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DISCARDING AND REPLACING OF BREEDER SOWS

DESCARTE Y REMPLAZO DE CERDAS REPRODUCTORAS

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Abstract

The work consists of a review of the literature on the process of discarding and replacing of breeder sows in pig farms. The procedures to be applied in this process are addressed, such as the analysis of reproductive records, replacement and disposal rates, causes of discarding and the sows mortality. The post-mortem monitoring of the organs of discarded sows and the selection of new breeders are also discussed, all in order to apply discard and replacement strategies that favor the productive efficiency of the stock. It is concluded that the causes of discard and their frequency of presentation show great variations, mainly due to the differences between farms, the inclusion or not of nulliparous sows in the total number of discarded sows, and the criteria used to discard sows, identify and classify the causes of discarding, all of which correspond to the large variations in the rates of discard and replacement that appear in the literature.

Keywords: discarding, replacing, breeding sows

Resumen

El trabajo consiste en una revisión de la literatura sobre el proceso de descarte y remplazo de reproductoras en granjas porcinas. Se abordan los procedimientos a aplicar en dicho proceso, como son el análisis de los registros reproductivos, las tasas de reposición y desecho, las causas del descarte, y la mortalidad de las cerdas. También se trata el monitoreo post mortem de los órganos de cerdas desechadas y la selección de nuevas reproductoras, todo ello con el objetivo de aplicar estrategias de descarte y remplazo que favorezcan la eficiencia productiva del plantel. Se concluye que las causas de descarte y su frecuencia de presentación muestran grandes variaciones, debido a la diversidad de factores que influyen en las mismas, entre los que se destacan el efecto de granja, la inclusión o no de nulíparas en la cifra total de desechadas, así como los criterios empleados para desechar las cerdas, identificar y clasificar las causas del desecho, todo lo cual se corresponde con las grandes variaciones de las tasas de descarte y remplazo que aparecen en la literatura.

Palabras clave: cerdas reproductoras, causas de descarte, remplazo

Introduction

Pig farming is an economic activity of great importance in many countries, since pork is an important source of protein in the human diet, so it must be taken into account that to guarantee the profitability and sustainability of this activity, it is essential to know and control the reproductive parameters of pigs (Bermejo and Orozco, 2017).

Among these parameters, Peña (2011) stated that it is important to manage the renewal of breeding sows, determining when a sow does not meet the minimum production required for the farm and is no longer profitable, at which point it should be sent to the slaughterhouse as soon as possible.

The economic aspect of this process was also highlighted by Sánchez et al. (2018) when they pointed out that culling and replacing breeding sows is an activity of great importance in pig production, since the use of a correct culling policy allows for a breeding herd whose structure guarantees high productivity and savings through the purchase of females for replacement.

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The acquisition or preparation of sows for replacement has a significant economic impact, therefore, the culling of breeding sows must be a technical process that includes records of culling and annual replacement rates, causes of culling, reproductive records, and inspection of the genital tract after slaughter at the processing plant (Vélez, 2023).

The present work aimed to review the available literature on the culling and replacement of breeding sows, in accordance with the procedures that currently govern this process, as well as the preparation and selection of new sows to replace those that are excluded from the herd.

Development

Evaluation of the culling of breeding sows on pig farms

The components of the culling process were stated by Barrales et al. (2017). They stated that for a complete evaluation of culling in pig farms, four sections must be considered: a) Annual culling rate and annual replacement rate, b) Causes of culling, c) Reproductive records and d) Inspection of the genital tract in the refrigerator. These sections will be addressed in general terms below.

a) Annual discard and replacement rate.

The annual culling rate (ACR) is the percentage of females culled by an establishment over a year. The ACR values presented by different authors vary within a very wide range (Sasaki and Koketsu, 2010).

On all farms, sows are brought in and out every year, which changes the census. The percentage of sows brought in or brought into the farm, whether purchased or self-replaced, is known as the replacement rate (Piñeiro, 2008).

b) Reasons for discarding

Knowledge of the causes of discard is useful to determine the occurrence of each one and detect problems. Grouping them into categories facilitates their study and allows comparisons between different establishments (Sasaki and Koketsu, 2010).

Several authors have grouped these causes intoreproductive and non-reproductive, including Barrales et al. (2017) and Williams (2021). The first add that there are two ways to carry out the discard: programmed, scheduled, due to causes such as low productivity, advanced age and overweight; or unscheduled, caused by locomotor disorders and reproductive failures. Scheduled culling is planned by the producer, allows for the organization of replacement and, consequently, does not produce a significant increase in non-productive days; unscheduled culling has a greater economic and productive impact, because it can lead to the retention of sows that should have been culled.

c) Reproductive records

The data that producers obtain from their farms provide them with information and tools to make decisions on their farms. The validity of this information is closely related to the accuracy with which the data is collected. Data collection and subsequent analysis allow them to obtain an idea of how production is working, detect problematic areas of the farm, learn about the performance of the animals and make decisions, such as which animals should be discarded and which should not (Carballo, 2007).

The economic and productive impact of purchasing and preparing new breeding sows is an argument that Barrales et al. (2017) also used to highlight the importance of evaluating reproductive records and culling causes as an essential tool for applying effective culling strategies and achieving greater productive efficiency.

d) Post-mortem inspection of the genital tract

The collection of the sow's genital tract post mortem at the slaughterhouse and its subsequent study in the laboratory is a useful diagnostic tool for the veterinarian, which helps in decision-making to solve a reproductive problem (Falceto, 2016). The author points out that this diagnostic strategy can be used routinely in daily clinical practice in the pig sector, in search of the following objectives:

- To assist in the diagnosis of a specific reproductive problem in a pig farm (anoestrus, pseudoanoestrus, vulvar discharge syndrome, nymphomania, repeated heat cycles and mycotoxicosis).
- To facilitate the periodic evaluation of the reproductive status of sows on a pig farm as a complement to the study of their production data.
- Identify errors in reproductive management (poor heat detection, insemination failures, pregnancy diagnosis failures, management failures during pregnancy and maternity).
- To determine the prevalence of animals affected by subclinical pathologies (ovarian inactivity, ovarian cysts, salpingitis, endometritis and cervicitis), as well as the extent and severity of the lesions and the economic consequences on the farm.

The author herself pointed out that it is necessary to collect a large number of genital organs, which can be done in a specific period such as summer, to quantify the influence of reproductive seasonality. At the end of the study, changes in reproductive management and improvements in on-farm diagnosis can be planned.

Annual replacement rate

The annual replacement rate (ARR) was defined more precisely by Quiles (2008) as the relationship between the number of culled sows, including those that died, and the average number of breeding sows on the farm over the course of a year. He adds that it is an extremely complex parameter that cannot be explained by a single factor. Like most of the zootechnical parameters in pigs, ARR is conditioned by genetic and environmental factors, which determines that its value varies greatly between farms, and can range between 30 and 50%.

The results of a study carried out in Mexico by Huerta (2004) in 19 technologically advanced pig farms are within this range, with a culling rate of 28.77% and mortality of breeding sows of 7.93%, values that presented great variability between farms and were different from those proposed by the PIC company, which supplied the breeding stock used (38% and 5% respectively).

In the Argentine swine industry, Williams (2015) reported that the annual replacement rate has historically fluctuated between 25 and 35%, although in recent years he observed increases reaching 40 to 50%.

In commercial farms, PIC Latin America (2015) stated that the objective should be to achieve a TRA that ranges between 39 and 40%, where replacement by discard represents 35 or 36% and that due to the death of breeders is between 3 and 5%.

For farms managed through intensive production flow, ltoannual replacement rate recommended by Feldens et al. (2007) was somewhat higher (35 to 55%), taking into account that the culling of breeding stock is carried out for various reasons and the decision is made based on physical condition, health status and reproductive performance..

The TDA and TRA must be balanced with each other, with values ranging between 35% and 40% (Casanovas, 2020). The author considers that in this way it is possible to maintain a constant inventory of breeding sows to achieve reproductive and immunological stability of the herd, with a greater probability of maximizing the productivity of the farm.

In Cuba, the breeding stock of pig genetic centers are periodically evaluated with the aim of discarding those that do not meet what is expected of them and maintaining the herd replacement rate within limits that do not exceed 60%, a value that may vary depending on some emerging improvement strategy (MPTCGP, 2017).

Causes of culling breeding sows

As previously stated, several authors group the culling causes into reproductive and non-reproductive ones. Barrales et al. (2017) stated that the former represent 3 to 42% of the total and consist of fertility problems (regular or irregular return to heat, negative pregnancy control), lack of heat, abortions and vulvar discharge; while non-reproductive causes represent between 58 and 97% of cullings, and include: advanced age, overweight, musculoskeletal disorders, mammary gland disorders and low productivity (low number of piglets born alive and weaned).

Rodríguez (2023) cites a work by Quiles (2012), who defined the reproductive criteria by which a breeder is discarded:

- Repeated heat after insemination. In general, a sow that repeats heat tends to continue repeating it, so nulliparous, primiparous or multiparous sows up to the sixth birth are culled after the third repeated heat. If they are sows that have had more than seven births, they are culled after the first repeated heat.
- Weaning-oestrus interval: this period is considered unproductive and influences the duration of the sow's cycle, since the longer this interval is, the lower the number of farrowings/sow/year. Thus, sows that do not go into heat within a month after weaning are eliminated.
- Abortion rate: this includes sows that are gestating normally, but the gestation is interrupted by the premature expulsion of the fetuses before days 109-112 of gestation.
- Number of piglets born and/or weaned: sows that produce a number of piglets lower than expected on each farm are eliminated.

As can be seen, the last of these criteria, also called low prolificacy index, was not included among the reproductive problems by Barrales et al. (2017), nor was it included by Lucia et al. (2000) and Saballo et al. (2007).

A study conducted by Mabry (2002), described by Saballo et al. (2007), on farms in Iowa, United States, covered 10 years and showed that the main causes of sow culling were: reproductive problems (49.1%), physical problems (14.1%), advanced age (8%), agalactia problems (6.2%) and low piglet production (1.1%). At culling, sows had achieved 3.4 to 3.6 births, although he adds that in 2001 and 2002 this average rose to 4.0 births. The author mentions other studies where 53.6% of the reasons for culling were reproductive and 20% due to the decrease in the number of offspring/birth.

The Manual of Technical Procedures for Cuban Porcine Genetic Centers (MPTCGP, 2023) does not group the causes of elimination of breeding sows, and declares the following:

- Sows that have completed their reproductive life stage or useful life (upon completion of the fifth farrowing).
- Presentation of abortions due to infectious causes.
- Presentation of dystocic births, uterine or rectal prolapse.
- Compromised physical integrity or bodily state.
- Sows that have received two matings or inseminations in two consecutive heats, without becoming pregnant.

- Weaned sows that do not show heat after 30 days. This includes sows that, after being selected and in contact with the caretaker, do not show heat for 60 days.
- In the case of sows, those that have not shown heat in 30 days or have received two inseminations or matings without becoming pregnant and are more than 270 days old.
- Cumulative reproductive performance that is below the flock average.
- Having suffered from Metritis, Mastitis and Agalactia syndrome or another pathology continuously or in their last two births, for which their exploitation is contraindicated by veterinary prescription.
- Bad maternal behavior.
- Trauma that does not respond to treatment or whose recovery is not advisable.
- Sows that are empty at birth or that engage in postpartum cannibalism.
- Physical defects or illnesses that harm health or reproductive activity.

Culling of sows for reproductive reasons

Several authors have reported that reproductive failures are the main cause of sow culling on farms. Palomo (2018) noted that these failures can reach between 25% and 40% annually, although higher figures appear in other articles.

Lucia et al. (2000) identified reproductive problems as the main cause of culling, with 33.6% of the total number of sows culled, a figure that includes nulliparous sows and does not consider low prolificacy as a reproductive problem. Their data show that these problems were the main cause of early culling: 64.5% in nulliparous sows, 43.4% in primiparous sows and 31.9% in those that had given birth twice.

Jiménez (2012) also did not consider low productivity as a reproductive failure, but did not include nulliparous sows, and found that such failures only represented 22.3% of the total culled sows. Between the two farms included in his study, there was a notable difference in the proportion of sows culled for this reason.

As can be seen, among the reasons that explain the wide range of values offered by different authors for culling due to reproductive causes, is the inclusion or not of nulliparous animals among the total number of culled animals and what is considered or not a reproductive problem, particularly low prolificacy.

The faults that are commonly considered to be of reproductive origin are discussed below.

Repetition of jealousy

The main cause of discarding of reproductive originis the repetition of heats. Sows are usually allowed to remain until the next heat or repeat heat, and then they are culled. Cordova(2014) states that after the first service, the unproductive days of all the females that were served and did not give birth are accumulated. Then another service is performed and if the sow repeats heat, it is reported as a problem and most of the time it is discarded.

According to Marco (2020), if there is a birth rate of less than 85% and in addition the total repetitions exceed 8%, it is important to know when these occur, in order to identify the causes that produce them. The author classifies the repetitions as: early (before 18 days post-covering); cyclical or regular repetitions (18 to 23 days post-covering), where there was no fertilization; acyclic or irregular repetitions (25 to 37 days post-covering), where there was early embryonic mortality, and late repetitions (45 to 59 days post-covering).

Reproductive management, and especially the timing of mating or artificial insemination, which is related to heat detection, has a great influence on the efficiency of reproduction (Solano, 2022). The author considers that failures of this type cause sows to return to insemination or be considered to have fertility problems, especially in those in which early insemination is performed, and especially in females that reach heat for the first time.

Anestrus

Prieto et al. (2020) defined anestrus as the absence of heat or estrous cycle in a sow and distinguished two types of anestrus:

Physiological. It occurs in multiparous sows during gestation, lactation, and at the time of weaning before starting a new cycle.

Pathological or non-physiological. It is linked to poor hormonal regulation, a consequence of the appearance of factors such as:

- Inadequate feeding of the sow, leading to significant losses of body condition and fat.
- Reproductive cycle of the sow.
- Genetic line.
- Seasonality. Closely linked to the increase or decrease in photoperiod.
- Any cause that may produce a stressful situation for animals, such as inadequate facilities, social stress, poor environmental regulation, reproductive pathologies and locomotor problems that cause pain.

Due to various factors, the sow becomes infertile or sterile. These factors have been classified as infectious and non-infectious, the former being widely studied, while the non-infectious ones are the subject of research. In this regard, Knox (2019) pointed out that the inhibition of follicular development has been found to be related to: time of year, photoperiod, heat stress, negative energy balance, poor body condition, growth retardation, first parities and short lactation. He added that, according to their origin, non-infectious factors can be classified as environmental, nutritional, endocrine, congenital-genetic and management.

Palomo (2018) estimates that anestrus accounts for up to 25% of reproductive failures; however, Ek et al. (2016) studied sow culling due to reproductive causes in four commercial farms, which included nulliparous sows, and concluded that anestrus represented the main category of such failures, with 34.2%.

Metritis

The significant economic impact generated by vulvar discharges in sows is an important factor in pig production and is classified as a serious reason for culling the animal (Cruz, 2017). Among the most relevant variables of the problem, the author relates the anatomy of the genitourinary tract of the females and, in some cases, poor asepsis conditions both in the handling of the animal and in the facilities, which favors bacterial proliferation and therefore the increase in the frequency of infections of this type.

Abortions

Abortions are one of the factors to consider when discarding a breeding stock, and may or may not be of infectious origin. During pregnancy there are a large number of risks that can endanger the viability of the embryo and cause the death of the embryos or fetuses, as well as their premature expulsion before the appropriate time of delivery, which is considered an abortion (Cuéllar, 2022).Among the infectious causes, the author includes the following:

- Porcine parvovirus. Viral disease that is present in most regions of the world. Infected sows acquire permanent immunity, but those in their first delivery are affected: if they are infected before the first month of pregnancy, there is embryonic mortality; if in the second third of pregnancy, there is fetal death and mummification. Fetuses infected in the last third of gestation are born with immunity and overcome the infection.
- Porcine reproductive and respiratory syndrome (PRRS). The etiological agent is an RNA virus of the Arteriviridae family, Arterivirus genus, characterized by a marked increase in full-term abortions, stillbirths and weak pigs, decreased farrowing rates, high mortality rates in weaned pigs and delayed return to estrus. Another important aspect is the presentation of the respiratory form in lactating and weaned pigs (Senesa, 2020).

According to Cuéllar (2022), this disease can occur in two ways:

- Reproductive: mainly affects females; causes repeated heats, abortions, deaths of piglets or weak offspring, which decreases productivity.
- Respiratory: It can be observed in animals of any age; it causes weakness and respiratory signs similar to a cold, which makes them prone to contracting other secondary diseases.
- Aujeszky's disease. It is a virus caused by Suidherpesvirus 1 or Aujeszky's Disease Virus (ADV) that affects pigs and causes a great negative impact on pig production systems due to the death of young animals, abortions in females and respiratory deficiencies in adult pigs. The natural host is the pig, which can manifest the disease with reproductive, respiratory or nervous problems, but the infection can also be inapparent. AAV establishes a state of latency, and in stressful situations it can be reactivated and excreted again into the environment (Cané, 2022).
- Porcine circovirus. It is caused by a ubiquitous virus called Porcine circovirus type two. Abortions can occur in the latter part of gestation and increase the number of stillbirths, fetal mummies and weak piglets. Exposed animals naturally become immune (Cuéllar, 2022).
- Classical swine fever(PPC). Villat (2017) describes it as a highly transmissible, febrile, hemorrhagic, viral infectious disease that affects domestic and wild pigs, characterized by involvement of the endothelial cells and the reticulohistiocytic system, degenerative lesions in the walls of blood vessels, presence of hemorrhagic lesions of varying intensity (petechiae, ecchymosis, erythematous areas, necrosis and infarction of internal organs), motor disorders, prostration and death. It is caused by a virus of the Pestivirus genus of the Flaviviridae family.

Cuéllar (2022) states that if a pregnant sow is exposed to the CSF virus, the infection goes unnoticed initially, but the virus can be transmitted to the fetus in utero. This congenital infection causes: fetal death, reduced litter size, mummification, infertility and increased perinatal mortality of piglets. Those that survive are carriers of the virus and a source of dissemination of the disease.

The Cuban Porvac vaccine, against CSF, is a safe drug, because unlike others developed from live attenuated viruses, this one is biotechnological and is based on a single protein of the virus. The set of characteristics that Porvac possesses make it possible to hypothesize that the gradual application of this vaccine in a region endemic for the disease could, in the medium term, completely eliminate the virus from the territory where it is applied (Duarte et al., 2022).

- SMEDI. Stillbirth, Mummification, Embryonic Death, Infertility. It is sporadic and similar to parvovirus, affecting mainly primiparous sows and causing small litters, stillbirths, mummification, embryonic death and infertility. The virus is difficult to isolate, with the fetal lung being the most likely. Antibodies can be found in fetuses measuring more than 16 cm (Done, 2005).
- Brucellosis. According to the Department of Global Animal Health Information and Analysis (2022) Brucella infection in pigs is primarily caused by Brucella suis biovars 1, 2 or 3. Sporadic infections with B. abortus or B. melitensis have also been reported in pigs, but these are very rare. The disease is generally transmitted by ingestion of feed contaminated with products of parturition or abortion, or by uterine secretions. Pigs instinctively ingest aborted fetuses and fetal membranes. Transmission during copulation is also common, and shedding of B. suis in semen has implications for personnel performing artificial insemination. In pigs, following initial bacteraemia, B. suis colonises the reproductive tract of both sexes. In females, the placenta and fetuses are invaded, while in males invasion occurs in one or more of the following tissues: testes, prostate, epididymis, seminal vesicles or bulbourethral glands.

The department itself states that the most frequent sign of brucellosis in sows is abortion at any time during gestation, although it is more common between days 50 and 110. Vaginal discharge is not usually evident and, in chronically infected herds, the most relevant clinical sign is infertility, not abortion.

Leptospirosis. It is an acute and febrile disease caused by a bacterium of the Leptospira genus. It manifests itself through reproductive losses, often reflecting an immunological imbalance through abortions, stillborn piglets, weak or low viability piglets, and infertility in the sow (González, 2020).

In pig farms, the disease is usually subclinical, the animals are apparently healthy but infected, which is not the case when the animal is first admitted. The most common signs are: abortions at term, infertility, stillbirths, mummified or macerated fetuses and increased neonatal mortality. Sometimes fever, decreased milk production and jaundice can be observed. In some farms, transient fever has been reported as the only sign of infection (García et al., 2017).

Regarding non-infectious causes that can lead to abortions, Pinto (2015) states that the most important is the one linked to seasonality: autumn abortion. He warns that care must be taken with sudden changes in temperature and air currents, because they have an effect of increasing the susceptibility of the sow.

Another cause that can lead to reproductive failures, including abortion, was exposed by Gómez and Murcia (2017). It is the ingestion of food contaminated by mycotoxins, especially Zearalanone, although they clarify that other toxins such as T2 and Claviceps purpurea can have similar effects.

Problems during delivery (Dystocias)

The distinction between normal or eutocic birth and dystocic birth was explained by Muñoz (2010): Normal birth is when the interval between births lasts an average of 15 minutes to one hour, the average total birth time is three hours, and the fetal membranes are expelled in groups of two to four after the last piglet is born. On the contrary, dystocic birth is defined as a deviation from the different phases of normal labor and can be attributed to different causes, such as: weak contractions of the uterus, mechanical impediments such as narrow genital tract, bulky fetuses, malformation of piglets, and uterine and placental infections.

Saballo et al. (2007) reported that, in a total of 6,567discarded or dead sows, only 0.5% were due to difficulties in delivery, a cause that was included in a group called production problems.

Glardon (2020) states that all births should be assisted, even those that occur at night; however, it is considered optimal to have at least 70% of the total births attended. On average, each sow should be monitored every 30-40 minutes and high-risk sows every 20 minutes, with the aim of reducing the number of stillbirths.

Culling of sows for non-reproductive reasons

Although there is no unanimity in the classification or grouping of causes, the most common is to include in this section: Locomotion problems, Balance problems, End of useful life or longevity, Illness and Low prolificacy rate.

Problems of locomotion

Lameness in sows is one of the most frequent causes of culling and slaughter, which entails a high cost for the farm due to a high replacement rate, lower productivity and lower value of the sow at slaughter. Many factors appear to be involved in these problems, including: genetic line, parity, reproductive status, seasonality, peripartum period, feeding practices, facility and floor conditions, previous presence of lesions, genetic selection and agents, either alone or generally in combination (Lazo, 2018).

When a sow is lame, she consumes less feed, especially during lactation, and her joints, muscles and skeletal development may be affected. The pain associated with lameness causes a negative physiological reaction, including decreased appetite, reduced milk production, and a slower return to estrus. All of this reduces her reproductive performance and she is eventually culled earlier than expected, thereby reducing the productivity and profitability of the farm (Wilson, 2016).The author points out that lameness and its effect on pig reproduction are responsible for the culling of many sows after their first birth, since eliminating these problems is expensive and increases the cost of production.

Lameness in breeding sows significantly reduces farm productivity, so Rapp (2020) recommends that producers give greater priority to preventive measures in order to reduce its incidence and the impact of hoof lesions. He points out that around 15% of all sow cullings are due to lameness, which he identified as the third most important cause.

Locomotion problems were responsible for 18.3% of breeding sow waste and among these the first reason was downed sow syndrome (Saballo et al., 2007).

Lescay (2016) explains that in this anomaly, the formed bone loses minerals and mass due to a process of osteolysis, mainly as a consequence of inadequate feeding during the advanced phase of gestation, lactation, or postpartum. The bones become weaker and are prone to fractures. The main causes of osteodystrophy are deficits or imbalances of calcium, phosphorus and vitamin D in the diet. These elements are found in the diet and are absorbed in quantities that depend on the source of the minerals, intestinal pH, dietary values of vitamin D, calcium, phosphorus, iron and fat. Sometimes sows cannot absorb sufficient amounts of micronutrients even though the levels in the ration are correct.

Deficiencies in the footing can lead to failures in locomotion. Moncada (2023) states that footing problems are of genetic origin: weak-kneed pigs that fall forward as if kneeling and pigs with very straight legs that are very sensitive at the base of the hoof. Among the ways to prevent these deficiencies, the author includes: recognizing that footing is a serious problem that impacts herd performance.

Longevity, age, or high parity

In general terms, longevity is defined as the duration of a sow's productive life. In pig production, it mostly reflects a sow's ability to remain productive by raising piglets and thus avoid being culled (Vestergaard, 2020).

Longevity is commonly measured as the number of parities at the time of sow culling (Koketsu and Lida, 2020). According to these authors, in North America, Japan, Sweden, and Spain, the average longevity ranges between 3.3 and 5.6 parities. However, they estimate that from farrowing to culling is not an accurate way to monitor sow longevity because it does not take into account age, which can vary between herds for sows of the same parity. They add that sow life days are the number of days from birth to culling, while herd life days are the number of days from the date a sow is first mated to the date of culling. Therefore, sow life days or herd life days can be used to measure longevity.

Sows culled due to advanced age generally cannot maintain high biological performance, high ovulation rate, fertilization, embryonic survival and ability to maintain gestation to term; they have a longer stay on farms, have the lowest number of non-productive days, and the highest number of weaned pigs (Ek et al., 2011).

Longevity has a major impact on piglet production efficiency by reducing the number of gilts needed for replacement and increasing the proportion of sows in their prime production phase (Hoge and Bates, 2011).

Ek et al. (2011) acknowledged that this is a relative category, as some producers routinely cull sows after the fifth or sixth parity, and others only after considering their productivity at an advanced age, although commonly the highest frequency of culling for this reason occurs after the fifth parity.

Later, Ek et al. (2016) reiterated that the variability of the stay of breeding sows between different intensive production systems is mainly associated with the criteria used to cull sows, in addition to factors such as: the environment, the season, herd size, year, and the particular management of each farm.

The above influences the structure or frequency of the causes of culling and is a reason why longevity or high parity is sometimes one of the main causes of culling of sows (Jiménez, 2012), and other times only represents 8.7% of the culled sows (Lucia et al, 2000).

Moreno (2022) stated that the maximum lifespan of a sow in an intensive breeding farm is between two and three years. The reproductive cycle is repeated up to seven times, a time that the industry assumes is the useful life for breeding sows.

According to Vestergaard (2020) Longevity is a trait with low to moderate heritability; its values, estimated in studies with Landrace and Yorkshire breeders, usually vary between 0.08 and 0.17. The variation in heritability is not only due to differences between breeds, but also to the quality of the data and the environmental differences where this trait has been recorded.

Caballer (2017) states that the longevity of sows is a trait that is selected, along with other extrinsic factors, to reduce mortality and the elimination of breeding sows and thus increase the retention percentage and stabilize the census and health of the farm.

Longevity or productive life Sow longevity plays an important role in economically efficient piglet production, yet direct selection for improvement is not commonly practiced in any pig breeding program (Mote et al., 2019). According to these authors, studies indicate that sow longevity is a complex parameter, for which there

Table 1. Calculation of the prolificacy index in Cuban genetic centers

Prolificacy index (I)	$I = 100 + (\bar{x} - \bar{p})\frac{Nh^2}{1 + (N-1)R}$	$\bar{x}$ = Average corrected live litters of each sow according to its birth sequence $\bar{p}$ = Corrected average of all sows h^2 = heritability of live litter size at birth (0.10) R= coefficient of constancy or repeatability (0.15) N= Parity number

is sufficient genetic variation for its improvement through selection to be effective. They add that sow longevity is genetically related to prolificacy and certain limb conformation characteristics, and that this trait appears to be ideal for using genomic selection for its improvement.

Low prolificacy rate

Productivity of sows during their stay in the herd is an appropriate indicator to evaluate the productivity of a farm, since it includes productive and reproductive components. Productivity can be measured by the number of pigs born alive or weaned, or as the kilograms of piglets produced at birth or weaning per litter, per year or during the entire stay in the herd (Hoge and Bates, 2011).

The elimination of unproductive sows and the introduction of replacement sows are essential components to maintain productivity at an optimal level. Commercial pig producers try to increase sow productivity and reduce the percentage of culled sows, taking into consideration the high cost of replacement sows (Batista, 2014).

Lida and Koketsu (2015) observed that sows with high numbers of piglets born alive at first parity (>13), continued this trend in all subsequent parities, and very few of them were culled for low litter size, resulting in high survival or longevity. Later, Koketsu and Lida (2020) stated that the number of piglets born alive at first parity is an early predictor of sow prolificacy.

Prolificacy affects the ideal structure of the population. In general, high prolificacy is associated with a higher percentage of sows at the most productive ages, from second to seventh parity; it also influences the maximum productive age, causing its shortening.(Fernández et al., 2015). The authors add that biological deterioration over time causes the prolificacy of sows to decrease, after having reached its maximum in the first farrowings. Thus, sows should be replaced when their expected productivity is lower than that of a replacement sow.

Pérez (2016) stated that the possible causes of small litters are multiple, and most are interrelated. Among these, he refers to: synchronization between insemination and ovulation,seminal quality, embryonic mortality and consanguinity.

The following table shows how to calculate the prolificacy index in Cuban pig genetic centers (MPTCGP, 2023).

Monitoring of discarded sows in the slaughterhouse

Inspections of culled sows at the slaughterhouse level are a source of information that is generally underused as a diagnostic tool in pig production (Rodríguez et al., 2008). These authors state that sampling of animals at the slaughterhouse level and the subsequent examination of reproductive organs is a tool of great diagnostic value in pig reproductive management, as it provides a series of data on the possible causes of reproductive failures and allows corrective measures to be taken at the herd level on the parameters that are affected; it is particularly useful in the case of non-infectious reproductive problems, where microbiological analyses are of limited use.

The authors add that these analyses allow for the classification of pathologies that may be affecting the reproductive performance of the herd, which will translate into fertility or potential litter size. The study includes the characteristics of the ovaries, evaluated through their activity: firstly, by the total number of follicles present. The ovaries of sows that fail to return to estrus after weaning have small follicles (less than 5 mm in diameter). Secondly, due to the presence of cysts, it is observed that approximately 5 to 10% of sows culled due to infertility problems are affected by ovarian cysts, which can cause irregular estrous cycles. Anestrus is another pathology characterized by a state of complete sexual inactivity, without signs of estrus and in any case the animals do not conceive, affecting the reproductive efficiency of the herd.

Some authors, such as Feldens et al. (2007), have reported that errors in determining the reason for culling on farms are frequent, which increases the removal of females that could be used for a longer period of time, reducing expenses related to replacement. The results of Jiménez (2012) are in the same sense, when he evaluated post mortem 58 sows culled due to reproductive failure and found that 84.5% of them showed cyclic activity in the ovaries.

Falceto (2016) warned that the post-northern examination of the ovaries allows verifying that the diagnosis of anestrus made on the farm is correct, identifying the cause of infertility and checking whether the methods of heat detection and pregnancy diagnosis are adequate on the farm.

Mortality of breeding sows

Traditionally, mortality of breeding animals has not been given as much importance as other indicators on production farms, despite the weight that this factor has in the cost of production (Toledo and Belenguer, 2017). These authors relate the following mortality risks:

- Farm size. Larger farms have more difficulties in identifying symptoms in affected sows.
- Facilities. Their quality and environment have a strong influence on the percentage of casualties.
- Staff training. Their training and the existence of action protocols significantly reduce the percentage of casualties.
- Food quality, handling and presentation. They directly influence the occurrence of ulcers and torsion.
- Microbiological and physical-chemical quality of drinking water.
- Condition of the meat. Greater number of losses in fat sows, especially during hot periods.

Saballo et al. (2007) reported that 6.6% of sows excluded from the herd in five commercial farms in Venezuela were due to diseases, mostly respiratory, and 5.4% due to death. On the same basis, Lucia et al. (2000) obtained a 7.4% of breeding sows excluded due to mortality.

Piñeros et al. (2007) referred to the most common findings obtained by Sanz et al. (2002) in necropsies of breeding sows: enteropathies, dystocia, urinary tract infections, respiratory problems and gastric ulcers, all of them according to the type, size and management conditions of the different farms. For their part, the authors mentioned at the beginning also studied the causes of elimination or death of breeding sows in two farms and found that:

- Young mothers are at greatest risk of death or culling, as are lactating sows in the first 10 days of lactation.
- In both farms, the main causes were of gastrointestinal and cardiovascular origin. Other causes varied between farms, such as respiratory (11.43% vs 31.58%) and musculoskeletal (22.86% vs 0.00%).
- The causes of death and culling of breeding animals did not coincide between the retrospective and prospective studies carried out on one of the farms.

Finally, they suggested that it was necessary to implement a monitoring and evaluation programme for these causes at farm level, which would guarantee their analysis and decision-making.

Selection of sows for replacement of breeding sows

In pig farming, first-time females are crucial for the future of the farm, since this replacement involves a cost, and also a risk due to the possible introduction of diseases; therefore, their selection must be governed by specific rules to achieve optimal reproductive performance and a long useful life (Vásquez, 2013).

Castro (2019) expressed similar opinions when he stated that the quality of replacement sows is an element that can improve production in the medium or long term, since a correctly selected female with good immunity will demonstrate good performance consistently throughout her stay on the farm.

In a more practical sense, Paulino (2020) highlighted that replacement sows are the females that allow meeting the weekly service quotas and thus achieve stability in the zootechnical flow and future sales.

The selection of future breeders is very important, so it starts from birth to achieve good final results (Paladines, 2018). The author lists some aspects that must be taken into account for a good selection of breeders, such as birth weight, number of functional teats and health. At the time of the first service, nulliparous sows must meet certain requirements, among which Foxcroft et al. (2002), cited by Williams (2015), included a minimum live weight of 135 kg and a dorsal fat thickness of 15 mm.

In Cuba, the MPTCG (2023) defines the fundamental objective of selection in genetic units: to produce an animal that integrates the greatest growth, with the increase in meat production in the carcass at the expense of the decrease in fat. To do this, an index is used that includes two selection criteria: Weight for age and Dorsal fat thickness measured live. The first measures the growth rate, while the second indirectly measures body composition. The use of both criteria indirectly improves the efficiency in the use of feed.

Bioalimentar (2019) states six aspects to take into account when selecting future breeding stock:

- That they come from large and uniform litters.
- Mothers without problems during childbirth.
- Mothers who are good milk producers.
- Mothers with good mothering skills.
- Good food consumption during lactation.
- Long-lived reproductive life.

Regarding herd retention, Ordaz et al. (2021) reported that a considerable percentage of young sows (1st and 2nd farrowings) are culled due to poor selection in the replacement phase, therefore, modern pig farming aims for a restructuring that has been associated with the sow retention rate. The results of Ek et al. (2020) are also in this direction, who concluded that early culling of sows increased the proportion of non-productive days, which in turn could reduce farm profitability.

Vestergaard (2020) raised that longevity, like conformation, has an unfavourable genetic correlation with common production traits (daily weight gain, lean meat percentage and backfat thickness). This fact underlines the importance of including robustness traits, such as longevity and conformation, in pig breeding objectives taking into account the increasing demand for high productivity to ensure a sustainable and balanced breeding objective.

The correct structure of the limbs of the young sow contributes to preventing later problems in its locomotion and possible culling. To know if this structure is correct, Moncada (2023) recommends observing the following points: width of the bone, straightness of the legs seen from the front and back, lateral aspect with slight forward deviation from the top to the base and strong structure. To prevent problems with aplomb, he recommends: selecting breeders with a good structure, placing the feeders at the appropriate height, maintaining a balanced diet, and diagnosing and combating the diseases that cause these problems.

The economic benefits of reducing early culling were recognized by Engblom et al. (2008) when they stated that sows culled early produce fewer weaned pigs compared to sows kept for longer periods, leading to economic inefficiency of commercial farms and low reproductive efficiency.

As a result of a study with Duroc breeding sows, Fernández de Sevilla et al. (2008) considered a direct genetic improvement of sow longevity feasible, but the expected response would presumably be small. Even so, they add that indirect selection through the conformation of specific deficiencies or defects could be useful given the moderate-high heritabilities described in some works.

Conclusions

1. There is consensus that a complete evaluation of the culling of breeding sows on pig farms should consider four aspects: Culling and annual replacement rates, Causes of culling, Reproductive records, and Inspection of the genital tract of sows culled post mortem.
2. The causes of culling of breeding sows and their frequency of occurrence show great variations, due to the diversity of factors that influence them, among which the farm effect stands out, the inclusion or not of nulliparous sows in the total number of culled, as well as the criteria used to culle the sows, identify and classify the causes of culling, all of which corresponds to the different culling and replacement rates that appear in the literature.

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