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Review Article

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Management Strategies for Sows and Piglets to Increase the New-born Piglets' Survivability Rate

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Abstract

In an effort to increase profitability, sows have been systematically selected for higher litter sizes. That may have led to an increase in pre-weaning mortality. To improve new-born survival, sows should be taken cared of stringently, especially the housing system and the sows' nutritional management in both the gestation and the farrowing houses. Additionally, the sows' reluctance to drink water after giving birth and the sow induction at the farrowing house can negatively affect both the new-born piglets and farrowed sows. Also inevitable is the extended farrowing duration associated with exceptionally large litters. Therefore, assistance during farrowing time is essential. The importance of colostrum intake should also be emphasized and that piglets should be fostered, if needed, to ensure that they have teats to suckle on. Moreover, milk replacer and creep feeding are also helpful options to aid in piglet's nutrition requirement. Last but not least, farm caretakers who look after the piglets should be well-trained. This study looked into some strategies to improve piglet survivability by pointing out details in the routine activities at the farm.

KEYWORDS
Farm, Management, Piglets, Survival rate.

INTRODUCTION

Vietnam's pig industry has been developing in recent years. The increase in the pig population is necessary to provide pork to meet human demand. In this case, pig production practices need to be improved to guarantee better performance and hasten the investment returns. High pre- and post-weaning growth ratio and low mortality are necessary to achieve this; this depends on the ideal the number of viable live-born piglets (Kirkwood *et al*., 2021).

The use of very prolific sows in commercial herds has resulted to high piglet pre-weaning mortality and remains a pressing challenge in pig production. Piglets are extremely fragile at birth. They have a high ratio of surface area to body mass, few reserves, and a weakened immune system. In addition, numerous management procedures are implemented in a farrowing house during the first two days after birth to increase piglet survival (Vila and Tummaruk, 2016). According to Feyera *et al*. (2018), the top 3 causes of mortality in their study are, in descending order: crushing, low birth weight, and poor viability at birth. First of all, low colostrum intake is perhaps the most influential among the various reasons of early death (Muns *et al*., 2015). Besides colostrum, housing system at farrowing house have also affected piglet's mortality rate and piglet performance. The design of farrowing pen is a factor that may lead to piglets crushing (Nicolaisen *et al*., 2019; Wiechers *et al*., 2022) and also the ability of piglets to access the teats. Additionally, nutritional management for sows at the transition time between gestation house and farrowing house is a final opportunity to improve piglet litter and milk yield (Langendijk and Fleuren, 2018). As for piglet nutrition, milk replacer is commonly offered to counter milk insufficiency (Amdi *et al*., 2021). The induction of sows, due to the prolonged farrowing duration will be a visible risk in the long term and will increase pre-weaning mortality (stillborn) if unsuccessfully induced (Kirkwood *et al*., 2021). Farrowing assistance and cross-fostering are the game changers to help improve piglet's survival rate which was mentioned in previous studies. Moreover, often overlooked are the farrowing house caretakers who should be well-trained; to keep sows and piglets in the best conditions during the first three days.

As mentioned above, there are several factors affecting piglet's survival during the first three days. Based on those factors, the strategies to improve piglet's survival should be executed. Therefore, the purpose of this study is to provide strategies to improve piglet's survival during the first three days.

Sow management of high-prolific sow

The first 72 hours after farrowing are crucial for piglets since the mother's rolling movements at this time can crush some piglets. To reduce piglet's death during the first 3 day, the first priority should be focused on sow breeds that are prolific. A prolific sow usually produces more piglets than a normal sow, especially at the first parity. The competition of teats in a large litter causes piglet crushing and starvation. Therefore, for gilts and low parity sows, piglets should be given more attention. Hales *et al*. (2014) and Rangstrup-Christensen *et al*. (2017) debated that piglet mortality is higher at sow with parity above four compared to sow with

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lower parities. Sow parities are also associated to piglet crushing because the sow is significantly larger at greater parities and may have poorer leg health and mobility, reducing her ability to control lying and respond to piglet crushing (Rangstrup-Christensen *et al*., 2017). A small sow takes up less area in the crate, giving the piglets more room to retreat while she is lying down and standing up, hence reducing the chance of piglets being crushed. Additionally, sows with high number of teats should be considered the most suitable sow, and the minimum functional teats requirement for a sow is 14. More piglets are produced in prolific sows. Thus, more functional teats are required. If functional teats are not enough, starvation will ensue. There is a favourable correlation between the number of functioning teats accessible per piglet and piglet survival. Wiegert and Knauer (2018) demonstrated that an increase in the number of functional teats had no effect on weaning piglet weight; nevertheless, the increase in colostrum intake and total colostrum output increased piglet survival by 3.25 percent. Where piglets had access to fewer than one functional teat, mortality was greater than 14%, whereas it was below 8% when more than one teat was available (Alexopoulos *et al*., 2018). Another issue associated with using prolific sows is low birthweight. According to a similar remark by Schmitt *et al*. (2019), the percentage of piglets born underweight (1.0 kg) is substantially associated with the size of the litter. Pigs with low birthweight have a greater risk of pre-weaning death than pigs with a normal birthweight (Kirkwood *et al*., 2021). Piglets with low birthweight have a harder time vying for a teat and suckle enough colostrum because of variation within a litter. Moreover, in bigger litters, when intrauterine crowding develops, the embryos that connect initially can physically inhibit the growth of embryos that attach later (van der Waaij *et al*., 2010). Once the uterus has reached its customary limitations of uterine capacity, each consecutive embryo relates to a fall in the growth of the individual foetus, which results in a low birth weight for the piglets (Kirkwood *et al*., 2021; Madsen and Bee, 2015; Wolf *et al*., 2008). In addition, 11% of pigs born weighing less than 1.0 kg were stillborn, and 17% had died within 24 hours (Kirkwood *et al*., 2021). As a result, prolific sow is playing a role in piglet survival since it is interdependent with other factors such as housing management, fostering management, colostrum management, nutrition approach and other performance.

Farrowing duration and induction

Following high production by hyperprofilic sows, prolonged farrowing durations were observed. The number of times a sow has given birth influences the probability of a piglet being stillborn significantly more than the interval between births (Langendijk, 2021). According to the findings of Bjorkman and Grahofer's (2020) research, the 'normal' farrowing length increased from a maximum of 5 hours to an average of more than 5 hours, indicating that more than fifty percent of sows may be experiencing an excessively long farrowing duration. The maximum farrowing length was found to be 5 hours. In addition, Oliviero *et al*. (2010) discovered that the time of farrowing was longer in sows with a greater back-fat thickness, which could have a negative impact on the piglet's likelihood of surviving after birth. Myometrial contractions temporarily reduce blood supply to the growing piglets during the delivery process; nevertheless, this does not pose a problem in the immediate future. The repeated restrictions on blood flow between the uterus and the placenta leads to significant hypoxia in the fetus and an increased risk of stillbirth in cases of prolonged labour. Oxytocin injections, administered under supervision, can speed up a protracted labour. Induction may also raise the chance of future birth weight reduction; hence the economic and welfare cost/benefit must be evaluated (Kirkwood *et al*., 2021). Moreover, oxytocin medication during labour may have a deleterious impact on fetal oxygen supply at delivery (Ward *et al*., 2020). Farrowing is an energy-intensive process (Vallet, 2013), and inadequate energy reserves of sows during parturition would delay the farrowing process (Feyera *et al*., 2018).

Due to the risk associated with employing induction during farrowing, the tactics should be favoured above nutritional approaches such as increasing the energy content of meals. The inclusion of a fibre-rich dietary supplement in sows' standard gestation and transition rations (350 g/d of dietary supplement from day 102 to day 108 of gestation and 700 g/d of dietary supplement from day 109 of gestation until farrowing) has a positive effect on energy reserves at the onset of farrowing and significantly decreases the number of stillborn piglets. This is because the sows' digestive systems are better able to utilize the fibre in the supplement (Feyera *et al*., 2018). Moreover, the probability of stillbirth increased by 30 percent for every 30 minute-increment after the sow began labour. This makes sense when one considers the cumulative length of time that the labour and delivery process takes, as well as the cumulative effect that contractions have on the fetuses, which might result in inadequate oxygenation and hypoxia (Langendijk *et al*., 2018). Considering that the majority of stillbirths occur in the later stages of labour, early administration of oxytocin is unnecessary and should not be performed unless a need is identified. In addition to feeding tactics and support, the focus should be on reducing piglet mortality during farrowing. The majority of intervention strategies are built on the idea that if the amount of time that passes between the birth of two consecutive piglets is greater than a certain threshold, then there is an increased risk of stillbirth and assistance should be provided (Kirkwood *et al*., 2021).

Nutrition management for sows

The importance of transition feeding in sow

The fact that the number of weaned piglets has a considerable influence in determining sow productivity and the most of piglet losses occur within the first three days following parturition, the transition phase is crucial despite its brief duration (Rootwelt *et al*., 2013). During the transitional period, a wide variety of physiological mechanisms linked with reproductive output undergo major changes. Several of these features may be affected by the sow's diet. In addition, fast physiological changes occur during the transition from late gestation to early lactation (Feyera and Theil, 2017), and feeding during the transition may impair sow performance during lactation (Theil, 2015). During early and mid-gestation, pregnant sows are physiologically similar to growing/finishing pigs due to the fact that nutrients are predominantly required by the sow body (for maintenance) and maternal growth, with only a little proportion utilized for reproductive purposes (Solà-Oriol and Gasa, 2017). Pregnant gilts and sows devote a lot of energy and amino acids to fetus growth, placental expansion, conceptual fluids and membranes, and mammary growth during the third trimester (NRC, 2012). A lactation diet is low in fiber to prevent decreased average daily feed intake during peak breastfeeding, which is unfortunate because low fiber intake increases the stillbirth incidence (Feyera *et al*., 2017). Therefore, feeding late gestating sows a simple transition diet with intermediate levels of CP and fibber in comparison to gestation and lactation diets may be beneficial.

When sows are actually moved from gestation stalls to farrowing units, they are often fed a gestation diet first, followed by a lactation diet. Some farms change the diet a week before delivery, which makes biological sense given that fetal and mammary growth as well as the production of colostrum require a sizable amount of protein and lysine (Theil, 2015). Other farms have the same purpose, but the actual movement is postponed until a few days before delivery due to a lack of space in the farrowing units. These farms may have a higher incidence of postpartum dysgalactia syndrome, however it is unknown if this is due to dietary changes, sows being physically moved too close to giving birth, or other factors (Papadopoulos *et al*., 2010). The farms that employ these latter methods claim that they are superior because they reduce the strain on the sow's udder during early lactation, when the piglets' ability to suckle is limited. Instead of scientific evidence, the timing for this dietary change is based on a strong conviction. As sows start lactation, their nutritional requirements increase to fulfil the demands of large, rapidly-growing litters (Tokach *et al*., 2019). Typically, sows are fed a limited amount of a gestation diet followed by a predetermined amount of lactation feed for two to three days prior to giving birth. The breastfeeding diet has more lysine (Lys) and more calories than the pregnancy diet. The switch from a Lys-restricted gestation diet to a nutrient-rich nursing diet may cause metabolic issues, as the sow must fast adapt to the dietary composition change. To prevent negative effects on parturition and breastfeeding performance, it is vital to minimize this sudden shift in nutrition at the time of delivery (Martineau, 2013).

Feed during gestation and lactation phase

As mentioned above, the weight of piglets and the survival rate might be firstly associated to the feeding strategies at gestation house, especially at lately gestation phase. Controlling the feed transition between gestation and lactation is regarded as an effective method for encouraging the consumption of the lactation diet in sows with decreased feed intake or apprehension toward the new diet. This control can also reduce postpartum health issues including agalactia (Eissen *et al*., 2003). In addition, fetal growth is significantly influenced by the nutritional state of the sow (Noblet *et al*., 1985), therefore the feeding regimen employed during gestation may also have an effect. Any improvement in dietary or managerial techniques for late gestating sows that promotes energy transfer to the piglets is anticipated to increase new-born piglet survival (Theil *et al*., 2014). According to recent studies, raising sow feed intake during the transition week (the last week of gestation) increases sow (but not gilt) lactation feed intake and piglet weaning weights (Langendijk *et al*., 2018). These findings have since been confirmed (Gourley *et al*., 2020), with sows fed ad libitum for two to three days prior to farrowing showing enhanced sow weight maintenance and backfat depth maintenance, as well as higher piglet weaning weights. Despite this, increased pre-partum feed consumption and the prevalence of constipation may be cause for concern. Constipation in sows at the time of birth may delay piglet delivery and prolong the farrowing period (Oliviero *et al*., 2019).

Piglets are enhanced when diet is regulated during late gestation. Particularly, the overall number of weaned piglets was greater among traditional sows than among those fed ad libitum. The usual feeding technique also increased the birth weight of piglets; hence, it can help to reduce piglet mortality in the first three days. The research by Pedersen *et al*. (2020) shown that feeding transition time affects primiparous and multiparous sows differently. The dietary inclusion amount of fat (10%) was applied beginning on day 84 of gestation, and it had a significant impact on survival until day 3 for piglets weighing less than 1,1 kg at birth. Sows are able to mobilize body protein and energy to fulfil the amino acid and energy requirements for milk synthesis; however, if sows are not fed with sufficient nutrients, sows may produce less milk (Bettio *et al*., 2016).

Theil *et al*. (2012) shown that piglets are born with an energy deficiency, and that energy intake from colostrum and milk at the commencement of lactation is crucial for the new-born piglets. Energy derived from oxidized glycogen, colostrum and transitory milk all help to piglets' ability to maintain a stable body temperature and stay alive (Theil *et al*., 2012). To survive until day 3, adequate energy must be accessible from three sources: glycogen depots, colostrum, and transitory milk (Theil *et al*., 2014). In the event of a sow's movement, the supplied energy can enable piglet's escape. In the absence of sufficient energy, piglets may be crushed by their mother as she changes position. Due to a lack of energy, sows are unable to control their entire bodies throughout their normal movement routine. Survival increased from 48% (in sows fed soybeans) to 80% (in sows fed coconut oil) and 99% (in sows fed medium-chain fatty acids) in sows fed coconut oil and medium-chain fatty acids, respectively (Theil *et al*., 2014).

In another study, the survival rate of piglets with a birth weight of less than 1 kilogram was increased from birth to three weeks later when sows were fed corn oil instead of corn starch from day 109 of gestation till parturition (Seerley *et al*., 1974). Although it is difficult to assess the nutritional needs of nursing sows, milk production accounts for 75% to 80% of the total needs, while the remaining 20% to 25% are maintenance needs (Noblet *et al*., 1990). Reduced feed intake impacts mammary gland development and milk production (Kim *et al*., 1999). Strathe *et al*. (2020) demonstrated that the improved average daily weight of the litter with higher dietary standardized ileal digestible CP was most likely due to an increase in milk supply during lactation and an increase in protein concentration at peak lactation. When there are enough nutrients, particularly milk supply, piglets will have more chances to survive and grow.

Water management

Among the nutritional factors, water is one of the most important but often neglected. This paper tries to highlight water supply as nutrition requirement for sows to improve piglet's survival. Though generally thought as important, it is often undermined in formulating the nutrition requirements of piglets and even sows. After farrowing, sows need a large quantity of water to improve health and produce milk for piglets. To improve sow and piglet's health, water should be given at least three times per day. Most of the sows are tired and some gets ill due to the energy-draining farrowing process. Thus, they are reluctant to consume water which leads to milk shortage and/or milk loss during lactation of some sows. To improve piglets survival, water supplement for sow should be emphasized. The recommendation is to find an appropriate method to encourage sows to stand up and to drink water. Traditionally, farmers have only given pigs water combined with their feed (Chittavong *et al*., 2013), a method that may result in inadequate water consumption and dehydration. Low water consumption can reduce feed intake, milk output, and piglet growth rate (Kruse *et al*., 2011). The availability of water ad libitum has markedly resulted to positive impacts on piglet survival and growth. Survival at weaning and weight gain were best in the group that received ad libitum water. The improved growth of piglets was likely a result of the sow's increased milk production, but it could also be attributable to the piglets' access to water (Phengvilaysouk *et al*., 2018). The provision of water ad libitum increased the survival and growth of piglets, as well as the physiological and reproductive health of the sow. During the first few days after giving birth, a majority of sows have a degree of reduced milk supply or hypogalactia (Martin and McDowell, 1975). In some circumstances, decreased milk output in early lactation has been related to limited water consumption by sows, particularly if using a nipple drinker requires considerable effort. If drinking necessitates that a sow stands and operate a slow-flowing nipple drinker, then the more sluggish animals may not be persistent enough to obtain an optimal water intake. Alternately, as pigs consume the majority of their water while eating (Bigelow and Houpt, 1988), a sow's lack of interest in food could deprive her of her primary motivation to drink. A breastfeeding sow will require between 12 to 23 minutes to consume her daily water intake from a drinker. Since they are producing milk, which is typically 80% water, lactating sows have an increased water requirement. In the first three days after giving birth, a sow's water consumption is especially crucial. Water is required for biological function, and water restriction in lactating sows may result in decreased milk supply, nursing, and piglet growth. On the other hand, sows may experience extreme thirst before water deprivation impacts nursing behaviour and milk output (Jensen *et al.*, 2016). Consequently, milk supply will be inadequate and insufficient to meet the needs of piglets. In order to meet the demands of milk production, sows require high amounts of water during lactation. Also crucial for encouraging feed uptake during lactation is water drinking. The daily water needs of lactating sows range from 5 to 10 gallons (Kruse *et al.*, 2011). To provide enough milk for piglets in the first critical days, lactating sows requires approximately an average total amount of 27 litters water per day and it should follow breeds, temperature, farming conditions.

Colostrum management

The importance of colostrum in piglet's survival

The absorption of nutrients from colostrum is crucial, not only for growth, but also to health since it is the first food given to piglets after birth. Colostrum plays an essential role in the transmission of antibodies, which is necessary for proper immunological function. Colostrum contains a high concentration of an antibody called immunoglobulin G, which is responsible for the piglet's immunity to illnesses. In addition, colostrum contains immunoglobulins A and M, leukocytes, selenium, and vitamin E; all of these components are essential for proper immunological function (Dividich *et al.*, 2005). Rooke and Bland (2002) conducted research that examined the significance of colostrum for the development of immunity in piglets. Intake of sufficient colostrum is essential for the survival and growth of piglets, and this goal must be accomplished before any discussion about cross-fostering can take place. Intake of colostrum by individual piglets or by the litter is related to growth during lactation (Devillers *et al.*, 2011) and after weaning (Declerck *et al.*, 2016), indicating that factors in colostrum impact on neonatal development and subsequent performance. The minimum of 250 grams is critical for survival, and in addition, intake of colostrum by individual piglets or by the litter is related to growth during lactation. The gilts generate less colostrum than multiparous sows, and as a result, their litters can require more care than those of older sows (Kirkwood *et al.*, 2021). The amount of colostrum produced by a herd can range anywhere from 1.5 to 6 kg, and it is predicted that one-third of sows may not produce enough colostrum to meet the minimum 250g required for each piglet to have the best chance of survival (Quesnel *et al.*, 2012). As was indicated earlier, increasing the feed allowance, or even feeding sows ad libitum during the transition phase can help improve colostrum production (Kirkwood *et al.*, 2021). This method can enhance colostrum production.

Piglet's suckling management

As colostrum production is not determined by litter size (Oliviero *et al.*, 2019) and the fixed volume of colostrum provided by the sow must be shared amongst all piglets, there is a lower likelihood of low-birth-weight piglets ingesting an adequate amount of colostrum (Herpin *et al.*, 2002) and they are more likely to be outcompeted by larger littermates for teat access. Various methods were adopted to improve the piglets' survival rate. Before being fostered, piglets should consume colostrum as the first essential nutrition for optimal growth. Piglets should be placed in a crate, in the corner of the farrowing pen as soon as they are born. The crate temperature should be set to 34 degrees Celsius (Kirkwood *et al.*, 2021). Technically, the likelihood of low-birth-weight piglets (800–1200 g) surviving to weaning increased by more than 89% when they were administered 200 mL of colostrum (50 mL every 6 hours) (Moreira *et al.*, 2017). Effective solutions include the split suckling approach which permits smaller piglets to suckle by temporarily confining larger piglets (Alexopoulos *et al.*, 2018). The pre-weaning mortality rate in the litter increased from 8% to 14% when there were more piglets than functional teats, i.e., teats that supply acceptable amounts of colostrum. In situations where piglets must be fostered off a sow, fostering should commence after piglets have consumed colostrum from the sow but before littermates have established teat order. Deen and Bilkei (2004) observed that low-birth-weight piglets had a greater chance of surviving in litters when larger piglets were fostered off; hence, it is advised that little piglets remain on the sow (Alexopoulos *et al.*, 2018).

Fostering management

Cross-fostering is a management technique that distributes surplus piglets from large litters to smaller litters so that sows with more functional teats can be utilized (Schmitt *et al.*, 2019). According to Zhang *et al.* (2021), piglet survival in large litters can be improved by cross-fostering surplus piglets to smaller litters, thereby utilizing surplus teats in these sows. Aim to do cross-fostering between 12 and 24 hours after birth. Due to the fact that piglets only absorb immune cells from their own mothers, this timing accounts for the 12 hours required for passive cellular immunity transfer (Bandrick *et al.*, 2011). Alexopoulos *et al.* (2018) also recommended that piglets remain with their delivery sow for a minimum of 12 hours. If it is deemed important to cross-foster piglets before 12 hours, colostrum quality and the piglets' ability to absorb immunoglobulins must be taken into account. Numerous writers recommend implementing cross-fostering shortly after birth (Vaillancourt and Tubbs, 1992). Nonetheless, some piglets with poor development performance arise in litters during lactation (i.e., more than 3 days after birth), and they may also require foster care. Low birth weight and intermediate birth weight piglets may be better eligible for cross-fostering as soon as feasible (i.e., 12–48 h after farrowing) when cross-fostering is applied (Zhang *et al.*, 2021).

Housing management

The design of a housing system or pens is a visible factor that can affect the survival of piglets directly. The piglet is able to access the teats depending on how the farrowing pens are designed and arranged. The pen is narrowed leading to the piglets being crushed by their mothers. Starting from the 1960s, farrowing crates were introduced to swine farm design to reduce piglet crushing (Robertson *et al*., 1966). Although farrowing system with crates can reduce the occurrence of piglet crushing and sows' behaviour, it has also increased the welfare concerns in sows and piglets. The farrowing cage has certain welfare issues for sows because it restricts the sows' natural behaviours, including body movement, nest building, and maternal behaviour, for example, interacting with the piglets (Baxter *et al*., 2012). Additionally, the housing system influences the maternal behaviour of sows. In get-away pens, for instance, a stronger or faster reactivity of sows towards squealing piglets was seen than in single- or crate-housed sows, resulting in decreased piglet crushing losses and total piglet losses in get-away pens (Grimberg-Henrici *et al*., 2016). However, a number of research on the incidence of piglet crushing and the behavior of sows and piglets in systems without crates have been documented (Quesnel *et al*., 2012; Zhang *et al*., 2021). In addition, sows in loose-farrowing pens terminated more nursing episodes and nursed for a shorter duration than sows in farrowing crates, according to Wiechers *et al*. (2022). When sows were standing, piglets raised by sows in pens were generally less active than those raised in crates, and they spent more time inactive at the sow's udder when sows were laying (Chidgey *et al*., 2017). Therefore, it can be argued that housing sows in single loose-housing pens inhibits their ability to produce milk. However, these behavioural patterns (i.e., shorter breastfeeding duration and more nursing terminations) resemble the nursing behaviour of sows in semi-natural environments. Sows in farrowing crates had a longer farrowing time (93 min longer) and higher stillbirth rates (Oliviero *et al*., 2010) when compared to those in a loose pen. In contrast, excellent nest-building activity in farrowing crates has been related with a lower risk of crushing (Andersen *et al*., 2005) and improved suckling success for piglets due to an increase in oxytocin secretion by sows (Yun *et al*., 2013). As a novel method, raise farrowing crates appear to lower piglet mortality in the first 72 hours, but it will increase the stress level of sows (Costa *et al*., 2022). Regarding housing design, the piglet's temperature is also a challenge that must be solved. They are born covered in foetal fluids, which reduces their skin temperature significantly if they do not dry quickly. They have very little fur, which could limit body heat loss, and they lack brown fat, which could be digested to generate heat and maintain body temperature equilibrium (Berthon *et al*., 1994). Consequently, new-born piglets are extremely sensitive to environmental temperature. It is possible to limit heat loss and keep piglets warm during the first three days of life through the use of the warm creep area, a removable rubber soft mattress, bedding, or floor heating in the farrowing house. Although all techniques have good benefits on the survival of piglets, only floor heating demonstrated a positive effect. Malmkvist *et al*. (2006) demonstrated that 48-hour floor heating at the birth site of litters born to sows housed in a free-range environment avoided hypothermia and boosted survival. Later investigations demonstrated that floor heating for only 12 hours before to farrowing had a comparable effect on hypothermia (Pedersen *et al*., 2013). The decision to choose a best-suited housing is difficult to make at this time because farrowing crate system or even loose-housing system both have their negative effects on piglet's survival. When it comes to the best housing design for improving piglet's survival, it can be based on many factors such as: climatic conditions, facility design and the interaction between human and pigs. Therefore, the most suitable system to increase piglet's survival right now is the farrowing system with the correct and adequate adjustment. A new and suitable housing design which can keep piglets warm, prevent piglets from crushing and gives easy access to teats would be the best choice.

CONCLUSION

The development of large litters is associated with decreased average birth weights, higher birth weight variation and an unacceptable degree of preweaning mortality. In addition, the performance of these pigs after weaning is likely to result in the increase of days-to-market. Intriguingly, the farms are currently actively attempting to minimize litter sizes in an effort to lower piglet mortality. The positive correlation between the increase in litter size and pre-weaning mortality can be used to determine the ideal litter size. Contrastingly, further increases in the litter size, if managed correctly at the farrowing house, can result to increase the number of weaning. Therefore, it is important to ensure that we have optimized and done the best practices in the housing management, feed and water management, colostrum management and fostering management to achieve high piglet survivability rate.

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CONFLICT OF INTEREST

The author confirms that there is no conflict of interest.

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