INTRODUCTION

Parity profile influences both biologic and economic performance of sow herds. Understanding the factors that can affect parity structure and to be able to manipulate them is essential to optimize long term profitability of pig producers. Optimum parity profile is a mathematical function of sow removal rate, gilt availability, hog market price and feed ingredient cost.

Sow removal rate for any given period is defined by the sum of culling rate and death loss. In turn, culling rate can be arbitrarily divided into (1) voluntary, due to old age and/or low performance; and (2) involuntary, as in long wean to service interval, reproductive failure, lameness, and poor body condition.

When deciding to cull a sow, it is assumed that the replacement gilt will have better chance to farrow and wean more heavier and healthier pigs. It is also assumed the replacement gilt will have an earlier return to estrus after weaning with higher probability of producing a good litter in the subsequent cycle.

The purpose of this document is to review and understand the implications of culling and parity structure and to provide management recommendations to optimize performance of sow farms.

TARGETS

When evaluating farms or systems, it is necessary to understand where it ranks compared with industry benchmarks. In this case, the benchmarks are based on PIC targets and the top 25% of the producers and companies recorded by Agristats (Table 1).

Sow mortality has not been an issue recently, but culling rate is the main opportunity to reduce removal rate, optimize parity structure, average age, average age at removal, and consequently to optimize herd performance and profit.
The difference is based on different culling rates. The numerical difference is 6% between PIC target and the 25% most successful producers in terms of cost. In a 20,000 sow complex, that difference equals to 1,200 additional culled females per year, even more in the other 75% of producers.

Table 1. Key Performance Indicators (based on 2.5 Litter/Sow/Year)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>PIC Targets</th>
<th>Agri-Stat Top 25%</th>
<th>Difference</th>
<th>Interference Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sow Mortality (%)</td>
<td>&lt; 6.0%</td>
<td>5.0%</td>
<td>1.0%</td>
<td>&gt; 9.0%</td>
</tr>
<tr>
<td>Culling Rate (%)</td>
<td>&lt; 44%</td>
<td>NA</td>
<td>NA</td>
<td>&gt; 50%</td>
</tr>
<tr>
<td>Annual Replacement Rate (%)</td>
<td>&lt; 50%</td>
<td>56%</td>
<td>(6%)</td>
<td>&lt; 30%; &gt; 60%</td>
</tr>
<tr>
<td>Average Herd Age (parities)</td>
<td>3.5</td>
<td>3.0</td>
<td>(0.5)</td>
<td>&lt;3.0; &gt; 60%</td>
</tr>
<tr>
<td>Average Age at removal (parities)</td>
<td>5.5</td>
<td>4.5</td>
<td>(1.0)</td>
<td>&lt; 5.0</td>
</tr>
</tbody>
</table>

(I) Top 25% Ranked on Cost of Production

Even though there is an opportunity to capitalize on culling rate, the US industry has not been proactively dealing with this. Perhaps what the producers are missing are clear targets for culling (see Table 2)

Table 2. Culling Targets

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Target (I)</th>
<th>Target (II)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voluntary</td>
<td>30%</td>
<td>68</td>
</tr>
<tr>
<td>Reproductive Failure</td>
<td>10%</td>
<td>23</td>
</tr>
<tr>
<td>Unsoundness &amp; others</td>
<td>4%</td>
<td>9</td>
</tr>
<tr>
<td>Total Culling</td>
<td>44%</td>
<td>100</td>
</tr>
</tbody>
</table>

(I) % of the average sow inventory.
(II): Breakdown of 100 culled females.

USE OF PERFORMANCE RECORDS

Understanding why, when and how sows are removed from the farm is the first step to establish corrective actions when there are deviations from the target. When facing high sow removal and/or early sow removal, the first approach to the issue is a record review. To be relevant, records have to be updated and accurate. A special consideration must be taken when comparing system using different record systems, to make sure the comparison is fair and the conclusions are valid.

It is essential to train the farm personnel in the correct identification of culling reasons and sow mortality reasons. It is common to see 30 or even more culling reasons in a system, so training and expertise can reduce the numerous reasons that different farms or systems are currently reporting. In turn, this helps to simplify the farm staff’s job, does shed light on the field diagnostic, and does support establishing action plans to deal with the issue and be successful in controlling it.
Making sure that destroyed females are included in the records as part of the sow mortality is part of the initial approach so that they are not added in the culling.

CULLING AND PARITY PROFILE

A review of culling records from a total of 50 sow farms, with an inventory of more than 180,000 sows in the Midwest (Table 3), revealed that almost a third of the females are unable to wean more than three litters before culling. This fact is one of the main opportunities that the industry has to realize. It identifies the need to look for management procedures and health programs to allow pig producers to capitalize the benefits of higher sow retention rates and consequently a more mature sow herd.

Table 3. Culling Rate By Age

<table>
<thead>
<tr>
<th>Parity</th>
<th>P-0</th>
<th>P-1</th>
<th>P-2</th>
<th>P-3</th>
<th>P-4</th>
<th>P-5</th>
<th>P-6</th>
<th>P-7+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culling Rate (% of sow inventory)</td>
<td>5.3%</td>
<td>10.4%</td>
<td>6.7%</td>
<td>5.2%</td>
<td>5.3%</td>
<td>5.4%</td>
<td>4.8%</td>
<td>9.4%</td>
<td>52.52%</td>
</tr>
<tr>
<td>Cumulative</td>
<td>5.3%</td>
<td>15.7%</td>
<td>22.4%</td>
<td>27.6%</td>
<td>32.9%</td>
<td>38.3%</td>
<td>43.1%</td>
<td>52.5%</td>
<td>52.5%</td>
</tr>
</tbody>
</table>

(IV) 180,000 sow inventory; 94,600 culling records analyzed; 12 month period ended in October 2009.

Younger parity females are often removed by involuntary culling. Removed young females are not fully amortized so they increase cost of the weaned pig. These removed young females are replaced by even younger females, adding to the cost of additional replacement rate to the challenges on production associated with lower immunity against reproductive diseases and digestive diseases, lower litter birth and weaning weights, and potentially compromising pigs’ performance after weaning.

The most important single factor that makes gilts eligible to be bred is body weight but in reality a minor group of sow herds can weigh gilts. Thus, flank taping or gilt age is the most common methods to estimate eligibility. When contrasting weeks of age at first breeding versus culling rate from breeding to first weaning, it is noticed that removal rate remains constant in gilts first bred from 28 weeks of age until 31 weeks of age. From 32 weeks of age, there is an increased culling rate (Graph 1). It is unclear with the current recording system why older gilts tend to have a shorter productive life; however it can be speculated that they were bred late in life due to limitations in growth rate, in their reproductive ability, or both.

Producers should consider implementing action plans to retain sows longer in
farms when planning to be more profitable in the future. The advantage to retain sows longer in farms operates at different levels. Thus, a more mature herd can optimize production of full value piglets, and consequently finisher performance and percentage of full value pigs to market. A 45-50% annual replacement rate is proposed as the more reasonable target, with an average age in the neighborhood of 3.5 parities, and a 33% of the breeding group in the P-0 and P-1 category and more than 50% in the P-2 to P-5 group (Graph 2). Exception to those rules would be start up farms and when there is a herd closure due to disease outbreaks.

Farms or systems not retaining 70%, or above, of the bred gilts through P-3 are not able to consistently hit the targets associated with 50% annual replacement rate and average removal age of P-5. This emphasizes the concept that producing enough high quality gilts is a key element of any plan to have the right parity profile. The correct ratio of great-parents to commercial females should be allocated: 1 great parent female will produce 7 commercial females per year, assuming 70% of selection rate at 25 weeks of age. From selection, gilts should be raised in no less than 12 sq. ft per gilt to ensure proper growth rate and make the

Graph 1. Removal Rate in Gilts According to Age at First Breeding

Graph 2. Breeding Groups and Annual Replacement Rate.
heat detection simpler. In order to maximize the number of eligible gilts from any given batch of gilts consider providing them a dry environment, non-slippery floor, full feed and one drinker per every 15 gilts, daily boar exposure to a mature boar for at least 6 weeks prior to the actual first breeding, and crate brake them for a minimum of 15 days prior first breeding. The crate broke is the time allowed to the gilts to overcome the negative impact on litter size that the transference from pens and full feed to individual crate and feeding once or twice daily can have on litter size. PIC data shows that this drop in litter size can be from 0.5 to 1.0 pig born alive in P-1 (Piva & Pinilla, 2008. Non-published).

Within the same system or pyramid of production there can be major variations in sow retention rate, as shown in Graph 3. A 40,000 sow system shows a retention rate of 69% up to P-3, with ranges anywhere from 55% to 85%. These variations do exist even within farms getting their replacements from the same source and are managed by the same SOPs. Factors like annual feed usage and body condition, labor turn over and qualification, staff motivation, health, and facility lay out should be investigated and ruled out as potential risk factors.

Automated feeding system and farrowing feeder design are essential today to optimize production and sow retention. It is well documented the positive impact of automated feeders in farrowing in terms of litter weight gain and the correlation between higher feed intake in lactation and sow retention rate. In the same line, a different size of farrowing crate should be considered to maximize milk production and sow appetite in lactations longer than 21 days. Any disruption of the normal production flow can potentially impact culling rate,

**Graph 3. Sow Retention Rate Variations.**
average age at removal, annual replacement rate, and/or even sow death losses. In this case, farms have to retain marginal sows and/or have a low selection pressure of the replacement gilts to hit the breeding target at any given time. This is the beginning of what has been called the death spiral, characterized by higher sow mortality rates, lower retention sow rates and lower reproductive efficiency.

GENETIC CONSIDERATIONS

It is well accepted that heritability of sow longevity and sow mortality is low\(^4\), so they are mostly modulated by environmental factors. However, structural soundness of legs is moderate to highly heritable, so breeding stock supply companies can make a difference when they select against unsoundness.

The current PIC GN Cross Bred Program allows the Genetic Nucleus Operations to select pure lines based on family performance in commercial environments. Selecting for good performance in those environments is selecting for robust pigs and significant improvements have been realized\(^5\). In terms of use of indexes, the estimated breeding value in dam lines considers sow mortality and leg scoring. Thus, a strong trend downwards and an inverse trend in leg score have been both

Graph 4. Sow Mortality: 15-Yr Trend in Camborough\(^\text{®}\) Female
realized in the PIC maternal lines (see Graph 4 and Graph 5), providing the global pig industry with an increased frequency of genes to express higher level of robustness.

**ECONOMICS**

In an expensive feed ingredient environment, sows enter into positive margins later in life. Thus, in a model based on cost of production of $29/weaned piglet, 11.1 weaned piglets per litter and a purchase price of $200/gilt, females remain in negative margin until P-3 and start to move into positive territory at P-4 (Graph 6 and Graph 7). They gain economical advantage until P-5, remaining in this area until P-7. After that, there is no advantage to retain them in the farm.

**CULLING: PRACTICAL RECOMMENDATIONS FOR FARM STAFF**

1. Avoid culling sows before their third weaning. Cull the ones that were not able to wean 30.0+ piglets until P-3.
2. Avoid retaining sows after P-7.
3. Pick the sows to be culled in the farrowing house and avoid housing them in the weaning row.
4. Cull gilts with no recorded HNS, 6 weeks after the beginning of boar exposure.
5. Cull sows with no heat after 4 weeks from weaning date.
Graph 6. Cost of Production of Weaned Piglet (in $) and Cumulative Margin per Female By Parity.

Graph 7. Return per Female By Parity

6. Cull sows with metritis (uterine infection and discharge) and return 2-5 days later.
7. Cull sows having mastitis and/or less than 8 functional teats.
8. Cull sows that have low chances to farrow next time.
9. Cull sows with abortion (excluding abort storm when facing PRRS outbreaks).
10. Cull sows in extreme poor body condition at weaning.
CONCLUSIONS

1. Culling process is part of the continuous improvement of biologic performance of commercial sow herds and a contributor of better economic results. To improve cost of production, replacement rates need to be reduced to the range from 45 to 50%, culling rate of 44%, female retention rate of 70% until P-3, average age at culling of P-5 and average herd age of 3.5 parities.

2. Value of records is limited but still a good tool to investigate low retention rate. Culling reasons must be recorded properly.

3. Personnel could have a potential positive impact to get better diagnostics and dealing with low retention rates. Variations due to environmental factors can create large differences in retention rates in sows getting their replacement from the same source and are managed under the same protocols.

4. Maximizing eligible gilts is part of the process to get optimum parity profile. Proper gilt development is essential to achieve proper culling rates and parity structure.

5. A female does not pay for herself after completing P-3.

6. Culling policies must be clearly defined and adhered to by farm staff. Culling provides an excellent opportunity to remove marginal females and replace them with more productive ones.

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REFERENCES