EXTENSION BULLETIN E-1220
APRIL 1990 (MAJOR REVISION)

pork industry handbook

COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY

Reproductive Efficiency in Managing the Breeding Herd

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The purpose of this fact sheet is to help pork producers to better understand the relationship between productivity and profitability of their breeding herd. Productivity refers to biological information such as conception rates, farrowing rates, pigs per litter, pigs per crate and pigs per sow per year.

Profitability refers to the difference between cost of production and product value. It is usually associated with high productivity but is frequently influenced more by market prices and costs of production than by production.

In evaluating the efficiency of the breeding herd both measures of performance are important. The primary purpose of the breeding herd is to provide a source of feeder pigs, either for direct marketing, or for rearing to market weights in the same herd. The profitability of the breeding herd should be measured by profits produced through the feeder pig production phase of the enterprise but not the additional profits made on the feeder pigs when finished to market hog weights in the feeding phase of the enterprise. The latter portion of the potential profits could have been earned through the purchase of feeder pigs rather than from raising them within the same enterprise.

Production costs can be divided into two categories: fixed and operating or variable costs. Fixed costs are those that relate to the investment in facilities and equipment used for the raising of pigs. They include taxes, insurance, depreciation and interest on the investment. Total annual fixed costs are not highly correlated to production. Annual operating expenses, on the other hand, are highly correlated to actual production and account for the majority of the costs in pig production.

On a per unit of production basis, fixed costs usually decrease as biological productivity increases. Figure 1 shows the influence that the number of pigs weaned per crate has on the fixed cost per pig weaned. Operating or variable costs are generally not very responsive to increased productivity and, in some situations, may actually increase. For example, if increased labor is required to increase the pigs weaned per litter, operating costs per pig weaned could increase.

Sizing the herd

On most farms the number of farrowing crates available is the resource that determines the maximum number of weaned pigs that can be produced. The frequency of use of the crates and the number of pigs weaned per litter are the remaining factors that are used to calculate the final number of pigs produced.

Most studies fail to show an advantage in sow productivity for lactation periods of less than 21 days. Allowing

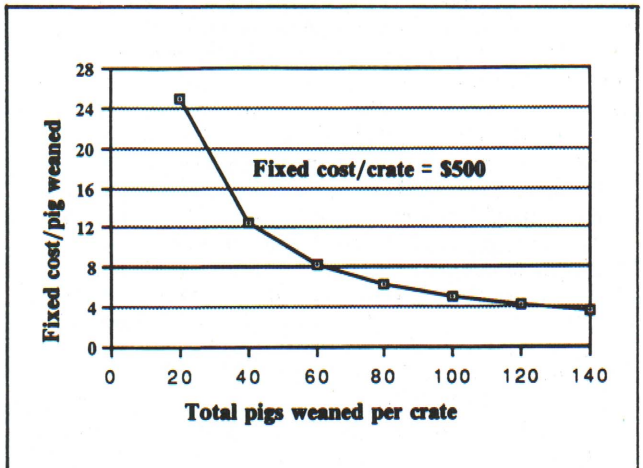
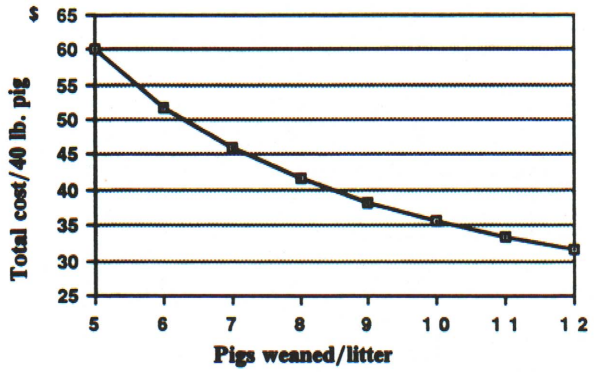


Figure 1. Effect of pigs weaned per crate on fixed cost per pig weaned.

for a few days variation in breeding dates and gestation lengths, 14 farrowings per crate per year could be obtained with three week weaning. Producers using an all-in all-out system allow some time for cleaning and probably obtain only 12 or 13 farrowings per crate per year. This rate of usage will require about 6 sows in the breeding herd for each farrowing crate. The next determinant of the total number of pigs produced is the number weaned per litter. When the unit costs of maintaining a sow through breeding, gestation and lactation are shared by the pigs weaned from that reproductive cycle, it is readily apparent that the sum of the fixed and operating costs per weaned pig will be lower when they are shared by a larger number of pigs. An estimate of the effect that pigs weaned per litter has on the total cost of producing 40-lb. feeder pigs is shown in Figure 2.



These costs are based on feed cost of 7¢ per pound and labor at $6.50 per hour.

Figure 2. Effect of number of pigs weaned per litter on the cost of producing a 40-pound pig.

Replacement Rate

Additional questions that producers face relate to what portion of the breeding herd should be replaced each year and at what parity sows should be culled.

Gilts typically do not farrow as many pigs in their first litter as they do in later litters. In addition, gilts are usually in the herd more days from the time of selection to weaning of their pigs, consume more total feed and consequently accumulate higher production costs than sows. Offsetting some of these costs is the value of the extra weight gained. In some herds second litter sows are also below average in productivity, measured by pigs weaned per litter, as compared to the third and later parities.

A percentage of farrowings on all farms is from gilts and in any one year can range from 0 to 100 percent. In many operations, gilt litters represent 20 to 40% of the farrowings. All selected replacement gilts do not produce a litter and therefore 50 to 120 percent of the average number of sows in the herd are added as replacement gilts each year.

Culling

Replacement decisions are usually based on biological and economic considerations. There are two types of culling that occur in breeding herds. Involuntary culling is the removal of females from the breeding herd for reasons such as death, anestrous, sterility, abortion, lameness, farrowing difficulties and old age. Voluntary culling is the removal of females from the breeding herd based on performance criteria such as numbers of pigs farrowed and weaned, weaning weights, days from weaning to rebreeding, production indices, and size or condition.

Since multiparous sows usually are more productive than first-litter gilts, biological productivity per sow can be increased by reducing the percentage of gilt farrowings. On the other end of the scale, the biological productivity of sows decreases as they produce beyond their 6th or 7th litter. The 1987 National Swine Improvement Federation Guidelines use the values in Table 1 for adjusting for parity differences in number of pigs born live and for litter weaning weight. These adjustments show that sows in 4th to 7th parities can be expected to wean more pigs per litter than other sows in the herd. If a limit is placed on the maximum number of litters any one sow can produce, and if a 15 percent culling level is uniformly distributed across the parities, Table 2 shows the portion of the farrowings produced from each parity.

With higher culling levels, a higher percentage of the farrowings will be from first-litter gilts, which tends to reduce the average number of pigs weaned from the total breeding herd. Offsetting that is the fact that the selected older sows will have slightly higher productivity and the herd productivity remains good when the maximum number of litters permitted per sow is from 6 to 10. Using the adjustments for number born live by parities from Table 1, and the parity distribution of farrowings from Table 2, the average values for pigs born live under the different maximum parity culling levels and for three different mature sow values are calculated and shown in Table 3. In a herd that has the genetic capability to average 10.5 pigs farrowed live per litter in 4th to 7th parities, if no sows are kept for more than 6 litters, 9.9 would be the average number of pigs born per litter. Similar procedures could be used to determine expected weaning weights.

By using the value of pigs farrowed live from the appropriate column in Table 3 and a value for pig survival rate to weaning, the number of pigs weaned per litter can be calculated for various maximum parities.

If additional parameters for sow death losses, weights of culled sows and feed prices are included, the break-even selling prices per 40 lb. pig for the various maximum parity culling levels can be calculated. The figures in Table 4 were calculated for herds producing 200 litters per year but with different limits on the maximum number of parities. The number farrowed live for 4th to 7th parity was 10.5. The survival rate to weaning was kept at 85 percent for all parities. Sow weights at culling ranged from 425 to 455 lb. over the range of the seven parity levels. Culled sow market price was kept constant at $40 per hundredweight. Sow feeding levels were kept constant on a per head per day basis for each of two stages of production, 5 lb. during prebreeding and gestation, and 12 lb. during lactation. Litters per sow per year ranged from 1.82 to 2.17 over the seven parity culling levels and the sow herd size was increased as necessary to keep the number of litters per

Table 1. Parity adjustments for number born live and litter weaning weights.*

Parity	No. born live	Litter weaning wt.
1	1.5	6.5
2	.9	0
3	.3	0
4	0	1.5
5-7	0	4.5
8-10	.4	8.5
>10	1.6	12.0

* National Swine Improvement Federation Guidelines, 1987.

Table 2. Percent of farrowings in each parity for various numbers of maximum parities.*

	Maximum parities							
Parity	2	3	4	5	6	7	8	9
1	54.1	38.9	31.4	26.9	24.1	22.1	20.6	19.5
2	45.9	33.0	26.6	22.9	20.4	18.7	17.1	16.6
3		28.1	22.7	19.5	17.4	16.0	14.9	14.1
4			19.3	16.6	14.8	13.6	12.7	12.0
5				14.1	12.6	11.5	10.8	10.2
6					10.7	9.8	9.1	8.7
7						8.3	7.8	7.4
8							6.6	6.2
9								5.3

* Culling level of 15% uniformly distributed over all parities.

Table 3. Expected number born live with involuntary culling of 15% for maximum parities of 2 to 9.

Maximum	Number born live for 4th to 7th parity sows		
parity	9.5	10.5	11.5
2	8.28	9.28	10.28
3	8.54	9.54	10.54
4	8.72	9.72	10.72
5	8.83	9.83	10.83
6	8.90	9.90	10.90
7	8.95	9.95	10.95
8	8.96	9.96	10.96
9	8.97	9.97	10.97

herd at 200. One hundred thirty gilts were grown to 230 lb. in each of the seven culling levels to keep the facility needs approximately equal for each culling level. The market pigs not needed for replacements were marketed at $43.00 per hundredweight. The feed prices include corn at $2.50 per bushel, supplement at $300 per ton and pig starter at $20.00 per hundredweight.

With sow salvage values deducted from the total costs, the differences in the break-even price needed to cover all costs per feeder pig produced were small and insignificant. The numbers in Table 4 are based on 15 percent involuntary culling at each parity. With higher culling levels, higher replacement rates would be needed and a higher percentage of gilt litters would be produced.

Many producers cull first and second parity females on the basis of performance criteria. This practice increases the need for more gilt litters and often doesn't result in much improvement in total herd performance because the "accuracy" or repeatability for numbers born live is low. Accuracy is defined as the relationship or correlation between the estimated breeding value and the animal's true breeding value. The animal's true breeding value is usually never known. The accuracy of the estimated breeding value is dependent upon the heritability of the trait and the number of records on the individual or its relatives used in the evaluation procedure. If only a single record is used to estimate genetic merit, the accuracy of the estimate is the square root of the heritability of the trait. For a trait, such as pigs born per litter, with a heritability of 0.10, the accuracy for that trait based on one record would be 0.32. Even with three records, it would only be 0.45.

Purchased or Homegrown Replacements

Purchased replacement gilts usually cost more than home raised replacements, but offer producers an opportunity to make dramatic changes in their herd's health level and genetic composition. This system also often simplifies the selection and breeding programs for producers. The extra cost of purchased replacement gilts might be recovered with improved productivity. Three areas that offer significant opportunities for improvement in productivity from changing genetics would be: carcass quality, feed efficiency and pigs weaned per litter. Additional

Table 4. Reproductive performance and economic benefits of varying maximum parity culling levels.*

	Maximum parities permitted						
Item	2	3	4	5	6	7	8
Litters farrowed	200	200	200	200	200	200	200
Percent gilt litters	54.1	38.9	31.4	26.9	24.1	22.1	20.6
Replacement gilts needed, no.	127	92	74	63	57	52	48
Average herd size, female yrs.	110	105	100	96	93	92	92
Sow deaths, % of breeding herd	4.0	4.5	5.0	5.5	6.0	6.5	7.0
Sow sale weight, lb.	425	430	435	440	445	450	455
Pigs weaned/litter**	7.88	8.11	8.27	8.36	8.42	8.46	8.47
Litters/female/year	1.82	1.90	2.00	2.08	2.15	2.17	2.17
Pigs weaned/female/year	14.34	15.41	16.54	17.39	18.10	18.36	18.38
Total pigs weaned/year	1578	1618	1654	1669	1684	1689	1691
Turnover rate of the breeding herd, %/year***	115.5	87.6	74	65.6	61.3	56.5	52.2
Break-even price, $/40-lb pig	$38.64	$38.95	$38.61	$38.46	$38.20	$38.26	$38.43

*Fifteen percent involuntary culling level at each parity.

**Values are from the middle column of Table 3 using a survival rate to weaning of 85%.

***Turnover rate is the portion of the breeding herd that is sold or dies during a year and is the replacement rate needed to maintain the average herd size.

parameters, such as heavier pigs at weaning, faster growth rates and higher conception rates, might also be obtained, but their influence on production costs will be less noticeable.

Figure 3 shows the amount of improvement a feeder pig producer would need to achieve in either feeder pig market price, or pigs weaned per litter to justify various replacement gilt premiums. Figure 4 shows the amount of improvement a producer would need to achieve in either pigs marketed per litter, market price or feed efficiency of the finishing pigs if the gilt premiums are to be recovered by that phase of the enterprise. These values were determined from base values of $43.00 per hundredweight market price, 3.6 feed efficiency of the growing-finishing pigs, 8 pigs weaned per litter, 2.0 litters per sow per year and 50 percent annual replacement rate of the sow herd. A 50 percent replacement rate is equivalent to 7th to 8th parity culling.

When productivity and cost evaluations of purchased replacement gilts are considered, voluntary culling should be kept to a minimum. The extra cost of the purchased replacement should be offset with pigs weaned over the herd life of the purchased replacement. From a practical standpoint that extra cost should be spread over as many pigs as possible. The more culling that is practiced, the more first-litter females one needs and the fewer litters a sow produces while in the breeding herd. The goal should be to reduce the number of first-litter gilts in the herd by reducing culling. For many herds, this is an area that affords considerable opportunity. Practices which reduce sow deaths, lameness and infertility are all helpful in reducing the number of replacement gilts that a herd will need.

Additional fact sheets on these areas are:

PIH-8 *Managing sows and gilts during breeding and gestation for efficient reproduction*
PIH-27 *Guidelines for choosing replacement females*
PIH-39 *Crossbreeding programs for commercial pork production*
PIH-46 *Care of the sow during farrowing and lactation*
PIH-89 *Managing the gilt pool*
PIH-96 *Troubleshooting swine reproductive failure*
PIH-106 *Genetic principles and their applications*

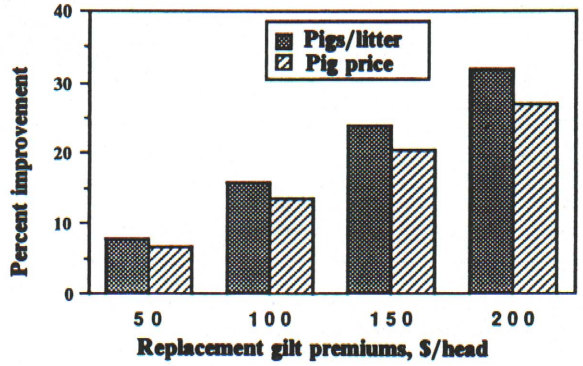


Figure 3. Percentage improvement required to recover purchased replacement gilt premiums in a feeder pig producing program.

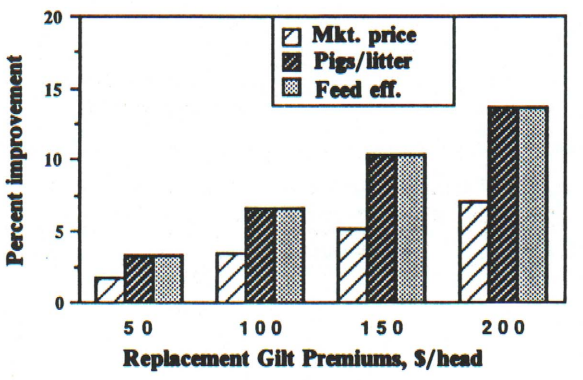


Figure 4. Percent improvement required to recover purchased replacement gilt premiums in a farrow-finish program.

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