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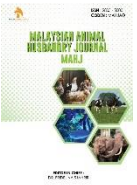

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*REVIEW ARTICLE*

# A REVIEW ARTICLE ON NON-GENETIC FACTORS AFFECTING REPRODUCTIVE TRAITS IN SWINE

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**ABSTRACT**

This review studies several factors affecting the reproductive performance of swine chiefly focusing on sow-related factors, which have significant economic importance. A sow's productivity is determined by different reproductive attributes, including litter size, litter weight at weaning, farrowing rate, the return of oestrus, and many more. The increase in number of pigs born alive and weaned piglets per sow is an aim for swine husbandry.Various factors such as parity, housing, feed, gestation length, season, and temperature are considered in this paper. Sows of differing parities have performed differently.The performance was influenced by various feeding systems, comfort, spacing, aggressiveness, and disease transmission in the housing system. Feeding intake and nutrition uptake are directly connected with milk secretion as well as other traits. Season and temperature are correlated with feeding intake, time of puberty, hormonal production, and seasonal infertility.Scientists are globally working for productive breeds. However, the rearing of swine will necessitate the consideration of different non-genetic factors of their reproduction from an economicpoint of view.The goal of this study is to understand non-genetic factors that affect sow reproduction and to advise swine farmers on how to create a better environment for swine to improve productivity.

**KEYWORDS**

Reproductive traits, swine, non-genetic factors

## 1. INTRODUCTION

Reproductive traits refer to those attributes that express the reproductive characteristics of the animal. It includes ovulation rate, gestation length, age at puberty, estrus and sexual cycle, the viability of newly born piglets, litter size at the birth in sow, rebreeding interval, etc, and semen quality, semen ejaculate rate, testicular size, and many more. According to MOAD (2021), the total swine population is 1,519,593 in Nepal which is the highest comparing the data of the last decades.This reflected the people's growing interest in swine farming. Farmers, on the other hand, are not receiving the gains that they should be due to a lack of good management and other environmental factors.

Both genetic and environmental factors are responsible for the reproductive performance in animals and such factors should be taken into account to achieve the expected output. Most of the people are focusing on the swine rearing for high carcass muscle and performing intensive selection for high-quality meat. Tuz et al. (2018) stated that this type of selection has resulted in inferiority in swine reproductive qualities and that the reproductive traits in swine are quite low, making selection difficult. Farmers should therefore concentrate on other non-genetic environmental factors that have proven to be a less expensive means of improvement.Low or high parity of farrowing sow, seasonal effect, temperature, light and photoperiod, altitude, group housing or individual crates, lactation feed, and pregnancy nutrition are some non-genetic factors that affect the reproductive performance.

Furthermore, parity order is linked to the physiology and growth of the individual and, more specifically, the development of the reproductive system(Knecht & Srodo, 2015).So better reproductive development has shown improved financial profitability from the 3rd year.Similarly, inflammation, lameness, infection wounds, disease transmission, ectoparasites, and other health problems are linked to the housing system, which might affect their performance. The season is linked to the impact of temperature on their physiology and dietary habits, which has an impact on their performance.

Moreover, season, parity, lactation length, and nutrition are most frequently highlighted non-genetic factors affecting the reproductive trait of sows(Bloemhof et al., 2008). This review outlines their effect on litter size, litter weight, oestrus period, farrowing rate, and other economically important traits in swine.

## 2. DISCUSSION

### 2.1 Parity

The performance of the pig was observed to be relatively growing from first to fourth parity (Pokharel et al., 2013)until the fourth parity and gradually lessen in further parity (Knecht and Srodo, 2015).Similarly, Hoving et al. (2011)reported that sows have the best reproductive traitsin between third and fifth parity.The reproductive performance was unsatisfactory at the most older parity but still was better than the first parity (Knecht& Srodo, 2015).Most of the researchers had shown that

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parity to be highly co-related with litter size. Tummaruk et al. (2010) and Suriyasomboon et al. (2006) revealed that increasing litter size on increasing parity is due to the release of more follicles during ovulation and increasing the uterine capacity of the sow. Moreover, Abayomi ( 2017) documented that there is no effect of parity except for the weight at weaning agreed with (Oluwole et al., 2014).

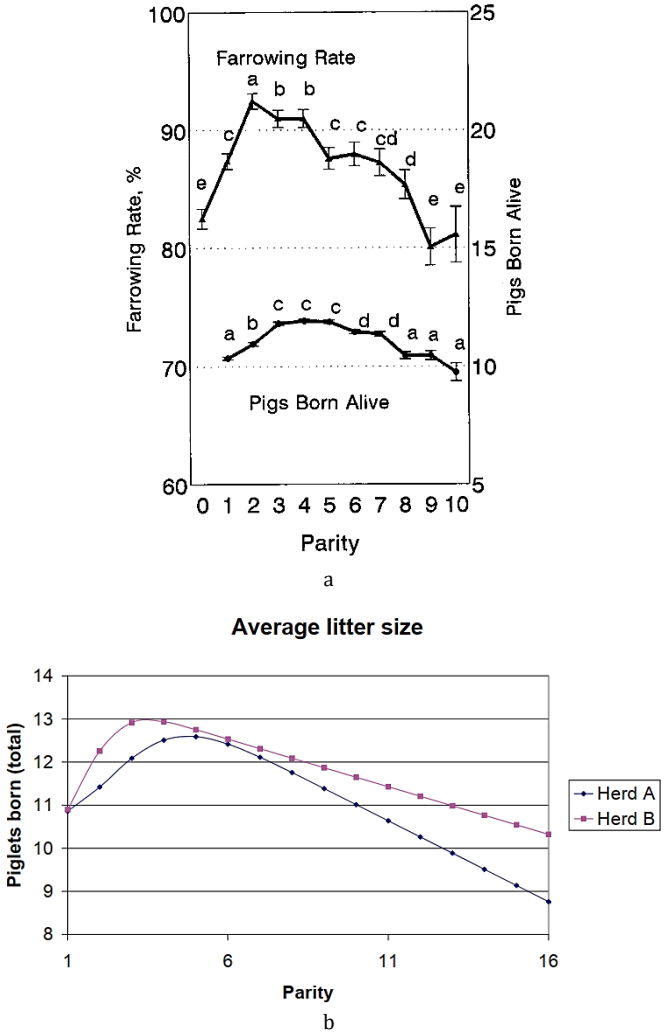


**Figure 1: a.**Effect of parity on farrowing rate and alive born pigs revealing better performance in early-mid and mid parities. **(retrieved** from(Koketsu et al., 1999)**. b.** effect on litter size in two herds retrieved from(Kristensen & Søllested, 2004)

Hagan & Etim ( 2018) evaluated data from first to fifth parity and revealed that parity has a significant effect on litter size and weaning, farrowing rate, and piglet weight during birth. Conferring to that study, litter size was significantly higher in the fourth parity and the farrowing rate was much lower in the first and fifth parity. The least mortality was observed in the second parity and the highest mortality began from the fourth parity. They concluded that the youngest and most older parity are least reproductively favored. Hoving et al. (2011) and Yang et al., (2019) revealed that the reproduction performance, litter size, and piglet weight were observed maximum in gilts (first parity) and the weaning trait was in peak in sixth parity. Usually, mid parities ( third and fourth )were observed with the largest piglet size and highest litter size than the very first or older parities (Lucia et al., 2002; Van Dijk et al., 2005).Moreover, it has been reported that piglets born to older parity have consistent thermoregulation(Santiago et al., 2019).

## 2.2 Season and temperature

Temperature and photoperiod vary seasonally, and both have been linked to seasonal variations in pig fertility and fecundity(Wettemann & Bazer, 1985). Seasonal effects have a significant influenceon the reproductive performance of both boar and sow (Kunavongkrit &Suriyasomboon, 2005).Altered farrowing rate caused by seasonal influence is the most convincing proof for it (O. A. T. Peltoniemi et al., 1999). Late puberty is the most noticed seasonal effect on reproduction in swine (Paterson & Pearce, 1990).Gilts born in Autumn undergo early puberty than spring-born(Gossett & Sorensen Jr, 1959; Mavrogenis & Robison, 1976) but some findings were the opposite of it (Scanlon & Krishnam., 1974) and some papers reported no relation at all (Christenson & Ford, 1979).

The subsequent decrease in the farrowing rate especially in the summer and autumn season is caused by the trouble of early pregnancy than due to conception failure (Love et al., 1993; O. A. Peltoniemi et al. (2000).Peltoniemi (2019) noted autumn to be the season of sexual arrest and conserving energy for the coming winter season and pregnancy. Seasonal infertility is a photo-period and season-induced phenomenon. High ambient temperature was considered the contributing factor for seasonal infertility issues (Love, 1978). Infact, various findings have observed that levels of the most important hormones affecting fertility like follicle-stimulating hormone (FSH) and luteinizing hormone (LH) showed distinct seasonal patterns (Love et al., 1995; O. A. T. Peltoniemi et al., 1997;Bassett et al., 2001) and the hormone level was higher in the winter season

The seasonal effect lengthened the weaning to oestrus interval, and it affected further when sows were kept in the individual pen after weaning (Hurtgen & Leman, 1980; Hurtgen et al.,1980; O. A. Peltoniemi et al., 1999).Hermesch & Jones (2007) andSchinckel et al. (2010) added that seasonal change can change the lactation feed intake as well. Due to high temperatures during lactation in the hot climate of summer and autumn, there has been a noticeable reduction in the intake of voluntary feed resulting in delaying oestrus after weaning(Prunier et al., 1996).Tummaruk et al. (2001) reported the longer intervals for oestrus in the dry season.

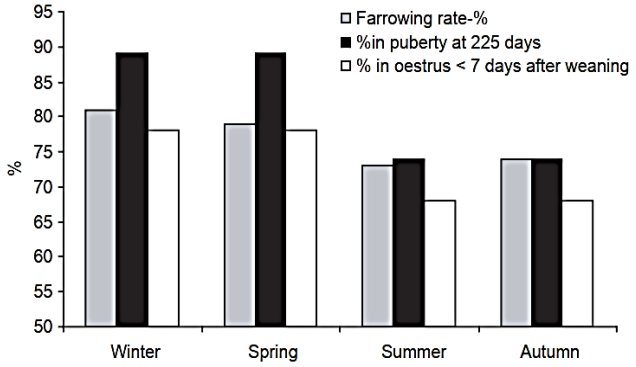


**Figure 2:** Infertility affecting reproductive traits in swine due to seasonal influence (figure retrieved from Peltoniemi, 2019; Data pooled from Peltoniemi et al., 1999;Paterson et al., 1991;Hurtgen et al., 1980)

Similarly, Love (1978) claimed that season has no actual effect on litter size consistent to (Paterson & Barker,1978;Mattioli et al., 1987, and O. A. T. Peltoniemi et al., 1999). Conversely,Claus & Weiler (1985)reviewed that number of piglets decreased by one piglet after summer matings. Sows tend to have a greater number of piglets during the first half of the year supporting theeffect of the season in the reproduction(OAT Peltoniemi et al., 1997).Bassett et al.( 2001)correlated the effect of season on prolactin secretion which consequently affected lactation.Almond et al. (1985)mentioned the Autumn abortion syndrome due to low temperature during the early winter and late autumn season.Damian Knecht, (2014) revealed higher production of litter during the rainy season. Hagan & Etim (2018)considered three main classes of the seasonfor their study; major rainy, minor rainy, and dry season; and concluded higher farrowing rates during the rainy compared to the dry season and significant pre-weaning mortality during the wet season.The reproductive performance was observed to be superior during rainy season (Hagan & Etim, 2018).

## 2.3 Housing

In general, housing systems include the herd size, house size, floor space, feeding system, beddings, and so on.The spread of contagious disease, lameness, and hygiene are also associated with housing conditions affecting swine reproduction.Group housing permit the animals to express their usual activities and normal behavior (Maes et al., 2016). From the viewpoint of animal welfare, some researchers suggest that 3–7 sows per group is the optimal size in group housing (Bracke et al., 2002). The gestating sows experiencing long-term stress due to social interaction in group housing had a bad impact on reproduction (Salak-johnson,2017 ).It is very difficult toindirectly compare the findings of various housing-related factors because of the limitations of data concerned withthe riskelements in various group housing systems(Spoolder et al., 2009).

The farrowing rate and number of piglets at birth are the most sensitive factors to be affected by housing (Rhodes et al., 2001; Mcglone et al., 2004). Return weaning and farrowing rate affected by housing systems are mostly studied by comparing the housing in pen and individual stalls (Mcglone et al., 2004).

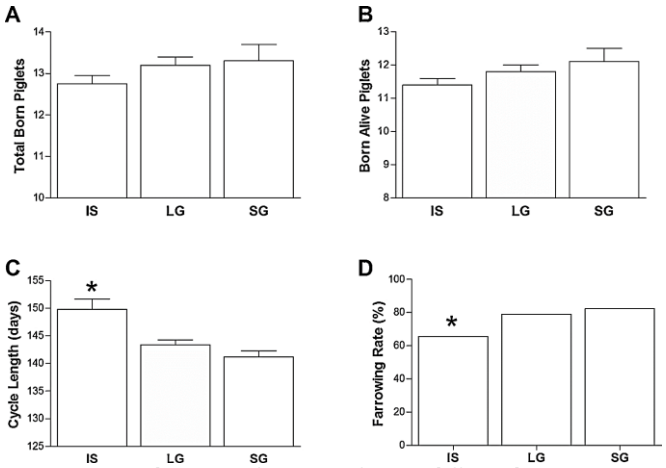


**Figure 3:** Reproductive performance of sow in different housing systems (Abbreviation LG Large Group of 30 sows, SG Small Group of 7 sows, IS individual confinement stalls; figure retrieved from Morgan et al., 2018)

Lameness has been observed to be especially common in urban groups housed on a cement slatted floor(Cador et al., 2014).Swines housed in group pan particularly receive impaired reproduction performance regarding duration between weaning and estrus, farrowing rate of the sow, and the number of piglets born (Karlen et al., 2007;Munsterhjelm et al.,2013; Pedersen et al. (2003).The influence of the housing system can have several combined reasons like long-term aggressive behavior of pigs for the competition of food, dominance, and finally affecting the reproductive traits (Bench et al., 2013;Hemsworth et al., 2013;Spoolder et al., 2009). Mixing sows in herd instantly just after impregnation caused a bad impact in the conception, implantation, and the growth of the embryo due to elevated and sustained cortisol concentration(Razdan et al., 2004a,2004b;Turner et al., 2005),so sows should be mixed with other after a certain time of insemination. Lower cortisol concentration was noticed in the sows mixed within 2-12 days after insemination than sows that were mixed between 35-42 days (Knox et al., 2014).In the research of the effectiveness of free-access feeding stalls and electronic sow feeders, a higher rate of return to oestrus was noticed in electronic sow feeders(van der Peet-Schwering et al., 2003). Conversely,Courboulay and Gaudre (2002) observedthatsows fed withelectronic sow-feeding gave fewer piglets in comparison with those which were housed in small pens given food in individual troughs.Floor space was observed to affect the rate of farrowing and litter size positively wherever the sow is housed in small group pens or larger (Hemsworth et al., 2013&Salak-Johnson et al., 2007), and the more floor space, the more number of piglets born was noted (Salak-Johnson et al., 2007). Hemsworth et al. (2013) correlated floor space with the aggression rate of the swine and observed decreased aggression onthe increase in floor space. In the group housing system, those sows which are stronger and dominating ( taken as higher-ranking) can displace the lower-ranking sows in feeding, floor space, etc (Kranendonk et al., 2007;Pacheco, 2016).

### 2.4 Feeding and Nutrition

Usually, animals rapidly lose their weight during lactation and insufficient feed makes it worse. Clowes et al. (2003)affirmed that if the estimated parturition protein is lost by more than 9-12 percent, it has detrimental effects on ovary function and lactation.Even more, studies have revealed the importance of feeding on swine reproductive performance. As per Eissen et al., (2003), offering sufficient feed during lactation aids in weight gain by reducing weight loss and backfat loss in sows.

Sows provided witha high amount of lactation feed producedgreater litter size, proper weight gain with low backfat loss (Eissen et al., 2000). It is a natural phenomenon for sows to lose weight during lactation to activate their body and sustain milk production. If those sows are not given adequate feed and lose huge weight, can undergo various inferiority in reproductive traits.Proper nutrition and sufficient feeding are necessary for the proper performance of the pig.Williams (1995) concluded that protein and energy supply in the feed are two major factors influencing milk production.Koketsu (1997) addressed that sows given a high voluntary feed ingredient had a shorter weaning to service duration, faster farrowing, greater litter size, and a higher litter weight.

Koketsu (1997) also discussed that good feed intake was shown to get rid of some reproduction-associated issues like short lactation period. The alteration in the lactation performance during the hot season was also explained to be due to a decrease in the intake of food (Bragança et al., 1998) which explained the importance of sufficient feed for the reproductive traits. The feed can be a responsible factor not only in the lactation period. Relatively poor energy before copulating also farrowed less number of piglets (Kongsted, 2005).L. L. Anderson & Melampy (1971) also supported the significant effect on ovulation rate and litter size after flushing. Proper feeding helps in gaining good weight and back fat as well. Theweaning to oestrus duration was related significantly to the weight and back fat quantity of the sow (Hughes, 1993).Low farrowing rate, more number of culled sows, and high interval for mating from weaning due to reproductive failure linked with lower feed (Koketsu et al., 2017). Chiboka (1981)claimed that the age of puberty can be decreased from 146 to 150 days by expanding the feed and improving housing as well as reduce the duration from weaning to service by 3-5 weeks.

### 2.5 Gestation length

Perry (1956) noted longer gestation periods are linked with small litter size. Coversely, Cox (1964) observed no significant relationship between them. Carmichael & Rice (1920) reported early farrowed pigs to be relatively bigger. Omtvedt et al. (1960) researched the relationship between age and gestation length observed a negative correlation between litter size and a positive correlation on litter birth weight with increasing gestation length. Similarly, they noticed higher aged gilts to give higher litter size and litter weight with the individual weight of the litter to reduce with increased litter size.

Photo-period is also another factor taken into account. Anderson ( 2000 ) in his study of the timing of male puberty and melatonin, evaluated that a short day stimulates pubertal maturation while a long day delays sexual maturation in males. Dark treatment in swine fastens the age at puberty without altering the ovulation rate (Dufour & Bernard, 1968)

## 3. Conclusions

Youngest and oldest parity were observed to show the least reproductive performancesThe housing system was correlated with the feed system, floor space, aggressiveness, and various social contact issues like the transfer of contagious diseases in response to their reproduction.The influence of season was linked with the feed intake alteration due to heat and cold stress in the changing season and temperature. The season has been shown to affect the farrowing rate, weaning to service interval, lactation, and many more traits.Comparing the age factor, higher aged gilts had better litter size and litter weight than the younger ones. We discussed the essentialities of sufficient feed and nutrition for the production of milk, a decrease in weaning to service interval, rapid farrowing rate, litter sizes, and other traits. These environmental factors are highly responsive to the alteration of reproductive performances in swine. Rather than changing the genetic component for improvement, improving the feeding practices and other environmental factors can provide the sooner commercial advantages (Colombiana & Pecuarias, 2014). Taking these non-genetic factors into consideration we can improve swine performance and productivity.

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