suggest that corpus lutea rather than polycystic ovarian degeneration was the cause for a failure to return to oestrus.

Lactation length can have a significant impact on ovarian activity and status. Weaning at less than 14 days of age showed that these sows had more cystic ovaries compared to older weaning ages.

Decreased productivity of sows weaned at 14 days or less can be a source of economic loss for producers. Early weaning is typically associated with a longer wean-oestrus interval.

Mabry et al (1996) reported first parity sows with lactations less than 14 days in duration produce major increases in wean to oestrus interval.

Embryo survival rates

Limitations in second litter size in primiparous, early weaned, sows was not attributed to low ovulation rate, abnormal endocrine profiles in the perioestrus period or variable fertilisation rates. Limited follicular development and incomplete recovery of the reproductive axis at weaning seem to be the most likely causes of decreased embryonic survival. With conventional weaning embryo survival can still be a limitation to second litter size, however this event seems to be mostly impacted by metabolic state and therefore good nutritional management of sows weaned older than 14 days is needed to offset catabolic events and improve second litter performance.

The negative effects of high temperatures on performance during sow lactation have been well documented. An increase in ambient temperature leads to a decrease in feed intake which, in turn, decreases milk production, increases the mobilisation of body reserves and delays the return to oestrus of weaned sows. Lactating sows are frequently exposed to temperatures above their thermal neutral zone (22-25°C) and sows will often reduce feed intake to reduce heat production.

Water needs of the sow in lactation are estimated to be 20kg (L) per day with a range of 15-30kg (L)/day altering to environmental and feed factors.

A good rule of thumb is that the sow should consume three times as much water as it does feed per day. This is why stage of lactation will impact actual water consumption.

Never limit water access to lactating sows if you want to optimise milk production and feed consumption. Factors such as height of the nipple, trough or cup can impact a sow's ability to drink. If the sow is drinking from a trough or feeder it is important to have enough water depth that they can drink easily.

It is very hard for a sow to drink water with less than an inch (2.5cm) of depth. It is a good idea to have a water meter on the farrowing rooms to get some idea of water usage by the sows since it has such an impact on feed consumption. Flow rate for nipple waters should be 1.5-2 litres/minute.

Re-evaluate mineral needs

Much of the data and information on mineral nutrition is 30-40 years old. Today's hyperprolific sows nursing and weaning much larger litters require mineral needs to be re-evaluated. Mahan (1990) reviewed the role and interaction of minerals involved in reproduction in sows.

Calcium and phosphorus requirements need to be met. Keep the ratio close as excessive calcium can cause interference with other minerals such as zinc.

Environmental concerns require use of organic minerals with higher absorption and utilisation rates to reduce manure contamination. Recently it has been shown that increased levels of dietary organic chromium have improved longevity and productivity of sows.

The most important rule in lactation is to maximise feed intake of the sows. Research has shown that across crossbred sow type, the likeli-

hood that sows remained in the herd increased two to four times when lactation feed consumption increased by approximately 1kg per day. Another study demonstrated that a 1kg increase in daily feed consumption decreased the likelihood of being culled by 30%. Sows that consumed less than 7lb (3.2kg) any day during the first two weeks of lactation, (day two through to day 14), had a greater risk of being culled compared to sows which ate seven or more lb (3.2kg) per day each day during the first two weeks of lactation. Furthermore, sows which did not consume any feed during any day during the first weeks of lactation (day 2-14) had the greatest risk of being culled.

The key to reduce culling of young sows is to make sure they are consuming enough feed.

Feet, legs and locomotion

Several major pork producers in North America have announced corporate decisions to adopt pen gestation as the preferred housing type for gestating sows.

These changes are being promoted on the basis of improved animal welfare even though research has shown that lameness scores increase in sows housed in pens compared to sows housed in gestation stalls.

A review of several studies by McGlone et al. (2004) reported that sows in stalls consistently had equal or greater reproductive performance compared with sows in group housing systems.

Karlen and coworkers (2007) reported that sows housed in conventional gestation stalls weaned 39 additional piglets per 100 sows mated than sows housed in large groups on deep litter (hoops).

Sows housed in stalls had less reproductive failure, improved farrowing rate and heavier weaned piglets compared with sows housed in groups. Other researchers have reported that gilts in small pen groups had similar reproductive performance as gilts housed in gestation stalls.

However, from a welfare perspective, lesion scores were higher and walking (gait) scores were poorer in gilts housed in groups compared with gilts housed in stalls.

To further confound the issue, Bates et al (2003) reported that sows housed in groups with access to electronic sow feeders (ESF) had higher farrowing rate, higher subsequent litter birth weight and higher litter weaning weight than sows housed in gestation stalls.

However, other measures of sow welfare (for example, lesions) were not reported. Boyle et al (2002) reported that multiparous sows housed in pens (loose) in groups of four had less forelimb lesions than sows housed in individual gestation stalls; however, no differences in lesions were reported for 33 additional body locations on the sows.

Author	Removal reason (%)					
	Old age	Reproductive failure	Feet, leg locomotion	Poor performance	Death	Other
Stone, 1981	33.4	12.9	11.0	20.6		1.6
Friendship et al, 1986	19.2	23.7	11.8	14.5		2.3
Dijkhuizen et al, 1989	11.0	34.2	10.5	20.1		
Boyle, 1998	31.0	30.0	11.0	11.0	6.6	9.9
Harper, 2002	42.0	21.0	16.0	12.0	3.0	9.0
USDA, 2007	36.6	26.3	15.2	13.0		8.9
Dhliwayo, 2007		16.3	26.3	36.8	6.9	2.5

Table 2. Reasons for sow removal from the herd. Some of the categories were not reported directly by authors and were summarised from the review of Stalder and Serenius (2004) as the estimated value.

● Lameness, culling and mortality.

Engblom et al (2007) reported the reasons for removal of sows group housed during gestation in Sweden. Of the 14,234 removed sows, the most common reasons were:

- Reproductive disorders (26.9%).
- Old age (18.7%).
- Udder problems (18.1%).
- Low productivity (9.5%).
- Lameness and/or foot lesions (8.6%).
- Traumatic injuries (7.1%).

Anil et al (2005) reported that culling and mortality rates for gilts and sows in a sampling of 11 farms ranged from 23-50% and 4.7-9.5%, respectively. Vestergaard et al (2006b) reported that sows with elongated claws or claw cracks had 1.91 and 1.93 times, respectively, the odds of becoming lame as sows without elongated claws. Sows with uneven claws (medial vs lateral) had 1.55 times the odds of becoming lame as sows with even claws.

Kirk et al (2005) reported that the main reason for euthanising sows in Denmark was for locomotive disorders (72%). Furthermore, euthanised sows had high prevalence of overgrown heels (75%), claw wall cracks (49%), sole cracks (77%), and white line cracks (65%).

Approximately 40% of the sows in their study were euthanised or died spontaneously before the second parity.

Vestergaard et al (2006a) recently reported similar results of a separate study in Denmark. Clearly there are animal well being and economic implications of these data. Recently, Dhliwayo (2007) reported that leg problems was the most significant reason for involuntary culling (26.1%) and represented the major cost of replacement.

Sow claw and foot health is critical to improving sow well being, maintaining sows in the herd for improved longevity, and maximising the economics of pork production.

● Environment.

Den Hartog et al. (1993) reported that sows housed in groups in gestation had increased replacement rates compared with sows housed individually (55.6 vs 43.7%).

Hoof lesion scores numerically were higher for sows housed in groups compared with sows housed individually. Although not statistically significant, group housed sows had one less piglet weaned per sow per year. Thus, there appears to be a connection between claw lesions, culling and productivity.

Van der Wilt et al (1994) reported that group housed sows in self closing free access feeding stalls generally had less heel and wall lesions than group housed sows in pens with a feeding station. More recently, Deen and coworkers (2006) reported that sows housed in pens with ESF had a higher likelihood of all types of claw lesions.

Many of the factors that play a role in developing lameness have been reviewed by Kroneman et al (1993).

Factors include the anatomical structure of the pig and the weight bearing distribution being more for lateral than medial digits. Other factors are the condition and type of floor surface that interacts directly with the pig's foot. The abrasiveness, wetness, slipperiness, hardness and cleanliness of the floor surface along with the pen design and management affect the amount and type of lameness, and resulting longevity.

● Nutrition.

Nutrition can also affect culling of sows. Over feeding energy during gestation or under feeding protein and energy in lactation can have dramatic effects on sows remaining in the herd. Anil and coworkers (2006) found that sows consuming 3.5kg of feed per day during the first two weeks of lactation were more likely to be removed from the herd. The odds of removing a sow from the herd before the next farrowing decreased by 30% with an increase in lactation feed intake of 1kg.

The odds of removal were highest for sows that did not consume any feed during any one day in the first 14 days of lactation. In addition to protein and energy, macro-minerals, trace minerals and vitamins have been implicated in maintaining claw health. Sow trace mineral status has been shown to decrease with increased parity. Recently it has been suggested that the level of trace minerals and vitamins fed to sows should be modified as the sow ages to account for changes in body mass.

Data in the dairy cow suggests that improved bioavailability of trace minerals by feeding Zinpro minerals improved claw health. Given the similarity in production environments and productivity expectations between cows and sows, it is logical that this response is likely for the sow also.

Recent field information reported at the Worlds' First Sow Lameness Symposium ind Minneapolis, USA, in April showed that sows fed Zinpro Performance Minerals had less heel overgrowth and erosion and wall cracks. Furthermore, the Denmark data showed that sows with improved mineral nutrition required less antibiotic treatment.

● Genetics.

There is relatively little scientific literature concerning the genetic correlations and a method is lacking to effectively measure longevity due to the large impact of epigenetic effects. This makes it very difficult to estimate breeding values and for effective selection for the trait of sow longevity. Although not directly linked with claw lesions, a study of several prominent genetics sources found that longevity was impacted by genetics.

However, sow longevity is a complex trait and heritability estimates have ranged from 0.02-0.25. Crossbred sows seem to have more durability than purebred sows.

Implications and research

Maximising sow longevity is an opportunity to enhance production system efficiencies while improving sow welfare. There are many factors implicated as contributing to sow removals. Feeding and nutrition, facilities and environment, genetics and management are all part of the challenge in maximising sow longevity. Clearly a multifactorial problem demands a multifactorial solution. There are many areas for improvement and additional research.

One area requiring more aggressive research effort is foot care and interaction of facility walking surfaces with the sow foot. How does flooring material, condition (wet or dry) and hygiene affect sow foot health? Management focus should be on identifying and treating lameness quicker. Nutritional modifications should be made to prevent lameness and maximise sow foot health. ■