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COMPUTERIZED RECORDS: USE IN TROUBLESHOOTING REPRODUCTIVE PROBLEMS OF COMMERCIAL SWINE HERDS

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Swine production has become, in a relatively short time, one of the most competitive agribusinesses. The increase in international exportation of pork, dynamic changes in the efficiency of hog production, and the increasing preference of consumers for alternative meats has mandated that the swine industry be competitive with other producers of protein foodstuffs. Recent changes in the American swine industry have been dynamic. During the past 10 years, the financial advantage of volume selling and buying has led to an unwavering, irreversible evolution toward increasingly larger herd sizes. Accompanying this has been an ongoing trend toward decentralization away from the traditional grain-rich regions of the Midwest and consolidation of the meat packing industry. Although America remains one of the largest international producers of pork, imports into the domestic market have increased dramatically in recent years and now constitute approximately 8 percent of all pork consumed. In this climate of increased competition for more discerning markets, the independent producer has been faced with the challenge of either becoming efficient in the next decade or running the risk of no longer being competitive and no longer having a product desired by the marketplace. So, why keep records? A necessary prelude to being competitive in hog production is a usable record system allowing the producer to monitor both biological and financial performance and to troubleshoot production and financial problems.

(Key Words: Swine, Records, Analysis, Evaluation.)

Biological Records

Numerous systems are currently available commercially for assessing the biological performance of the breeding herd. Although varying considerably in data entry, report format, and report content, all of the systems provide statistical summaries of breeding, farrowing, and weaning information. For example, most provide either time-related or group summaries for information relating to fertility, fecundity, lactational performance, entry/weaning to service, and piglet survival until weaning. Distinct differences among the systems are evident in terms of monitoring and troubleshooting reports. Monitoring reports are those that allow the producer to assess some measure of sow or boar performance either over time or by group, such as the changes in farrowing rate by week or by group number. Troubleshooting reports are those that can be used for diagnosing the cause of production problems, such as the day following service that sows are found nonpregnant.

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Monitoring Reports

Reports for production monitoring should be designed so that they are flexible. For example, it should be possible to examine changes in farrowing rate at weekly, monthly, quarterly, or yearly intervals or any other interval, including the farm-specific interval between consecutive farrowing groups for batch-farrowing farms. The time-window for reports should be easily varied, allowing the generation of reports back into time or the creation of reports over various time periods. In addition to means, simple descriptive statistics, such as the measure of variation about the mean (e.g., standard deviation) and median values, should be given for each measure of biological performance. The information system should accomodate intensively managed farms as well as those managed extensively. For example, the system should accommodate pen-mated breeding programs, in which the weaning-to-reservice interval, dates of services, and boar identification are not known, as well as hand-mating programs.

Targets or interference levels should be included in production reports, and they should be changed easily and regularly as herd performance changes. Monitoring reports should give estimates of sow and facility utilization. For example, sow utilization might be reported in terms of litters/inventoried sow/year, farrow-to-farrow interval, and nonproductive days; facility utilization might be reported as percent farrowing capacity (number of litters farrowed/potential litters farrowed), litters farrowed/farrowing crate/year, and pigs weaned/farrowing crate/year. In addition, the record information system should allow the producer to monitor how effectively he/she is meeting previously established breeding and farrowing targets. Cumulative sum (CUSUM) figures displaying the cumulative number of females bred or farrowed over time relative to a target should be available to assist a producer in understanding how efficiently facilities are being utilized.

Action lists (management aids) should be available to prompt producer to perform an activity, thereby promoting more efficient use of females. Commonly used action lists include: gilts entering the herd but not yet mated; sows weaned but not yet mated; and females to be checked for estrus or pregnancy status, loaded into farrowing crates, vaccinated, or weaned. Action lists should be sufficiently flexible to allow dates of events to be changed to fit management needs.

Monitoring records should display herd population characteristics, including culling, mortality, and replacement rates and animal inventories. It is also helpful for reports to list the current production stage and/or facility location for all inventoried females and to list the number of females in each stage of production.

Troubleshooting Reports

Although most record information systems allow satisfactory monitoring of biological performance, few facilitate the troubleshooting of production problems. There are numerous risk factors or differentials for the different types of reproductive failure. Many, if not most, of the differentials can be incriminated or ruled out through examination of records. In fact, although a diagnostic examination of environment, facilities, management, disease status, and nutrition may suggest one of them as a cause of reproductive failure, the diagnosis typically must be corroborated through the records. For example, a suboptimal total pigs born/litter may involve: parity distribution, lactation length, weaning-to-service interval, season and ambient temperature, systemic reproductive disease, genetics, nutrition, and breeding management. Several of these differentials are totally dependent upon the generation of customized troubleshooting reports in order to evaluate their role in the litter size problem (i.e., parity, lactation length, weaning-to-reservice interval, season, genetics, and breeding management). Other differentials (i.e., nutrition and disease) usually use other diagnostic tools beside records, such as laboratory tests, to incriminate them as a cause of suboptimal reproductive performance. But, even when a diagnosis is dependent upon a laboratory test, the diagnostic findings should be collaborated by looking for the "fingerprint" of clinical signs usually evident in the records.

The most widely used measure of the overall biological performance of the breeding herd is pigs produced (born alive, weaned, or sold)/inventoried sow/year. The two components of pigs weaned/sow/year are litters farrowed/inventoried sow/year and pigs weaned/litter farrowed (Figure 1). In turn, nonproductive days and farrowing schedule (lactation length) are the major factors influencing litters/sow/year. Nonproductive days is influenced largely by time from entry or weaning until first service; time from service until detection of nonpregnancy status; and time from service, entry, or weaning until female is culled or dies. Pigs weaned/farrowed litter is influenced primarily by number of pigs born alive/litter and the percent of those surviving until weaning. In order to be comprehensively useful in improving the biological performance of the breeding herd, computerized record systems must monitor all the components of pigs/sow/year and must allow the risk factors influencing each of the components to be individually assessed. For example, nonproductive days not only must be calculated, but also must be broken down into constituents (entry/weaning-to-service, service-to-reservice, and entry/weaning/service-to-cull intervals), and the risk factors for those constituents must be detailed in the reports.

Farrowing rate, litter size, preweaning mortality, and weaning-to-service intervals are parameters calculated by most computerized record systems. Although not very predictive of either biological or financial efficiency, they are commonly understood parameters that indirectly influence pigs/sow/year. Thus, record systems should be selected that allow the delineation of influencing factors.

Farrowing Rates. As shown in Figure 2, the principal causes to consider for suboptimal farrowing rates are:

- accelerated herd turnover where sows do not have an opportunity to farrow,
- farrowing-to-service interval (including prolonged weaning-to-service intervals and/or short lactation lengths),
- accumulation of repeat breeding females,
- asynchrony between ovulation and mating (estrus detection, timing of matings, matings/service),
- boar usage,
- individual boar differences,
- quality of matings,
- reduced pregnancy maintenance in females mated during the summer season,
- elevated ambient temperature,

- genetics,
- housing,
- inordinately high proportion of either low or high parity sows,
- mycotoxicoses (especially zearalenol and zearalenone toxicoses),
- urogenital disease, and
- systemic reproductive diseases (e.g., pseudorabies, parvovirus, leptospirosis, encephalomyocarditis virus).

The factors that cause a sow to fail to conceive are often different than those causing a sow to fail to maintain pregnancy (Figure 2). For example, the number of matings/service affects conception but not pregnancy maintenance, whereas season primarily influences the capacity of the sow to maintain pregnancy. To be useful in troubleshooting fertility problems, a computerized information system must be capable of indicating the pattern of return to service following an unsuccessful service. In addition, it should be capable of listing sows returning to estrus separately from preg-test negative sows, not-in-pig sows, and fail-to-farrow sows, when time of pregnancy loss cannot be determined.

Additional attributes of record systems useful in troubleshooting fertility problems are that they allow the generation of reports in formats highlighting the most common causes for infertility. In order to troubleshoot farrowing rates, record systems should determine:

1) whether served sows have had an opportunity to farrow or are being culled for health or managements reasons not relating to fertility;
2) the interval from service until return to estrus;
3) the proportion of each group that is repeat-served;
4) time-related, especially seasonal, changes in farrowing rates;
5) parity break-out of farrowing rates;
6) the relationship between lactation length, weaning-to-reservice intervals, and farrowing rate;
7) the temporal association between changes in litter size parameters, especially percent mummies and stillbirths, and fertility;
8) the relationship between boar usage during the time-period when a group of sows is being served and their subsequent fertility;
9) the effect of number of matings/service on fertility;
10) the influence of genetics, especially the impact of purebred boars on fertility; and
11) the impact of individual boars on group fertility.

Litter Size. As indicated in Figure 3, the principal causes for reduced litter size are:

- parity distribution,
- lactation length and weaning-to-service interval,
- season and ambient temperature,
- boar influence,
- systemic reproductive disease,
- genetics,
- nutrition (e.g., prebreeding flushing), and
- breeding management (e.g., number of matings/service and boar usage).

Many of the causes for suboptimal total pigs born/litter can be investigated using record systems that determine:

1) litter size parameters for all parities and parity combinations;
2) the relationship between lactation length, weaning-to-service interval, and subsequent litter size;
3) the effect of season and ambient temperature at service and prior to the completion of implantation on subsequent litter size;
4) the repeatability of litter size in individuals from one parity to the next parity;
5) the influence of genetic line on litter size;
6) the temporal association between reductions in total pigs born and increases in stillbirth or mummy rates or the occurrence of abortions and pregnancy failures;
7) the effect of boar usage on litter size;
8) the identities of individual boars having reduced litter sizes;
9) the influence of matings/service and timing of matings relative to onset of estrus on litter size;
10) the relationship between lactation feed intake and subsequent litter size; and
11) the influence of either gilt age at mating or interval from entry to service on subsequent litter size.

In North America, pigs born alive represents the number of pigs remaining from total pigs born/litter after correction for the stillbirth and mummy rates (Figure 4). Possible causes for suboptimal liveborn litter sizes with elevated stillbirth rates include:

- a high proportion of farrowing sows having advanced parities,
- prolonged gestation lengths,
- an increased percentage of sows having elevated stillbirth rates at consecutive farrowings,
- piglet birth weight and within-litter variation in pig size at birth,
- misdiagnosis of postpartum deaths as being stillborn,
- systemic reproductive diseases,
- poor prefarrow conditioning of sows,
- genetics,
- elevated levels of toxic gases in farrowing room (especially carbon monoxide),
- mycotoxicoses,
- sow housing prior to farrowing, and
- suboptimal levels of micro- and macrominerals and vitamins.

Reports useful in investigations of the differentials for suboptimal pigs born alive/litter should determine:

1) the relationship between parity and stillbirth rate,
2) the influence of gestation length on number of stillbirths/litter,
3) the identification of sows repeatedly having high stillbirth rates,
4) the relationship between birth weight and stillbirth rate, and
5) the relationship between stillbirth and preweaning mortality rates.

Preweaning Mortality. The four major types of preweaning mortality are traumatic injuries (pigs stepped upon, laid upon, or savaged by the sow); low viability piglets (pigs born undersized or weak at birth); starvation; and disease. Many of the risk factors for the different types of piglet mortality are the same; for example, facility and equipment design, piglet microenvironment, piglet size at birth, season, and parity affect mortality rates related to trauma, low viability, starvation, and disease (Figure 5). However, some of the contributing causes for the major types of preweaning mortality differ.

Troubleshooting reports for preweaning mortality should assess:
1) piglet mortality by category of death;
2) the relationship between age at death and the proportion of piglets dying from specific causes;
3) the relationship between birthweight, variation in birthweight among littermates, and specific causes of preweaning mortality;
4) time- and season-related changes in preweaning mortality; and
5) the effect of mean group parity or herd parity distribution on piglet survival.

Lactation Performance. Light weaning weights can be the result of either an infectious or noninfectious process (Figure 6). Infectious causes include generalized infections of sows, singular mammary gland infections (where only one or a few glands are infected and have reduced milk production), and infections causing reduced milk production by the entire mammary chain. Noninfectious causes of suboptimal weaning weights include:
- insufficient nutrient intake by the lactating sow (e.g., nutrient density of rations, facility and equipment design, feed management, etc.);
- mycotoxicoses;
- genetics;
- litter management (e.g., crossfostering, use of nurse sows, fractionated weaning, etc.);
- average piglet birth weight; and
- parity.

Reports to be used in troubleshooting problems of suboptimal weaning weights should determine:
1) the adjusted 21-day weaning weights of piglets, so as to allow comparison with established targets and with other farms;
2) the relationship between feed intake during lactation and weaning weights;
3) the relationship between birth weights and weaning weights;
4) weaning weight differences among different genetic lines on a herd; and
5) the effect of parity on weaning weights.

Facility Utilization. Troubleshooting reports should be available not only for assessing the biological performance and efficiency of utilization of the sow and boar but also for estimating facility utilization. Calculations potentially helpful in allowing the troubleshooting of suboptimal utilization of facilities include the ratios:
- number of inventoried females:total number of farrowing crates,
- number of inventoried sows:number of weekly farrowings, and
- number of gestation places:number of farrowing crates.

Commonly used measures of facility utilization include:

- litters farrowed or weaned/farrowing crate/year,
- pigs weaned/crate/year, and
- percent farrowing crate utilization.

Financial Records

Financial Enterprises

Swine producers generally can be described as being of three types: farrow-to-finish, finishing, and feeder-pig producers. Feeder pig producers breed and farrow sows and grow pigs though the nursery phase of production, when pigs first become marketable. Finishing-pig producers (growers) take feeder pigs and grow them through slaughter weight, the second time pigs are marketable. When considering the two stages at which pigs can be marketed together with the three producer types, swine farms can be considered as having three distinct financial enterprises: the breeding herd enterprise, which includes the financial aspects of producing the weaned pig (i.e., the costs and income associated with the breeding, gestation, and farrowing phases of production); the nursery-pig enterprise, which takes the pig from weaning until it is marketable as a feeder pig; and the grow/finish-pig enterprise, which includes the pig from its first marketable weight as a feeder pig until it is marketed for slaughter. Feeder pig producers are concerned about the breeding-herd and nursery-pig enterprises; finishing-pig producers are concerned primarily about the grow/finish-pig enterprise; and the farrow-to-finish producers are involved with all three enterprises.

The major costs for producing a pig are proportionately different for the three enterprises. For example, feed costs are less for producing a weaned pig than for producing a market pig; labor and breeding costs (cost of the replacement animals minus the salvage value of the adults) are higher for the feeder pig than for the market pig; and capital costs (facility, utilities, and interest) are about the same for the two enterprises. Thus, when trying to improve profitability of a finishing-pig enterprise, feed costs followed by capital costs are major areas of emphasis. In contrast, feed cost remains the greatest expense for producing a weaned pig, just as it is for the finishing pig, but capital, labor, and breeding costs contribute proportionately more to the total cost of producing a pig. Consequently, all four major costs centers must be considered when attempting to improve the profitability of the breeding herd.

Records for the breeding herd should keep financial information relative to producing a weaned pig independent of that for the other two enterprises. It is not possible to evaluate the financial efficiency of the breeding herd if costs and receipts for the grow-finish and nursery phases are included with weaned-pig financial information. Norms for production costs for the weaned pig reared in the Midwest have only recently been made available.

Feed Costs

The major cost of producing a weaned pig is sow-feed cost. Feed cost/weaned pig is typically computed based upon total gestation plus lactation feed disappearance corrected for the number of pigs weaned during a given time period. In addition to feed cost/pig, record systems should report or easily allow the hand-calculation of several other feed related parameters.

Regional differences in diet ingredient costs require that record systems be capable of reporting pounds fed/weaned pig, if farm-to-farm comparisons are to be made rationally. Because of its higher nutrient density, a lactation diet is generally more expensive than gestation feed. Lactation feed also influences the piglet and the postweaning reproductive performance of the sow to a greater extent than gestation diets. Thus, in order to optimize productivity while minimizing feed costs, record systems monitoring sow-feed disappearance should differentiate lactation feed consumption from gestation feed consumption.

Nutrient intake during lactation substantially influences the postweaning performance of the sow and the weaning weight of the pig. Thus, record systems also should allow the monitoring of lactation feed disappearance, so that average daily nutrient intakes during lactation can be calculated and diets reformulated as needed to ensure optimal performance at minimal feed costs. Lactation feed disappearance can be entered into a computerized swine record system either on the basis of feedbin inventories or summaries from individual sow feed consumption records. Because lactating sows eat more feed than gestating sows, consumption and cost data for weaned pigs on farms with longer lactations (e.g., 5 weeks) typically will be different from those with shorter lactations (e.g., 16 days). Thus, feed comparisons among farms may have only limited value without a knowledge of lactation lengths and diet ingredient costs.

In order to allow biological and financial monitoring of feed-related performance, record systems should record gestation and lactation feed deliveries and/or inventories, diet ingredients and costs. In turn, feed information should be related to average number of pigs weaned and feed disappearance/d.

Capital Costs

Collectively, facility (depreciated facilities and maintenance costs), utilities, and interest (operating capital, nondepreciated facility costs) account for the second largest cost of producing a weaned pig, Although slightly larger, capital costs are similar to labor and breeding costs, accounting for approximately 15-25% of the total costs of production.

Capital costs vary considerably from region to region. In general, regions with milder climates have lower capital costs, but higher feed costs, than cooler regions. Facility costs often attributed to a weaned pig can be given in terms of cost/pig space to construct a facility. When examined in this way, the most costly phase of production would appear to be the farrowing phase. However, when facility costs are corrected for the days that space is tied up by either the sow producing a pig or by the pig itself, the farrowing phase is second behind the finishing phase in terms of its contribution to facility cost/pig. In general, as efficiency of facility utilization improves (i.e., more pigs are produced per pig space), the facility cost/pig decreases. Record systems of the future should not only compute facility costs/weaned pig but should also enable the producer to determine the phases of production that are least financially competitive.

Breeding Costs

Breeding costs are the salvage values of culled breeding stock minus the costs of replacement stock corrected for number of pigs weaned. As with other fixed costs, improvements in pigs weaned/sow/year are accompanied by decreased breeding cost/pig. The decision to tolerate high breeding costs or to attempt to decrease breeding costs/pig is influenced by potential changes in sow productivity (e.g., pigs born alive/litter, pigs weaned/litter, and weaning weights) and the potential influence of herd genetics on market pig performance (e.g., feed efficiency, rate of gain, and carcass merit). Thus, lower breeding costs are not consistently related to increased profitability.

Labor Costs

Labor costs are difficult to accurately determine for the weaned pig because of producer uncertainties of the value of their labor and because of an inability to allocate time accurately to the breeding herd. In general, capital costs and labor costs are inversely related, so that highly capitalized facilities usually have a proportionately lower labor cost.

Additional Features

Data Entry

One of the most common frustrations with information systems is the inability to reconcile computer-generated reports with hand-held records. Data entry into computerized record systems should be flexible so as to allow multiple events for one sow to be recorded easily at one time or for the same event to be entered at one time for multiple sows. Prompts should indicate to the person entering data when there are missing events or erroneous information and when entered data are not biologically realistic. For example, a sow should not be allowed to farrow without having been exposed to a boar, and sows should not be allowed to farrow approximately 135 days after a recorded service.

Data Integrity

Many information systems calculate production parameters even when information is missing. For example, farrowing rates may be calculated on groups in which all sows have not yet had sufficient time to farrow. Reports should be available that assess data integrity, quality, and completeness. Furthermore, systems should not allow reports to be generated that are not biologically or statistically meaningful. Examples of less-than-meaningful production parameters include: the mean weaning-to-reservice intervals for a group of females, in which part have been bred at the first postweaning estrus and part have had services delayed intentionally until the second postweaning estrus, and the computation of nonproductive days for herds in which gilts are not inventoried in the herd until they are mated. An example of a statistically nonmeaningful computation is the calculation of a frequency distribution for the ages of piglet death prior to weaning when there is an insufficient number of sows farrowing during the time interval.

The adage "garbage in, garbage out" is extremely applicable to computerized swine records. Inaccuracies in the recording of events commonly results in meaningless reports. Common data recording errors potentially having profound effects on calculated parameters include: inaccurate determinations of the cause of piglet or sow mortality, not recording all piglets born mummified or stillborn, and failure to record piglets transferred on or off a sow.

Hand-Held versus Computerized Records

Computerized record systems are often intimidating to the inexperienced user, but they have several potential advantages. They

1) are more accurate;
2) provide more complete information;
3) provide more flexible report format;
4) require less time to maintain data;
5) can be used to improve financial credibility; and
6) can be used in conjunction with accounting packages, spreadsheets, decision aids, and other compatible software.

Disadvantages of computerized record systems are that

1) they may be difficult for the inexperienced user to initiate,
2) hardware problems may be frustrating,
3) computer-generated reports may not always be reconciled with hand-held reports, and
4) missing data and data entry errors may lead to inaccurate reports.

On-Farm versus Bureau Records

On-farm record systems have the following potential advantages:

1) Turn-around time from data recording until receipt of records is shorter, so records may be more up-to-date.
2) Special reports can be easily generated as needed (e.g., litter size diagnostic report).
3) The format of reports can be varied and customized for the farm or for a specific need (e.g., set up reports with varying time-intervals).
4) Troubleshooting is more flexible and extensive.
5) Error correction of data entries can be done more easily and promptly.
6) Disks can be mailed to consultants prior to farm visit, allowing the generation of special and custom reports.
7) On-farm systems are usually cheaper on a per-sow or per-entry basis than bureau systems to operate, even with depreciation of hardware and software and data entry time.
8) Data privacy and security are assured.
9) Start-up is usually easier and more rapidly made.

On-farm record systems have the following potential disadvantages:

1) Start-up costs are usually higher.
2) Some computer training or experience is required.
3) Valuable on-farm time is lost if records are not reviewed by consultants prior to arrival on the farm (time must be spent upon arrival reviewing records).
4) Software and hardware support may be less than optimal.
6) Assistance for report interpretation may not be available.

Commercial bureau systems have several potential advantages over on-farm systems:

1) more efficient and accurate data entry,
2) generation of statistically meaningful reports,
3) between farm comparisons are possible,

4) lower start-up costs than on-farm systems,
5) no computer skills required of the producer or consultant, and
6) support for production and computer problems often provided by bureau.

Commercial bureau systems have several potential disadvantages compared to on-farm systems:

1) longer turn-around time from data collection until receipt of report by farm,
2) error correction and incomplete data not easily handled,
3) difficulty in getting numerous diagnostic reports during a problem investigation in a timely and expedient fashion,
4) formats of reports usually being standardized across farms, instead of being customized for each farm, and
5) being more expensive in the long-term than on-farm systems.

Advantages of Computerized Records

Computerized record systems allow more accurate monitoring of breeding herd production and the assessment of a much broader range of production parameters than are possible with hand-held record systems. Thereby, they greatly facilitate an awareness of problem areas. Computerized records also enable the troubleshooting of production problems. Troubleshooting with hand-held records is much more time-consuming and much less complete than with computerized records. In fact, it is not possible to troubleshoot many types of reproductive failure using hand-held records without time-consuming hand calculations. Computerized systems minimize self delusion about performance level and enable more meaningful comparisons among farms. They also allow prognostication of levels of production and improve financial credibility. Computerized records can be used to validate progress and assess response to management changes. By being a substantial motivating influence, records also can modify producer attitudes toward the swine enterprise.

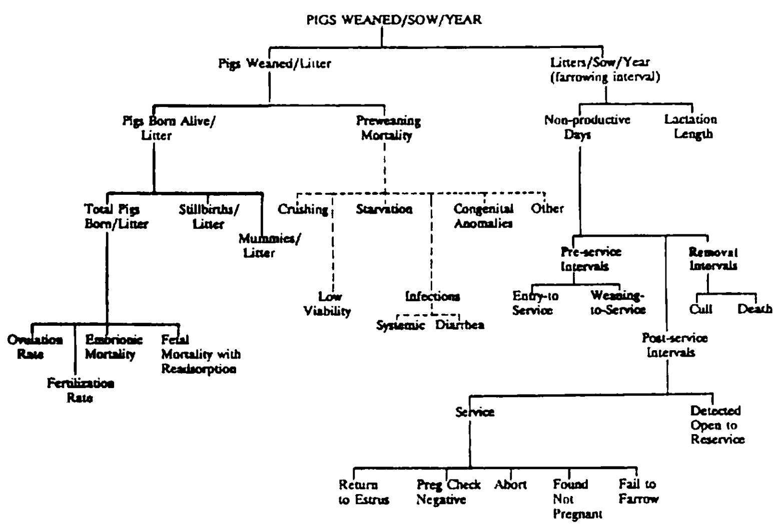

Figure 1. Flow diagram of the factors influencing pigs weaned/sow/year that must be capable of being troubleshooted in order for a record system to be competitively useful.

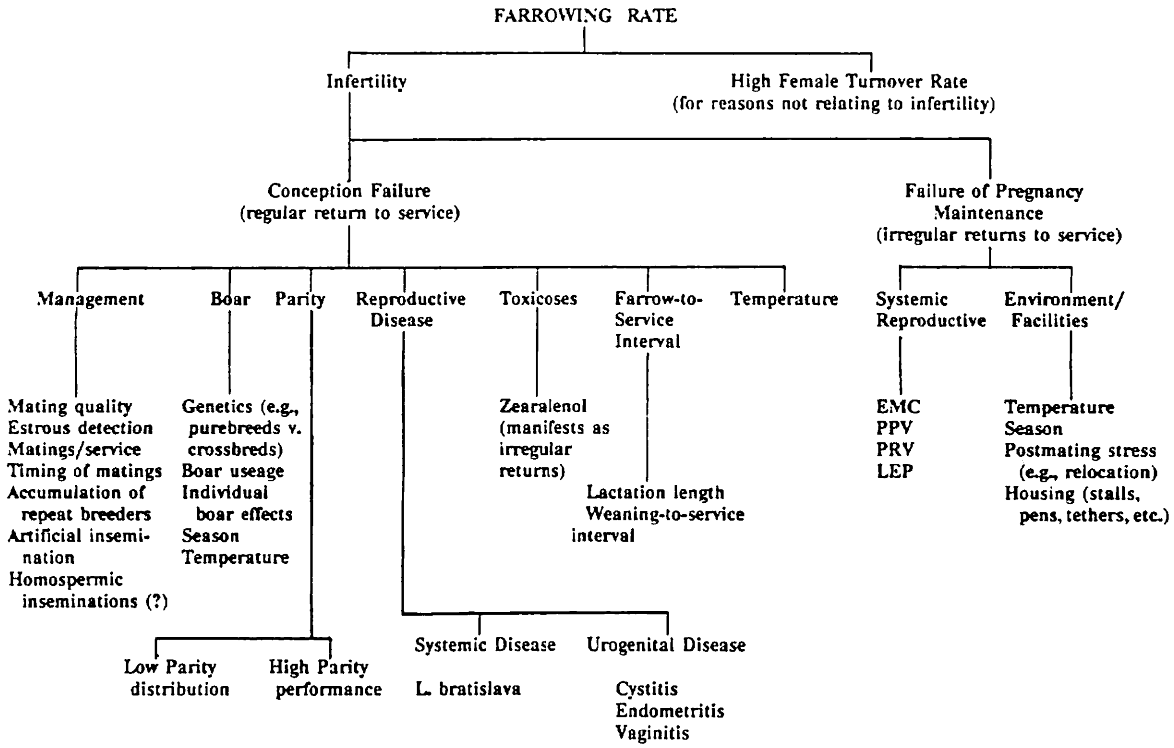

Figure 2. Flow diagram of the factors influencing farrowing rate.

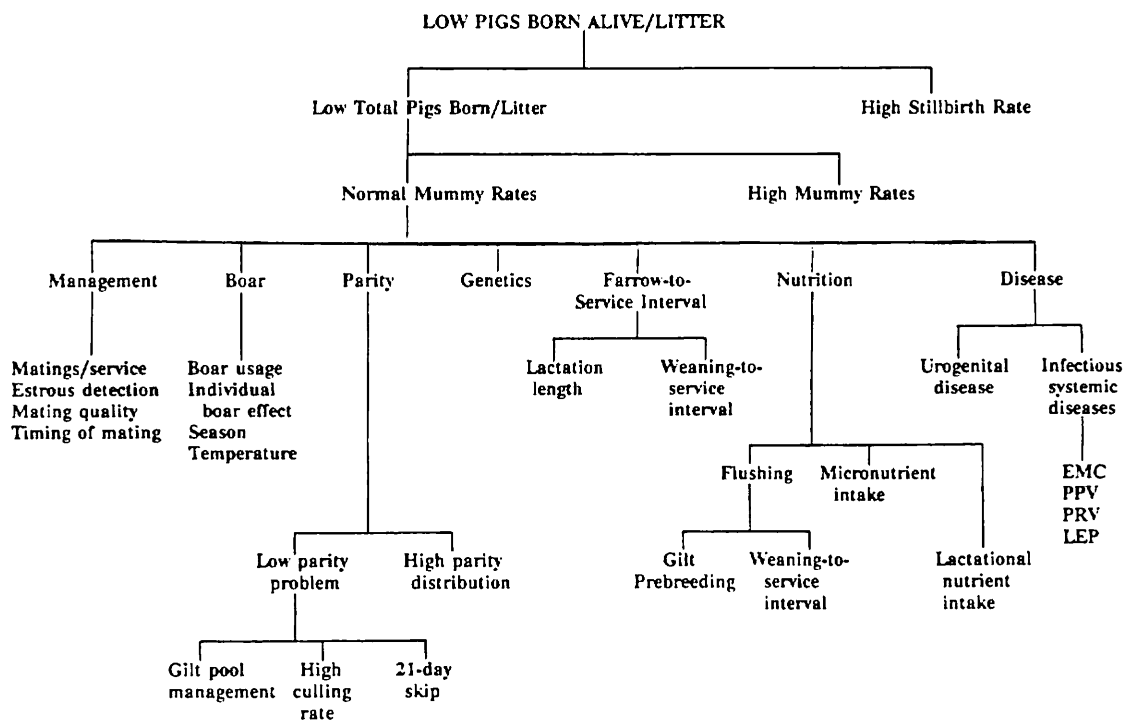

Figure 3. Flow diagram of the factors influencing litter size.

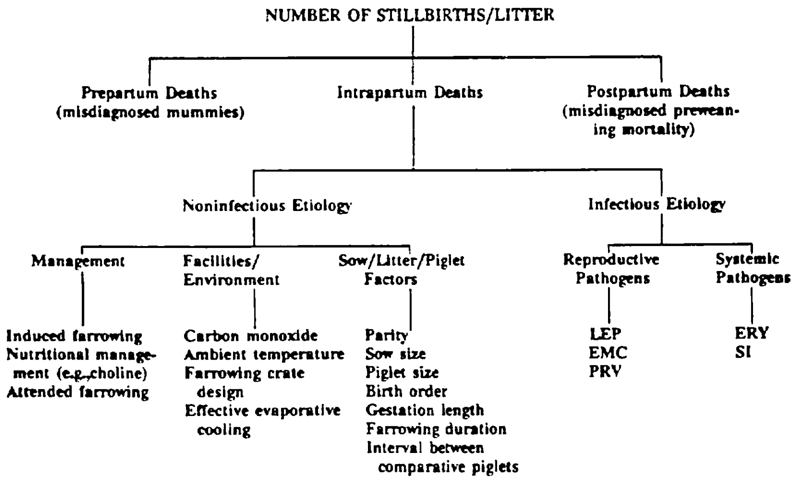

Figure 4. Flow diagram of the factors influencing number of stillbirths/litter

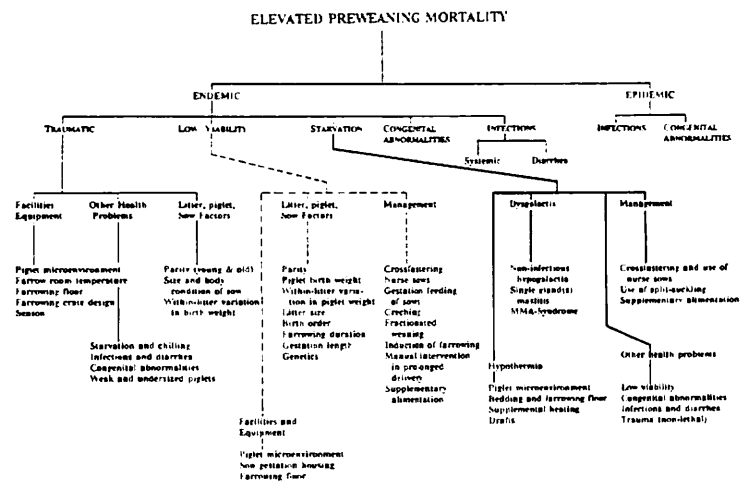

Figure 5. Flow diagram of the factors influencing preweaning mortality.

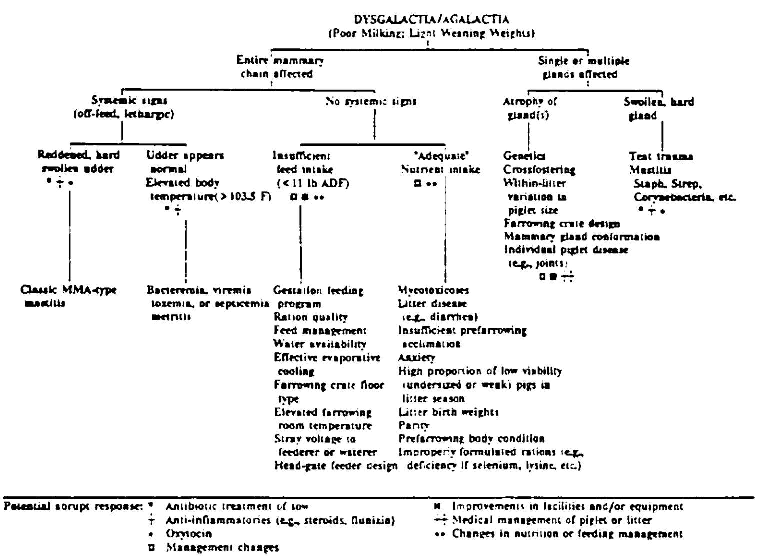

Figure 6. Flow diagram of the factors influencing lactational performance.