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Managing sow farms for high performance

J.C. Pinilla, DVM, MS; A.M. Williams, MS
Technical Services, PIC North America, Hendersonville, Tennessee

Introduction

It is not uncommon for a pig veterinarian to be asked how to manage a new and more prolific genotype. It is also not uncommon that pig producers all over the world invest in facilities and genetics and yield results that are a long way away from their expectations.

Highly productive farms are not an accident. Farms or systems that consistently perform above targets tend to have common views on principles and priorities in production and encompass a mentality of high performance. Good husbandry and an earnest focus on what is possible to effectively control play a role in creating differences in performance when everything else is kept constant. The impact of management practices, therefore, can be placed at the same order of magnitude as health status.

This document intends to summarize current knowledge on management strategies that have been consistently proven in the field to make a positive impact on the final result of sow units.

Defining a highly productive farm using benchmarking

Many aspects can be considered when defining a highly productive farm. Table 1 shows current targets that take into consideration today's main input costs on a sow farm and include all the traditional indicators commonly used on sow farms.

When farms are not even close to these figures it is necessary to understand the intrinsic limitations before establishing an action to plan to fix the issue. It is important to be very realistic in terms of the actual likelihood that a particular farm or system has to achieve the proposed targets.

Managing gilts for high performance

There is no question about the fact that successful systems are always built on optimized management of the gilt pool. Gilts have an impact on (1) every batch of farrowings, (2) subsequent sow parities, and (3) total cost of production. Current expectations for P-1 female production can be seen in Table 2.

Requirements to breed gilts

First, body weight is the single most important factor in the success of the P-1 and her lifetime productivity. Breed gilts in the 300 to 320 lbs. range, not heavier and not lighter. In order to get there consider a minimum of 12 ft²/gilt after selection, 1 drinker per every 15 gilts (1:20 if bowls are used) and 1 feeder space per every 12-15 gilts. Feeders must provide them *ad libitum* feed (full feed) and have a safe design to prevent injury. Crate break gilts in individual stalls ≥ 15 days prior to first service to overcome the effect of feed disruption produced by the movement from pens to stalls. After placing them in the stall, feed them at least 3.5 to 4 lbs. twice daily. Any type of feed restriction or feed supply disruption can be detrimental to ovulation rate.

When using physiological age as an indicator of gilt eligibility it is important to understand that there is solid evidence that litter size increases by breeding gilts during

Table 1: Key performance indicators for 2010

Input cost	Criteria	PIC target	Intervention level
Feed	Pounds of feed per weaned piglet	< 80	> 85
Energy	Mcal ME per weaned piglet	< 42	> 50
Facilities	Piglets weaned per farrowing crate	> 180	< 160
Labor	Piglets weaned per worker	> 9,000	< 8,000
Genetics	Piglets weaned per sow lifetime	> 55	< 50

Table 2: Key performance indicators for P-1 females

Indicator	PIC target
Avg. total born	14.0
Avg. born alive	13.0
Avg. weaned	12.0
Consistency	Absence of P-2 dip
Retention rate	> 70% bred gilts retained up to P-3

their second standing heat versus their first one. There is little advantage, however, if any, to wait until after the second standing heat.

Secondly, the tools to ensuring a constant supply of fully prepared gilts will enter into the system are boar exposure and heat detection. This has to be done from 24 weeks of age, once a day, 7 days a week, using active, adult boars. The quality and quantity of boar exposure are both important. Quality is understood as direct contact, allowing the boars to nose the gilts' flanks and jump on their back but not actually mate them. Quantity is the time of actual contact per gilt, which should be calculated as no less than 30 seconds per gilt per day. In a healthy population, > 70% of contemporary gilts will have their first Heat-No-Service (HNS) within 3 weeks from the beginning of boar exposure. Understanding the particular reasons why a system is unable to achieve that percentage of reported HNS events and fixing the issue will allow them to (1) keep the gilt pool as small as possible and target 5% of the total sow inventory; (2) not use unnecessary pharmacological interventions; and (3) make sure the majority of gilts are bred at their second HNS. Within 6 weeks of boar exposure, > 95% of the gilts should have at least one HNS. Cull gilts remaining in the pen no later than 9 weeks after the beginning of boar exposure. It is assumed they have a reproductive limitation, and to keep the gilt pool small they must be culled.

The third central element is to help the replacements build solid immunity prior to the first breeding. Vaccine programs and other health interventions equalize the health status of the replacements with adult sows and prevent any epidemiological activity in the herd. Once the health program is finished, allow 3 weeks to pass prior to breeding to ensure they have built a strong immunity against reproductive diseases that affect P-1 performance and against digestive diseases that may affect litter performance.

Last but not least, the fourth central point is to thoroughly select gilts before the beginning of boar exposure. Boar exposure and the vaccine program should begin only with selected gilts. Consider selecting a maximum of 90% of the present gilts (optimum 75-85%). Once gilts are selected it is reasonable to assume that out of every 100 selected gilts, > 95 will make it their first breeding, > 87 will be retained until P-1, > 79 will be retained up to P-2, and > 72 will be retained up to P-3. To optimize selection rate, gilts must be raised in an environment where humidity is ≤ 70% and ventilation is set according to weight/age and weather conditions. Selection rate from 180 days to insemination should be around 95%. An additional 5% of gilts should be shipped to the sow unit to account for that difference. Part of the selection requirements should include number of quality teats because a minimum of 12 functional teats are required to raise 12 piglets.

Chronological age is not as important as previously thought. In most cases, however, age is the only indicator that farms use as a reference. Typically, females of the Camborough® family achieve 300 lbs. anywhere from 28 to 32 weeks of age, depending on nutrition, feeding, health, density and other environmental factors. Finally, measuring backfat is not as important today as the previously mentioned indicators of eligibility.

Managing parity profile and optimizing lifetime lerformance

Current replacement rates for the majority of farms in North America are in the range of 60-70% (see Table 3). Attempting to reduce annual replacement rates to the 40-50% range seems to be the natural next step when looking for ways to optimize farm performance and cost:effectiveness of the gilt pool. A more mature herd, as a consequence of a reduced replacement rate, can optimize production of full-value piglets at weaning and effectively improve finisher performance and ultimately the percentage of full-value pigs marketed. A 40-50% annual replacement rate is proposed as a more reasonable target, with an average parity in the neighborhood of 3.5. Every breeding group should have 33% of the sows in the P-0 and P-1 category and more than 50% in the P-2 to P-5 group. Exceptions to those rules include start-up farms and when there is a herd closure due to disease outbreaks. When working with start-ups, the first year has to include a 15% replacement rate, starting with week 21 after the initial week of breedings. On year 2, replacement rate should be around 25-30% followed by 40-50% per year from year 3 and on.

Females that are removed before their third weaning are not fully amortized. These removed young females are replaced by even younger females. In addition to the cost of the increased replacement rate, this brings about production challenges associated with lower immunity against reproductive and digestive diseases, lower litter

Table 3: Key performance indicators associated with lifetime production (based on 2.5 litters/sow/year)

Indicator	PIC targets	Agri Stats® top 25%[1]	Difference	Interference level
Sow mortality (%)	< 6.0	5.0	1.0	> 9.0
Culling rate (%)	< 44	NA	NA	> 50
Annual replacement rate (%)	< 50	56	(6.0)	< 30; > 60
Average herd age (parity)	3.5	3.0	(0.5)	< 3.0; > 4.0
Average age at removal (parity)	5.0	4.5	(0.5)	< 5.0

[1] Top 25% ranked by cost of production within the Agri Stats® database.

birth and weaning weights, and potentially compromised pig performance after weaning. Farms or systems should be able to retain 70%, or above, of the bred gilts through P-3. Any disruption to the normal production flow can potentially impact culling rate, average age at removal, annual replacement rate, and/or even sow death loss. In this case, farms have to retain marginal sows and/or apply a low selection pressure to 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 sow retention rates and lower reproductive efficiency. In other words, it is mandatory to look for management procedures and health programs to allow pig producers to capitalize on the benefits of higher sow retention rates and consequently a more mature sow herd. Different replacement rates will produce different parity profiles in production batches, as shown in Figure 1.

As expensive feed ingredients become the new normal, analyzing the economics of replacement rates will be one of the tools to improve the cost efficiency of sow farm operations. Cumulative margin per sow is the economic function of cost of production, revenue per piglet weaned and performance expressed as average weaned piglet per farrowing. In general, farms with higher performance are able to leave the negative margin zone sooner in the sow's lifetime, and typically there is no advantage to retain sows after P-7 (see Figure 2).

Controlled weight gain and feed usage in gestation

The negative effects of excess body weight gain in gestation are well known: (1) higher sow removal (death rate plus culling rate); (2) higher stillborn rate; (3) limited feed intake and increased sow body weight loss during lactation; (4) added cost of production of the weaned pig when overfeeding sows; and (5) a compromised litter size in the subsequent farrowing.

In general, every pound decrease from 7.0 to 4.5 lbs. per day of gestation diet can be translated into 1.0 to 1.1 lbs. per day of additional feed intake in farrowing. In turn, every additional pound of average feed intake in farrowing can be translated into 20 extra lbs. of piglets weaned per sow per year. Major changes in sow body condition can have an effect on litter size by affecting embryo survival in early gestation and litter birth weight.

During their first gestation the female should gain around 80 lbs. (100 lbs. maximum) of body weight. From P1 to P6, an average increase of 35 lbs. (45 lbs. maximum) of body weight per gestation is acceptable. A maximum of 8% of body weight may be lost during the first lactation and a maximum of 5% average weight loss in older parity sows is considered the limit for body weight loss to maintain the capacity for high performance.

Practical experience with typical nutrient densities used in the United States indicates that normal conditioned sows require 4.5 lbs. per day, overconditioned sows require 4.0 lbs. per day and thin sows require 6 lbs. per day. A female in her first gestation (P-0) needs no more than 4.0 lbs. per day. Every sow in normal body condition should get 6 lbs. per day during the last 2 weeks of gestation. Under this management, the sows will use 1,450-1,600 lbs. of gestation feed per sow per year. Farms facing issues of sow mortality, low weaning weights, and eventually increased weaning-to-estrus intervals should compare themselves with the mentioned target.

The goal of any effective gestation feeding program is to have 85-90% of the gestating sows in "normal' condition or a body score 3 (on a scale of 1 to 5 with 1 being the thinnest and 5 being the fattest) by 4 to 5 weeks of gestation.

Maximizing the number of piglets born

Maximizing total born

Genetic potential must be supported by (1) a positive energy balance (as catabolic females will underperform);

Figure 1: Breeding groups structure & annual replacement rate

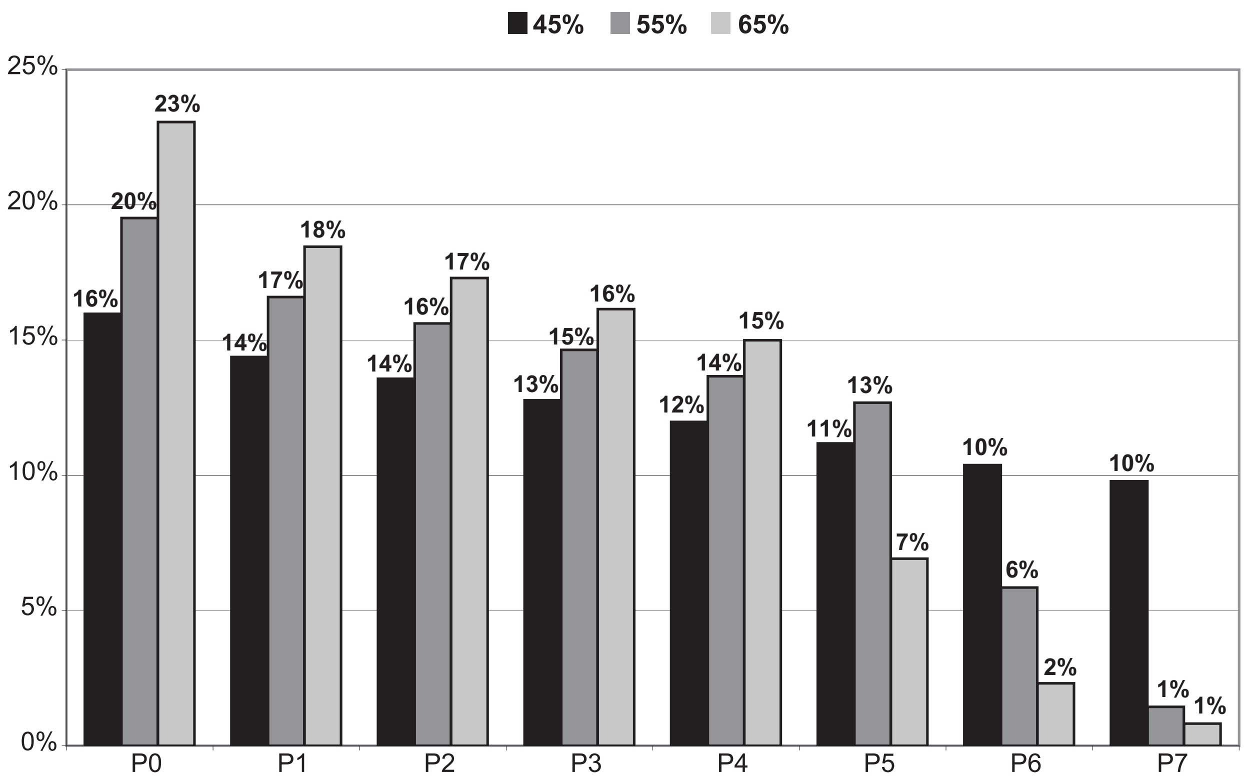
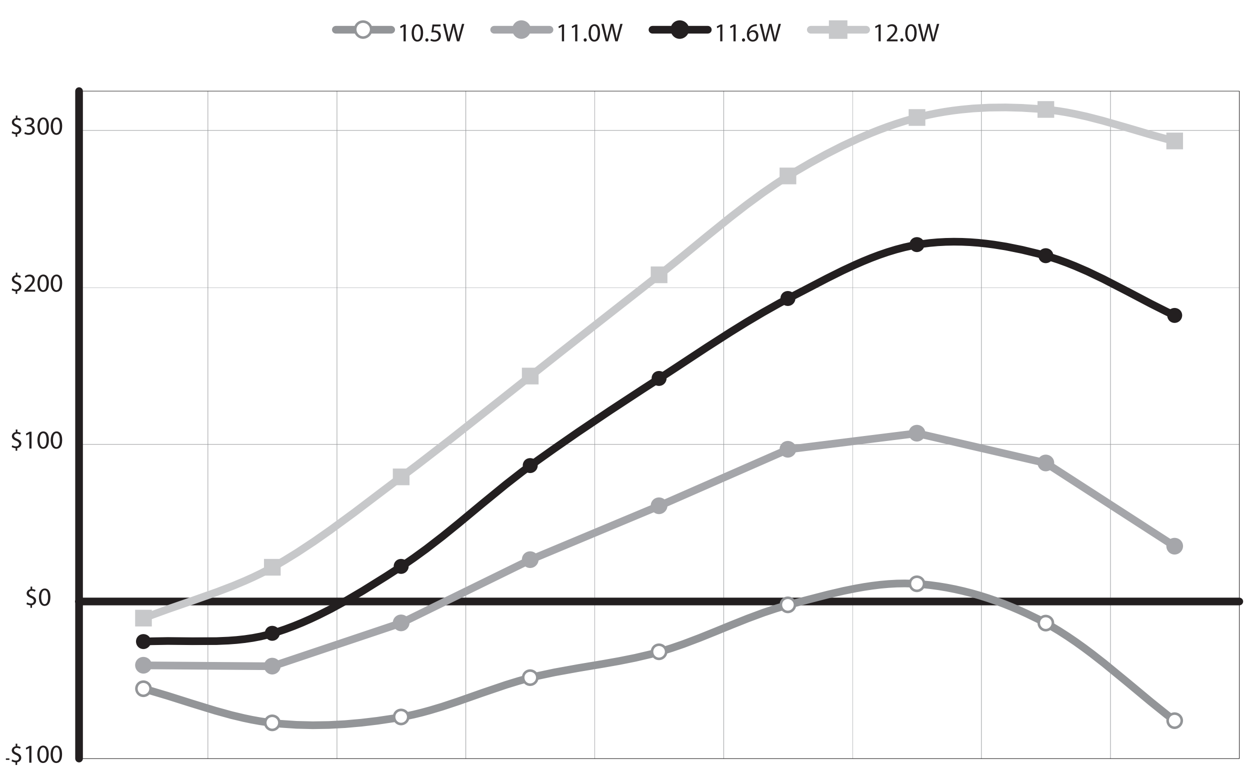


Figure 2: Economics of retention rate (cummulative net margin by parity)



(2) fresh semen (farms should get semen doses no less than twice a week); (3) a high level of hygiene during the breeding process; (4) proper stimulation with adult boars during insemination and in the following 15 minutes (to support semen transport and minimize semen backflow); and (5) a motivated staff that really cares about what they are doing and their results.

Strategies that maximize feed intake in farrowing are functional to the purpose to maximize littersize but also to increase retention rates and litter weaning weights. The key elements are: (1) water availability, glow rate an water temperature; (2) prevention of piglet's scours; (3) control of hyperthermia after farrowing; (3) feed quality; (4) feed management (including the use of automatic feeders, which when well managed allow higher daily intake); (5) controlled fostering practices; (6) cooler farrowing room (66-67 degrees 3 days after farrowing),

Both facilities and animal flow should take into consideration the detrimental effect of any movements around the implantation period. In practical terms, keep the bred animals in the same crate for the whole gestation or move them within 3 days of breeding and after 30 days of gestation. Even in loose housing systems, the most current recommendation is to not move gestating sows from crates to pens until they have been checked for pregnancy, which is typically done by 4-5 weeks of gestation.

Maximizing born alive to total born ratio

Stillborn rates can range from 3% to more than 10%. The variation can be explained by differences in staffing and in the implementation of peri-natal management and obstetric intervention protocols.

Understanding the risk factors for stillborns is the beginning of the solution. After identifying the risk factors it is possible to establish tailored strategies of intervention. Those risk factors are high litter size (13.0+ piglets born alive), female age (too young/P1 and too old/ > P5) and finally the farrowing duration (> 3 hours).

Stillborn rate can be reduced by increasing the ratio of assisted to unassisted farrowings. A proper farrowing induction program can also reduce stillborns by making more sows farrow during the working hours and by actually monitoring higher risk sows every 15 minutes (every 30 minutes in sows of lower risk). With trained people, the percentage of stillborn during the day should be < 3%. When unassisted, around 8 to 10% of stillborns can be expected. The stillborn percentage can be used to track staffing and labor force efficiency. Without farrowing induction the percentage of sows farrowing when the labor force is in the farm is in the neighborhood of 35 to 40%. With farrowing induction at d 115, the percentage of sows farrowing during the day should increase to 60%+.

Stillborn rates increase as the female ages. This is due to uterine atony, which occurs in older females and is strongly correlated with extended farrowing. To reduce this risk, induce older sows ($P > 5$) to farrow during the working hours and monitor them more frequently than younger females (every 15 minutes for older sows; every 30 minutes for younger sows).

The use of oxytocin should be monitored and controlled. Many systems inject sows too often with an excessive dose, without any real necessity. In general, before using oxytocin, (1) check that there is not a piglet stuck in the birth canal; (2) try to not use oxytocin before 5 or 6 piglets are born; (3) try to avoid using more than 10 IU (typically 1/2 cc) per shot and administer no more than 2 shots per female at 3 hours apart.

Weaning a greater number and heavier piglets

Piglet birth weight

Every strategy to save more piglets and wean them at heavier weights with less variation is supported by a competitive birth weight. One of the negative effects of major changes in sow body condition across the reproductive cycle is lower piglet birth weights. Interventions aimed to minimize body weight changes will result in heavier litter weights at birth.

Farrowing induction also plays a major role in the determination of piglet weight and survivability. Data collected from a commercial system supports that every additional day in gestation allows the piglets to be born 0.15 lbs. heavier per additional day in gestation from 113 to 118 days. Consequently those heavier piglets at birth have a greater opportunity to vigorously suckle the teat, have an increased survival rate, gain more weight per day and are weaned at a heavier weight.

Preventing chilling

Any management that improves weight, quality and vigor of the piglets is instrumental to minimize the negative effect of chilling. Chilling makes the piglets lethargic and they are unable to get enough colostrum. The effect of chilling is exacerbated when they are born too early in gestation due to a suboptimal farrowing induction strategy. Drying the piglets off is a cost effective management tool that should definitely be implemented in more farms to prevent piglets from being chilled.

Colostrum management/split nursing

There is little opportunity for the piglets to survive and to thrive if they have limited colostrum intake. Practices ensuring colostrum intake, like split nursing, may be utilized to provide colostrum for every piglet, particularly in farms with a high number of average born alive. Take the 5-6 heaviest piglets int he litter that have had a chance to consume colostrum to a heated box, leaving plenty of room for the other 6-7 piglets to drink colostrum for 90 minutes to two hours. After that, place the heavier ones back with their littermates. In order to organize this management practice, use split nursing twice a day. Use it once in the morning for sows that finished farrowing in the afternoon/night and once in the afternoon for sows that finished farrowing in the morning.

P-1 Lactation

Lower performance in farrowing can be traced to the practice of loading P-1 females with just 9 to 10 piglets in order to "prevent extensive catabolism". The current recommendation is to load P-1's with 14 strong and heavy piglets (as long as she has 14 functional teats) and support that with proper feeding management, cooler rooms, limited cross fostering, and water availability. In the author's experience, > 80% of the P-1 females are able to wean the same number of piglets that they nursed from day 1.

The female is able to react to a higher milk demand because of the number of piglets she is nursing by eating more feed. Suckled glands will be larger and more productive in subsequent lactations than unsuckled or poorly suckled glands.

Fostering practices

Cross fostering is one of the most common procedures implemented in farrowing. In general, looking for consistency in piglet size is something farrowing staff overemphasize and quite often its effect is counterproductive. When the equalization by size is made after day 1, and it is done too often, the benefits are limited because it disrupts the normal process of nursing, sows tend to retain milk, piglet weight gain is limited and mastitis can become a problem

Basic rules to implement when fostering are: (1) give all the piglets a chance to consume colostrum from their biological mother; (2) foster piglets within day 1; (3) place > 14 piglets on a P-2/P-3 sow; (4) never move piglets with diarrhea.

Nurse sows can raise the fall-behinds and litters can be created from day 3 to 5 by moving a fresh sow from the next younger room. It is important to limit the fostering at 3-5 days of age to a maximum of 10-15% of the litters.

Longer lactation

The PIC recommendation is to wean at 20+ days of lactation. The concept of longer lactation has been challenged in different systems looking for heavier piglets at weaning. The added value of a longer lactation is an increase in litter size in the subsequent farrowing (0.1 to 0.2 piglets/additional day in farrowing). This is a consequence of the ability of the endometrium to heal completely with more time, particularly in P-1 females. All sows experience a negative energy balance immediately after farrowing. Sows that consume feed during early lactation reach a neutral energy balance by d 5 to 7 of lactation. With continued feed intake, sows use available nutrients to produce milk and are in an anabolic state. Sows that decrease their feed intake or go off-feed become catabolic and are in a negative energy balance once again. Increasing lactation length gives the sow a little more time to consume feed, reach a positive energy balance and encourage follicular growth to increase litter size in the subsequent lactation.

Many modern farms cannot absorb additional days of inventory in farrowing unless some changes are implemented. The first option is to add farrowing spaces to the system plus a more efficient use of the farrowing rooms. To calculate how many new farrowing spaces are required multiply the factor 0.007 × the average sow inventory × the planned extra days of lactation. A second option could be to reduce the breeding target, which takes effect no sooner than 16 weeks after the action is taken for an average sow inventory, and it is not as cost effective as the addition of more farrowing spaces.

Special situations

Every process involving off-site breeding projects, like farm start ups, re-stockings, and expansions, has the potential to create performance issues and/or undesirable outcomes. It is common to see this happen to a good performing farm/system. In the particular case shown in Table 5, farrowing rate was more affected than litter size but P/S/Y was evidently affected. After a full year, the results are getting better.. The table indicates that even good farms/systems can have difficult times handling expansions. In many occasions, preweaning mortality and sow removal rate can also be negatively affected. Staffing the system with qualified labor, keeping high standards in gilt management, having enough gilts to start the breeding project, and achieving breeding targets from the first week of the expansion are the most critical points to have under control when expanding a farm/system.

Part of the reason that explains substandard performance is the existence of some level of self-complacency, which assumes that because it is a special situation the farm can operate under lower standards. Critical points to control these issues are: (1) gilt development (previously reviewed); (2) movement at wrong or critical points of gestation (too soon affects semen transport or too close to the implantation period); (3) undesirable matings when using intact boars for heat checking; and (4) proactively mitigating aggression in pen housing.

Table 5: Historic performance prior and after an expansion.

Indicator	2007	2008	2009 Expansion	2010 Jan-Jun	2010 Apr-Jun
Sows	2,317	2,678	5,218	5,557	5,575
Matings	5,092	8,319	15,600	6,455	3,869
Farrowings	2,665	6,661	12.170	5,598	3,492
Returns, %	NA	4.6	8.0	4.6	3.2
Farrowing rate, %	NA	90.3	86.9	86.7	87.4
Avg TB	13.1	13.4	12.9	13.5	13.7
Avg BA	12.0	12.3	12.0	12.6	12.8
Avg. weaned	11.1	11.4	11.1	11.5	11.7
P/S/Y	27.3	28.3	25.2	28.0	29.3
Lactation length, d	19	19	19	19	19
Sow mortality, %	1.0	3.2	2.8	2.3	2.7

Take home message

1. A highly productive sow farm is the outcome of many factors, strict standards in health and management are the most important.
2. Understanding the reason why a farm does not express its productive potential is the right way to start any intervention plan to get better performance. Be realistic in terms of expectations.
3. To prevent a disappointing experience, make sure to explain that setbacks can happen and overpromising is never a good option.
4. Body weight from 300 to 320 lbs. is the most decisive factor associated with success as a P-1 and retention rate in the herd.
5. Typically, sow farms bounce up and down in terms of gestation diet utilization and sow body condition. Make sure your system gets close to 1,450–1,600 lbs. of gestation diet per sow per year.
6. Many key elements of good management need to be present at breeding and at farrowing in order to maximize production of full value piglets. To name a few: hygiene at breeding, semen age, movements and animal flow, obstetric interventions, and lactation length.
7. Start up farms or expansions are always a challenge, basically due to lack of experienced crew or too many shortcuts used during the process.

References

1. Pinilla, J. C. and L. Lecznieski. Parity distribution management and culling.. Manitoba Swine Seminar 2010: 113–121.
2. Pinilla, J. C., J. Geiger, R. Kummer, J. Piva, R. Schott and N. H. Williams.. Management strategies to maximize weaning weight. 2008. AASV Annual Meeting Proceedings: 185–191.
3. Pinilla, J. C. Kummer, R., Piva, J., and Williams, N. H. Key components to wean 11+ piglets per farrowing. 2006. AASV Annual Meeting Proceedings: 215–220.
4. Williams, N.H., Patterson, J. and Foxcroft, G. Non-negotiables of Gilts Development. Advances in Pork Production (2005) Volume 16: 281–289.