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Reproductive Health Care and Management in Swine

Laxmi Sahu[1], Dhirendra Bhonsle[1], A. K. Santra[1], Rupal Pathak[1], O. P. Dinani[1], Mahendra Sinver[2], Mahesh Kumar[2] and Uttam Kumar Sahu*[2]

[1]Livestock Production & Management, CoVS & AH, Anjora, Durg, 491001, C.G. India

[2]ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh, India.

**Corresponding author: uttam33000@gmnail.com*

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ABSTRACT

Reproductive efficiency is the cornerstone of sustainable and profitable swine production, as pigs combine early sexual maturity with high prolificacy and strong sensitivity to management practices. This article presents an integrated overview of reproductive health care and management in swine, following the reproductive continuum from puberty and gilt development to post-weaning fertility. Emphasis is placed on the biological and managerial determinants of successful reproduction, including puberty onset, estrus expression, mating and artificial insemination timing, boar-to-female ratios, gestation care, farrowing management, and lactational energy balance. Global and Indian pig population data are discussed to contextualize reproductive management under diverse production systems. The article highlights how improper estrus detection, mistimed mating or insemination, nutritional imbalance, environmental stress, and infectious diseases contribute to embryonic loss, extended non-productive days, and reduced litter size. Particular attention is given to the role of timing relative to ovulation in both natural service and artificial insemination programs, as well as the impact of lactational negative energy balance on the weaning-to-estrus interval. Rather than focusing on corrective hormonal interventions, the review emphasizes preventive, physiology-based reproductive health strategies that align management practices with the sow's reproductive biology. By adopting a life-cycle–oriented and preventive approach, swine producers can improve fertility consistency, enhance sow longevity, and optimize herd-level reproductive performance under both intensive and smallholder production systems.

INTRODUCTION

Reproductive efficiency is the central biological determinant of productivity in swine farming. Unlike many livestock species, pigs combine early sexual maturity with high prolificacy, making their reproductive output extremely sensitive to management decisions. A few missed estruses, poorly timed inseminations, or nutritional imbalances can translate into substantial economic losses through reduced litter size, prolonged non-productive days, and premature sow culling. Effective reproductive health care in swine therefore requires a continuous, life-cycle–based approach that integrates

physiology, nutrition, environment, and disease prevention rather than focusing only on breeding events. At the global level, pig production remains one of the most important livestock sectors. FAO livestock stock data indicate that the world pig population has remained in the range of approximately 750–800 million head in recent years, despite regional fluctuations caused by disease outbreaks and market restructuring (FAO, 2023). In India, pig production plays a smaller but socially and nutritionally significant role, particularly in eastern and northeastern states. According to the 20th Livestock Census (2019), India had 9.06 million pigs, representing a decline of about 12% compared to the previous census (DAHD, 2019). These contrasting scales highlight why reproductive management strategies must be adapted to local herd size, resource availability, and production objectives.

Puberty, Gilt Development, and the Biological Foundation of Fertility

Reproductive health management in swine begins with gilt development. Puberty in gilts is governed by the maturation of the hypothalamic–pituitary–ovarian axis and is influenced by genetics, body weight, growth rate, nutrition, season, and social environment. Under well-managed conditions, puberty typically occurs between 160 and 200 days of age, but delayed puberty remains a common problem in poorly nourished or heat-stressed gilts. Gilts that attain puberty late or are bred before achieving adequate body reserves often show compromised lifetime reproductive performance. Body weight and body condition at first breeding are more predictive of future fertility than age alone. Studies consistently demonstrate that gilts bred at appropriate body condition exhibit higher ovulation rates, improved embryo survival, and greater longevity within the herd (Kemp et al., 2018). Insufficient body reserves predispose first-parity sows to excessive tissue mobilization during lactation, which suppresses gonadotropin secretion and delays the return to estrus after weaning.

Boar exposure remains one of the most effective tools for stimulating puberty onset. Physical contact, pheromonal cues, and auditory stimulation from mature boars accelerate luteinizing hormone secretion and ovarian activity. Strategic boar exposure, combined with balanced nutrition, allows producers to synchronize gilt entry into the breeding pool and reduce variation in age at first service, thereby improving overall herd reproductive stability.

Estrus Expression and Breeding Management

Estrus detection is a pivotal yet often underestimated component of reproductive efficiency. Estrus in pigs is characterized by behavioral signs such as standing reflex, vulvar swelling, and increased restlessness, all of which reflect rising estrogen concentrations from preovulatory follicles. However, the duration and intensity of estrus vary widely between gilts and sows and are strongly influenced by parity, nutritional status, and environmental stressors. Inadequate estrus detection leads directly to mistimed mating or insemination, which remains a major cause of repeat breeding. Ovulation in pigs typically occurs during the last third of estrus, and fertility is highest when viable sperm are present in the female reproductive tract prior to ovulation rather than after it (Soede et al., 2000). This biological principle underpins both natural mating and artificial insemination strategies.

Natural Mating Systems and Boar-to-Female Ratio

In natural service systems, reproductive performance is constrained by boar capacity and mating frequency. Practical field recommendations commonly suggest a boar-to-female ratio of

approximately 1:15 to 1:25, depending on boar age, libido, and mating management (MSD Veterinary Manual, 2024) (Fig. 1). Overuse of boars can lead to reduced semen quality, physical injury, and declining conception rates, while underuse represents inefficient resource utilization. Natural mating programs often rely on double mating during estrus, typically with services spaced 12–24 hours apart. This approach compensates for variation in estrus length and ovulation timing and increases the likelihood that sperm are present in the reproductive tract during the fertile window. Although natural service appears simple, its success depends heavily on accurate heat detection, proper boar management, and controlled mating frequency.

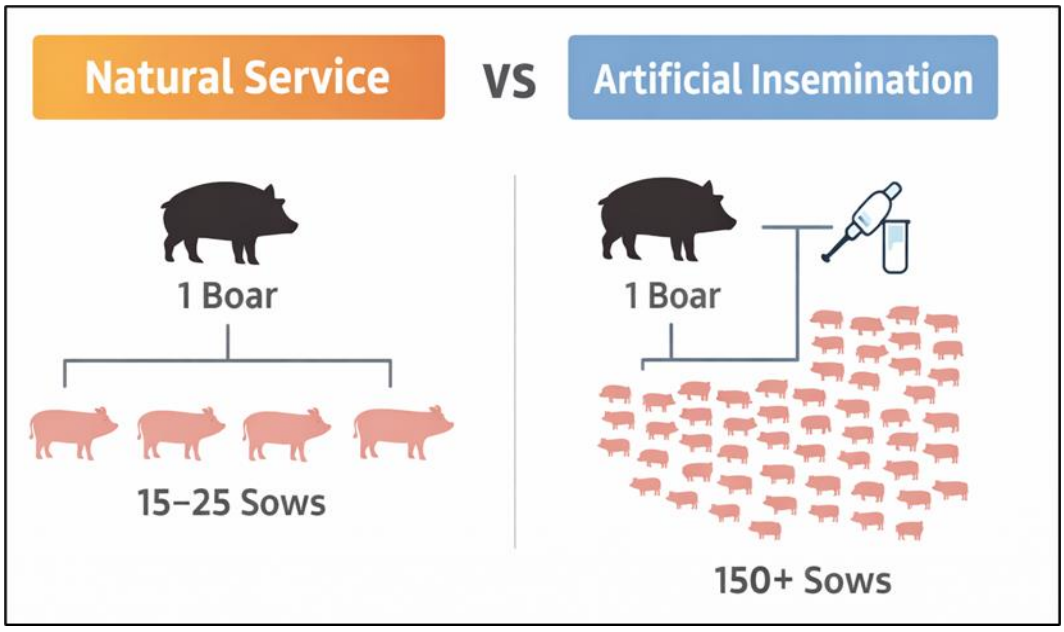

Fig 1: Boar-to-female ratio comparison

Artificial Insemination: Timing, Scale, and Precision

Artificial insemination (AI) has transformed swine reproduction by enabling rapid genetic improvement, reducing the number of boars required on farms, and enhancing biosecurity. In AI-based systems, the effective boar-to-female ratio can increase dramatically, often reaching hundreds of females per boar, particularly when semen is sourced from specialized collection centers (Knox, 2016). However, AI places far greater emphasis on timing precision. Research examining insemination relative to ovulation has shown that fertility remains optimal when insemination occurs during the 24 hours preceding ovulation, whereas insemination too late results in reduced fertilization and poorer embryo development (Soede et al., 2000) (Fig. 2). For this reason, many commercial herds continue to use two inseminations per estrus, especially in systems where estrus detection accuracy varies. Recent advances have explored fixed-time and single-service AI protocols, particularly in well-managed herds with consistent estrus expression. While these approaches can reduce labor and semen costs, their success depends on strict adherence to detection schedules, animal category–specific timing, and overall herd health (Kemp et al., 2018).

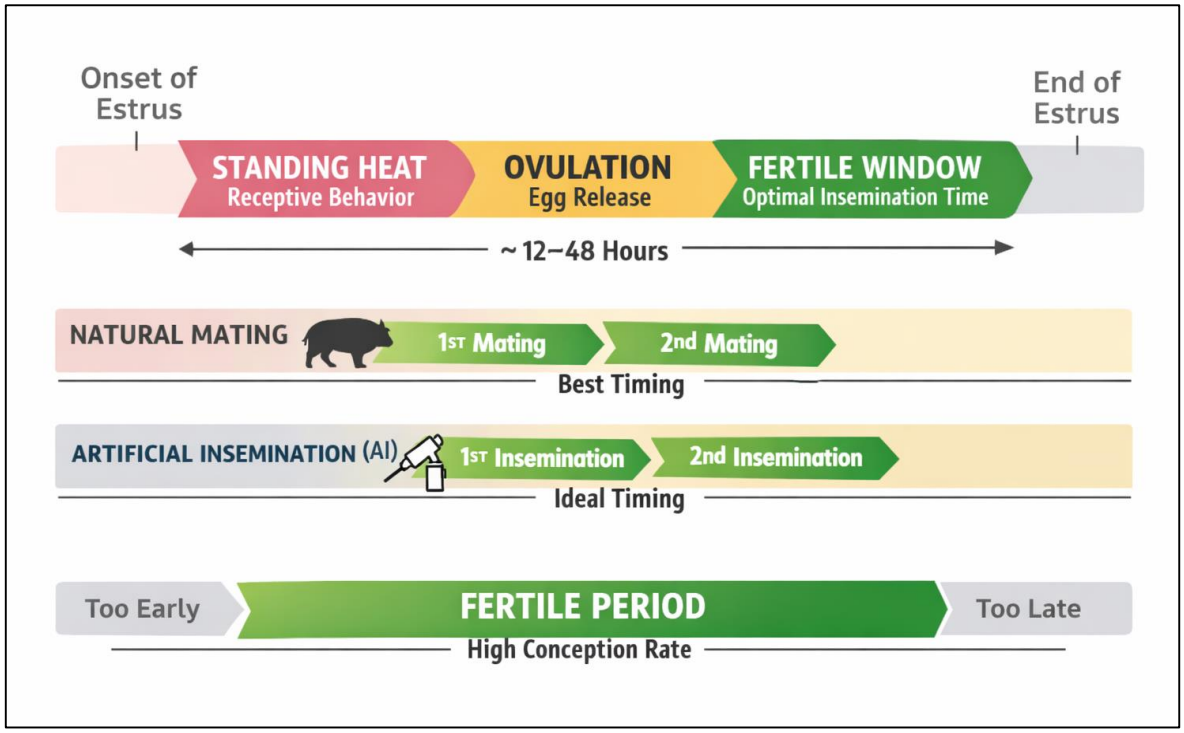

Fig. 2: Timing of estrus, ovulation, and mating/AI

Gestation Management and Embryo Survival

Pregnancy in swine is marked by substantial embryonic loss, most of which occurs during early gestation. Although fertilization rates are generally high, 20–30% of embryos may be lost before implantation under commercial conditions. These losses often go unnoticed and manifest later as reduced litter size rather than overt reproductive failure. Nutritional balance during early gestation plays a crucial role in embryo survival. Inadequate energy intake can compromise progesterone secretion, while excessive feeding may disrupt the uterine environment. Infectious diseases such as porcine parvovirus, leptospirosis, and PRRS continue to pose serious threats to reproductive success, emphasizing the importance of vaccination, biosecurity, and herd health surveillance.

Farrowing, Periparturient Care, and Reproductive Continuity

Farrowing represents a critical transition point where reproductive success can be either consolidated or lost. Prolonged farrowing duration and dystocia are associated with increased stillbirth rates and reduced piglet vitality. These problems are often linked to sow body condition, mineral balance, and environmental stress during late gestation. Proper farrowing management extends beyond piglet survival. Sows experiencing excessive farrowing stress or postpartum uterine infections often show delayed uterine involution, which negatively affects subsequent fertility. Thus, farrowing management must be viewed not as an endpoint but as the starting point of the next reproductive cycle.

Lactation, Energy Balance, and Return to Estrus

Lactation is the most energetically demanding phase of the sow's reproductive life. Modern sows, selected for high litter size, face enormous metabolic pressure to sustain milk production. When feed intake fails to meet these demands, sows enter a negative energy balance that suppresses ovarian

activity and prolongs the weaning-to-estrus interval, a key indicator of reproductive health. Under optimal conditions, most sows return to estrus within 4–6 days after weaning. Prolonged intervals often reflect excessive body reserve loss, inadequate nutrition, or underlying disease. Management strategies that promote high feed intake during lactation—such as optimized diet formulation and thermal comfort—are therefore essential for maintaining reproductive efficiency.

Preventive Reproductive Health Management

Modern swine reproduction increasingly emphasizes prevention rather than corrective intervention. Regular monitoring of reproductive records, including farrowing rate, litter size, and repeat breeding, allows early identification of emerging problems. Preventive strategies grounded in reproductive physiology reduce reliance on hormonal treatments and improve both animal welfare and long-term productivity.

CONCLUSION

Reproductive health care and management in swine is a continuous, biologically interconnected process that spans from gilt development to post-weaning fertility. Each stage of the reproductive cycle influences the next, and failures rarely occur in isolation. By aligning management practices with reproductive physiology and adopting a preventive, life-cycle–based approach, swine producers can achieve consistent fertility, improved litter performance, and enhanced sow longevity. In both global and Indian contexts, such biologically informed reproductive management remains fundamental to sustainable pig production.

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