Sow and farrowing pen sizes in Swedish pig production

Suggors och grisningsboxars storlek i svensk grisproduktion

Emelie Endrésen

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Department of Animal Environment and Health
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Emelie Endrésen

Supervisor:	**Anna Wallenbeck, Swedish University of Agricultural Sciences, Department of Animal Environment and Health**
Assistant supervisor:	Linda Marie Backeman Hannius, Swedish University of Agricultural Sciences, Department of Animal Environment and Health
Examiner:	Rebecka Westin, university, Swedish University of Agricultural Sciences, Department of Animal Environment and Health

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Swedish University of Agricultural Sciences
Faculty of Veterinary Medicine and Animal Science
Department of Animal Environment and Health

Abstract

There is currently an increased interest in loose housed farrowing environments internationally. Discussions are being held within the EU whether new requirements should be placed on pig farmers, and whether a total ban on confining sows should be introduced. An opinion that prevails in the pig breeding industry is that the sows, the litters, and the piglets are getting bigger and that this creates problems in animal husbandry. There is a lack of empirical data on both loose housed farrowing pen sizes and design, as well as on sow sizes. The aim of this thesis was to map and describe the sow sizes and the loose house farrowing pen sizes in commercial piglet producing herds in Sweden. This thesis include data from 35 medium-sized Swedish piglet producing farms, collected from July 2022 to September 2023. In total 153 sows, 51 types of farrowing pens and 35 piglet corners were measured. The results show that there is a wide range of sow sizes and farrowing pen sizes. Moreover, it shows the difficulty in designing a pen that works for all sow sizes, litter sizes and piglet sizes from farrowing to weaning, and the need for further research on the needs of the sows and her piglets.

Keywords: sow, sow size, loose housed, free farrowing, farrowing pen size, piglet, piglet corner

Table of contents

List of tables

List of figures

Introduction

The genetic change in modern pig *Sus scrofa domesticus* breeding continuously changes the breeding material used in commercial production. Besides genetic improvement in production traits of focus in the breeding programs, such as reproduction and growth, genetic selection also affects other traits, e.g. traits related to sow size and behavior. At the same time, most producers are tied to their existent stables and facilities, which in many cases were built decades ago, when production goals and breeding animals differed from those we have today. An opinion that prevails among many in the industry is that the sows, the litters, and the piglets are getting bigger and that this has created problems in animal husbandry (Hallgren & Eriksson 2020).

Internationally, there is currently an increased interest in loose housed farrowing environments. Discussions are being held within the European Union (EU) whether new requirements should be placed on pig farmers (*European Commission* 2021), and whether a total ban on confining sows should be introduced (*European Commission* 2021). In 2018, the European Citizens' Initiative End the Cage Age (ECA) was started with the goal of obtaining a ban on cage keeping in food production, sows in farrowing crates included. Over 170 organizations and nearly 1.4 million civilians signed the petition. In addition, 140 scientists also participated through an open letter to the commission with an appeal to support ECA. In 2021, the EU's Agriculture Committee voted for the initiative. The committee produced a resolution that ECA should be realized by the commission producing a measure where cages are to be phased out and banned by the year 2027 (*End The Cage Age* 2024).

The European Parliament voted in favor of the resolution which made the Commission announce that they would propose a ban on caged animals in livestock production in the new animal welfare legislation by the end of 2023 (*End The Cage Age* 2024). The new legislation has subsequently been delayed meaning that there are no new guidelines when this paper is published (March 2024). This means that farrowing crates still are allowed within the EU and there are still uncertainties about suitable pen area requirements and transition periods.

Countries like Norway, Sweden, Switzerland, and Austria have already implemented bans on permanent farrowing crates (*European Commission* 2021). In the Netherlands and Denmark, temporary crating are being promoted (*European Commission* 2021). Such a decision would mean that all EU member countries need to switch to l loose housing farrowing systems, something Sweden has had for decades, thus Swedish pig producers have unique knowledge within this area.

There is a lack of empirical data on both loose housed farrowing pen sizes and design, as well as on sow sizes in commercial production. It is argued among farmers and their advisers that sows get bigger with each parity and that there is a risk that the size of the pen thus becomes insufficient.

1.1 Aim and thesis

The overall aim of this MSc thesis is to map and describe sow sizes and loose housing farrowing pen sizes in commercial piglet producing herds in Sweden.

It is hypothesized that there is substantial variation in sizes of farrowing pens, piglet corners and pen area available for sows. Additionally, it is hypothesized that the sows differ in size and that sow size increases with parity.

The specific aims of this MSc thesis are to address the following questions:

- What is the maximum and minimum variation in sow sizes?
- How large and what is the variation in size of the farrowing pens (total area, piglet corner area and area available for the sow)?

Background

2.1 Farrowing behaviour

Sows are strongly motivated to perform a number of behaviours in relation to farrowing, where the behaviour is not only related to the function of the behaviour. Even if the pig has received a nutritionally complete feed, the pig has a need to search for food by burrowing, and even if the environment in the pen is dry and warm the sow has a need to build a nest before farrowing (Jensen et al. 1993). For example, the behaviour of domestic pigs kept in extensive conditions is very similar to that of wild boars. They perform the same behaviours although the frequency of certain behaviours is lower in domestic pigs. This means that the behaviours are inherited, and that the domestication and the modern breeding of domestic pigs affected the pig's behaviour only marginally. Moreover, the pig's behaviour is affected also by its environment and by the experiences of the individual animal, as well as by interactions between genetics, environment, and experience (Jensen et al. 1993; Gustafsson et al. 1999).

In the 24 hours prepartum, sows appear to be highly motivated to perform nest-building behaviour, seek isolation from other pigs, and walk longer distances compared with the previous days (reviewed in Barnett et al. 2001; Baxter et al. 2012). When comparing crated sows with loose housed sows, there is evidence that space is more important than substrate in allowing the behavioural expression of nest-building (reviewed in Barnett et al. 2001; Baxter et al. 2012).

2.2 Sow size

Within the Swedish pig industry, a common belief is that sows have increased in size in recent decades, but scientific evidence to support this belief is lacking (Nielsen et al. 2018). In Denmark, that has another genetic material (from the breeding company Danbred) than the genetic material commonly used in Sweden

(from TopigNorsvin), sows' body dimensions were not found to have increased between 2004 and 2017, although sow size increased with each parity (Nielsen et al. 2018). A study on key figures in larger Swedish pig farms shows that approximately 25% of the sows in an average Swedish farm has had six litters or more (Karlsson 2021).

Growth rate is included as a breeding trait in the breeding program, but adult size has not been included. However, due to the close biologic connection between growth and adult size, it is debated whether the breeding work led to larger sows as a result of selection for high growth (SLUs vetenskapliga råd för djurskydd 2021).

2.3 Litter size

The number of piglets per litter is increasing, both through genetic improvement with each generation and by parity (Nielsen et al. 2018). The larger litter sizes, in combination with larger sows, could mean that the size of the pen may need to be increased, and that the functional parts of the pen may need to be adapted, to allow large enough areas to satisfy the different needs of the pigs to rest, eat, dung, nurse, play etcetera.

For a long time, breeding has focused on increased litter size. In twenty years, litter size in Swedish piglet production has increased from average 11.3 live born piglets per litter in 2000 with 9.8 weaned pigs per litter to 15.0 live born piglets per litter and 12.4 weaned pigs per litter in 2020 (*WinPig* 2024). Pigs born alive per litter increased to 15.4 in 2022 and number of weaned pigs per litter to 12.9. The top 10% farms registered in WinPig had 15.8 live born pigs per litter and 13.9 weaned pigs per litter in 2022 (*WinPig* 2024). The drastic change in litter size from 2020 to 2022 is partly due to Swedish pig production during the period has changed genetic material, and partly on ever faster genetic progress through improved methods of genetic selection.

2.4 Piglet size

When suckling, it is important that the piglets have enough room to access the udder without obstruction (Zoric et al. 2016). In a 2017 study, the size of 202 piglets in a Danish herd was examined. The largest 5% piglets were over 57 cm long at 26 days of age and weighed at least 8.6 kg (Moustsen & Nielsen 2017). Danish recommendations therefore state that a width of the lying area of at least 127 cm (57 cm for the piglets and 71 cm for the sow) is required when the piglets are about

4 weeks old (*SEGES* 2020). The majority of Swedish herds wean their piglets at 5 weeks of age, and the piglets can then weigh well over 10 kg (Zoric et al. 2016). It is therefore reasonable to assume that Swedish piglets are larger at weaning and would therefore need more space than the Danish recommendations state. Moreover, as sows are loose housed in Swedish herds, compared to the crates used in Denmark, the space also must be large enough for the sow to turn around, for protection rails and for piglets to be able to move away from the sow during the risky movements when the sow lies down and stands up. A detailed study of the size of Swedish piglets at weaning would need to adapt recommended measurements to Swedish relationships (SLUs vetenskapliga råd för djurskydd 2021).

2.5 Pen size, pen design and space requirements

Very few have studied sow size and especially in relation to the size of the pen. Obviously, the ease of movement will depend on available space and dimensions of the pen in relation to the size of the sow. Baxter and colleagues (2011) reported that sows were not able to turn around if the available diameter of the pen was less than 120 cm. However, at a diameter of 153 cm, 95% of the sows were expected to be able to turn and if the available diameter matched the length of the sow, the sow was expected to turn unobstructed (Baxter et al. 2011; Goumon et al. 2022). The average length of Danish cross-bred sows was found to be 168 cm with sow dimensions increasing until full-grown at fifth parity (Moustsen & Duus 2006; Nielsen et al. 2018).

To protect piglets from being crushed by the sow, it is important that all piglets can fit in the piglet corner at the same time, the whole lactation period until weaning. The piglets' surface (the space a piglet takes when lying down) needs have been investigated in several different studies (Moustsen et al. 2004; Fels et al. 2016; Moustsen & Nielsen 2017) but none of these follow the piglets until 5 weeks of age. The studies then specified a recommended area for 10 piglets, even though it is common for a sow to wean up to 14 piglets per litter today. Moustsen and colleagues (2004) report calculations for how much space ten piglets, with a weight of 9 kg need, and recommend the farrowing pen to be dimensioned after the piglets measures of 58 cm long, 15 cm wide and 30 cm high and together occupy an area of 0.8 m^2-2.0 m^2.

The piglets' choice of lying position depends on the ambient temperature. In a cold environment, they lie on their stomachs, close together, while if it is very warm, they are in a completely sideways position. Based on the same formulas used by Moustsen and colleagues, 15 pigs weighing 10 kg at weaning would occupy an area

of 0.9-2.2 m^2, depending on ambient temperature and lying position (SLUs vetenskapliga råd för djurskydd 2021).

In a MSc thesis by Sonesson (2003) where the design of the farrowing pens in 33 Swedish farms were documented, the author reported that a larger lying area for the sow resulted in more live born and weaned piglets per litter in Swedish loose housed systems. The weaning weight of the litter was higher the larger the sow's lying surface. Large proportion of manure area of the total pen area resulted in a lower number of live births and number of weaned piglets per litter. Litter weaning weight tended to decrease with increasing proportion of manure area (Sonesson 2003).

Moutsen and Duus (2006) studied how much space the sow needed when rising up versus laying down in three different pen types, with dimensions 190x55 cm, 210x65 cm and 400x200 cm. During the "laying down" movement, the sows in the loose pen used on average 16 and 8 cm more in width compared to the sows in the confined pens. Regardless of pen type, the sows used the same amount of space along the length. During the "get up" movement, the sows in the loose pen used an average of 19 and 16 cm more in width compared to the sows in the confined pens. In the longitudinal direction, the sows in pen210 used 5 cm more than the sows in pen190. There was no difference between the loose pen and pen210 regarding the space used in the length.

2.6 Piglet corner size

In most cases, the farrowing pen has a corner screened off so that it is only accessible to the piglets, often called piglet corner/piglet area/creep area. There, the piglets are offered supplementary heat and extra bedding. There are no guidelines in the Swedish legislation regarding how much of the pen must or may be screened off from the sow. The placing and design of the piglet corner should be linked to several factors, such as how much space is left for the sow as well as how many piglets there are in the litter and how much space they need.

In 2003, Sonesson reported that the size of piglet corners in Swedish farms varied from 0.53 m^2 to 1.72 m^2. On several cases, piglet corners smaller than 0.75 m^2 were perceived as too small by the keepers. A very large corner was also perceived as negative by some of the staff, as the piglets used part of the corner as manure surface, which resulted in poor hygiene and greater workload.

2.7 Swedish legislation

The requirements of the Swedish legislation differ in several respects from the requirements set in EU and other countries, which is why it is difficult to find scientific literature that has directly applicable validity in Swedish farms. According to the Swedish legislation all pigs, including sows during farrowing and nursing, should be loose housed (SJVFS 2019:20). However, if necessary, sows' freedom of movement may be limited temporarily by using a protective gate or similar device. For example, it is defined necessary if a lactating sow is aggressive or has abnormal behaviour that poses an obvious risk to the newborn piglets or the caretaker (SJVFS 2019:20).

In the farrowing pen a minimum of 6 m^2 per sow is required, with a minimum of 4 m^2 of lying surface, of which a minimum of 3/4 must be a solid lying surface, meaning no slatted floor (SJVFS 2019:20). This part of the lying surface must be a coherent rectangular space as wide as the pen. Moreover, it is not regulated how much of the space that can be filled with furnishings, for example feeding troughs may be included in the area, provided that the function of the pen is not adversely affected. Up to 0.5 m^2 of the specified area may be made inaccessible to the piglets adjacent to the pen walls. It is also legislated that the animals must have thermal comfort in the stables (SJVFS 2019:20).

Material and method

This MSc thesis is part of the larger FORMAS funded research project Ask the pig, aiming to develop a pig welfare benchmarking tool adapted for Swedish pig production. This thesis include data from 35 medium to large-sized Swedish piglet producing farms, collected from July 2022 to September 2023. The farms had 106-1300 sows in production and some had integrated production. The farmers were asked to participate via their advisory organization. Those who were interested received more detailed information from a researcher in the project.

Each farm was visited once and the visit included a researcher from the research project (the same person at all visits) and a herd veterinarian from the veterinary company Gård & Djurhälsan. In total six veterinarians participated in the data collection. Information on pen and sow size was recorded by the researcher and the herd veterinarian recorded welfare indicators according to the protocol developed in the larger research project.

3.1 Sow size

On each farm, body dimensions of four sows were measured, and the sows parity were noted. Except for one farm, where 11 sows were measured, two farms where 8 sows were measured and two farms where 5 sows were measured. This was later considered to be too time-consuming. On one of the farms, there was insufficient assistance from the staff to carry out the measurement of the sows, so it had to be cancelled. In total 153 individuals were measured. In order to measure the variation in size two sows that had their first litter and two of the largest sows on each farm were selected. The sows were from 1 to 10th parity (parity 1: 66 sows, parity 2: 6 sows, parity 3: 3 sows, parity 4: 6 sows, parity 5: 10 sows, parity 6: 17 sows, parity 7: 20 sows, parity 8: 10 sows, parity 9: 2 sows, parity 10: 4 sows, data on parity missing: 9 sows). On the farms where there were several farrowing units, the sows were selected according to date of farrowing, to avoid stressing the sows that were about to farrow or had recently farrowed. Sows were measured 4-2 days before farrowing, and 2-35 days after farrowing, except for one sow that was measured 21 days before expected farrowing and one sow that was measured on the expected

due date. That means that sows from 38 different departments/pen types were measured.

Measurements of the sows made were consisting of length, height, and girth (figure 1). Length and girth were measured with measuring tape, and height were measured with a laser range finder. The length was measured from the tip of the snout, between the ears, along the spine and up to the base of the tail. The height was measured vertically, from the sow's highest point of the shoulder, down to the floor. The girth was measured around the sow, from the armpit, under the stomach, in front of the udder, straight to the other armpit, vertically up, around the animal and straight down on the other side.

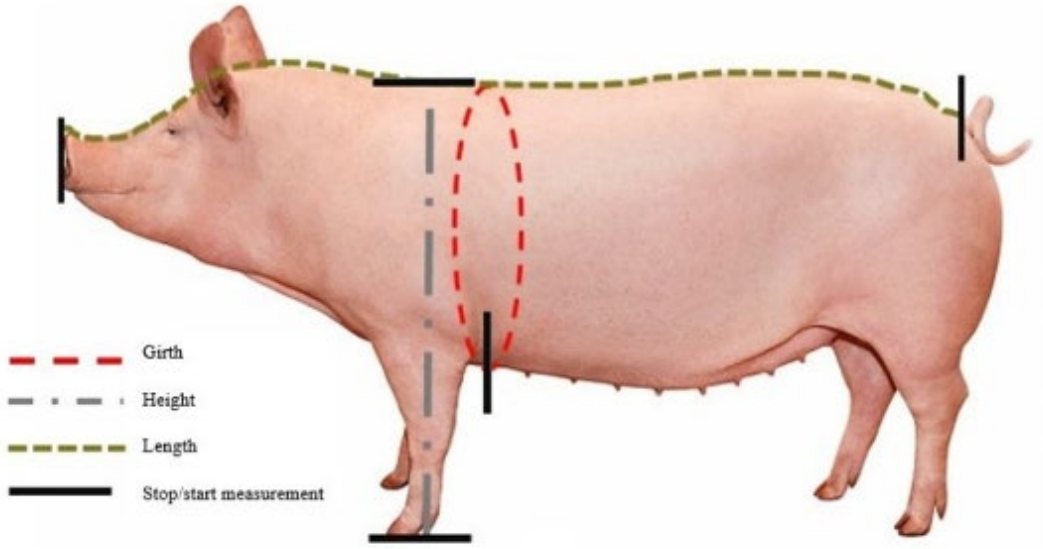

Figure 1. The measurements made on the sow and how these were measured.

3.2 Pen size

The farrowing pens were measured at each farm. Since several of the farms had multiple stables with different pen types, more than one pen per farm was sometimes measured. Twenty farms had 1 pen type, 14 farms had 2 pen types and 1 farm had 3 pen types, making 51 types of farrowing pens in total. The width and length of the pen were measured as well as the measurements of the corner that was fenced off and intended for the piglets (piglet corner) (figure 2). Since some of the sows were close to farrowing, and would not be disturbed more than necessary, it was chosen not to measure the piglet corners in all stables. Thirty-five piglet corners were measured in total.

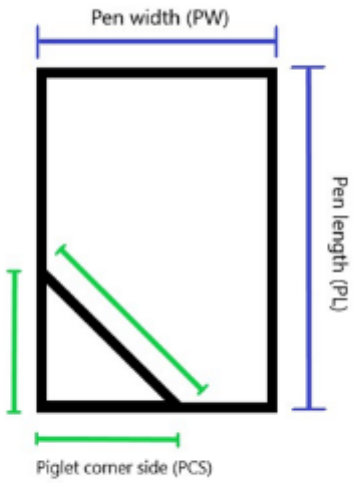

Figure 2. The measurements made in the pen and how these were measured.

3.3 Statistical analyses

Data were compiled and edited in Excel (version 2401). Descriptive statistics were calculated in Excel (version 2401) and Minitab (version 21). Associations between parity and sow height, length and girth length were analysed in Minitab (version 21) with a regression model, including the fixed effect of herd and parity as a continuous co-variate, with sow size variables as outcome variables.

Results

4.1 Sow size

Body length of the 153 sows varied from 129 to 238 cm (average = 191.1, median = 191, Std= 19.22) and the height varied from 74 cm to 133 cm (average = 86.6, median = 85.3, Std= 7.53) (figure 3). Girth varied from 107 to 184 cm (average = 150.3, median = 149, Std= 15.89). All sow size variables increased significantly ($p<0.001$) with parity (figure 4).

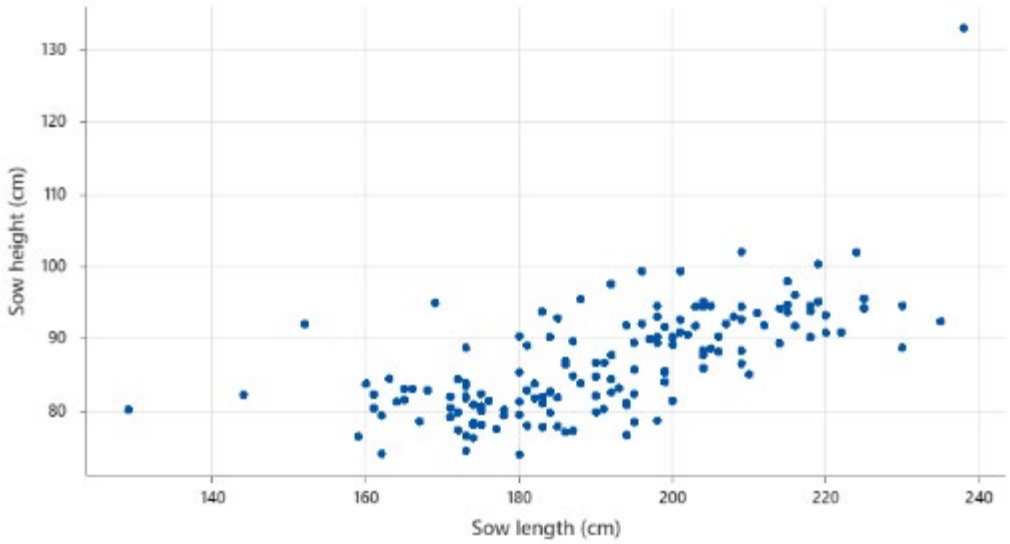

Figure 3. The body dimensions in length and height of each individual sow (n=153).

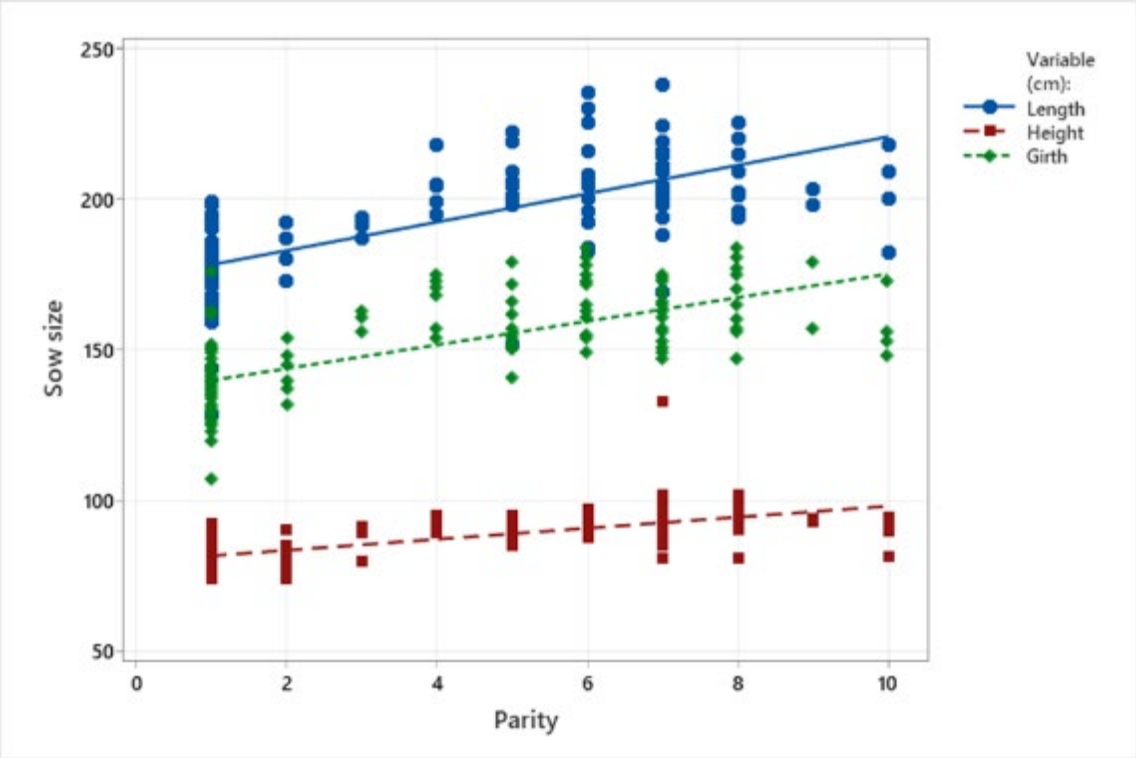

Figure 4. Regression analysis with a model adjusting for the fixed effect of farm showed that all three sow dimension variables increased significantly ($p<0.001$) with parity, but that the increase flattened out at around parity 6 (n=153).

According to the measurements given in table 1, larger, older sows take up approximately 2.3 m^2 (2.30 meters in length x 1.00 meters in height) of floor space when lying down on their side. The largest sow needs 3.2 m^2 of floor space to lie down on her side (figure 5).

Figure 5. The largest sow in the study were 238 cm long, 133 cm high and had a girth of 173 cm.

Table 1. Body dimensions of the gilts (n=66), the sows in average (n=153), the sows in parity 5 or higher (n=62), the 95th percentile and the maximum measurements. All measurements are in centimetres.

Dimensions	Gilts	Average	Parity ≥5	95th percentile	Maximum
Length	176	191	209	230	238
Height	81	87	94	100	133
Girth	138	150	166	181	184

4.2 Pen size

A total of 51 different farrowing pens were measured. The width of the pens ranged from 188-245 cm (207.0±10.67 cm) and the length of the pens ranged from 259-415 cm (315.1±24.34 cm) (figure 6). The smallest farrowing pen was 5.7 m^2 (figure 11), while the largest pen was almost 8.9 m^2 (6.5±0.50 m^2) (figure 12). When

subtracting the area for the piglet corner from the total area, we get a measure of how large area that is available for the sow. Those measurements ranged from 3.9-6.4 m^2 (5.4±0.57 m^2) (figure 9).

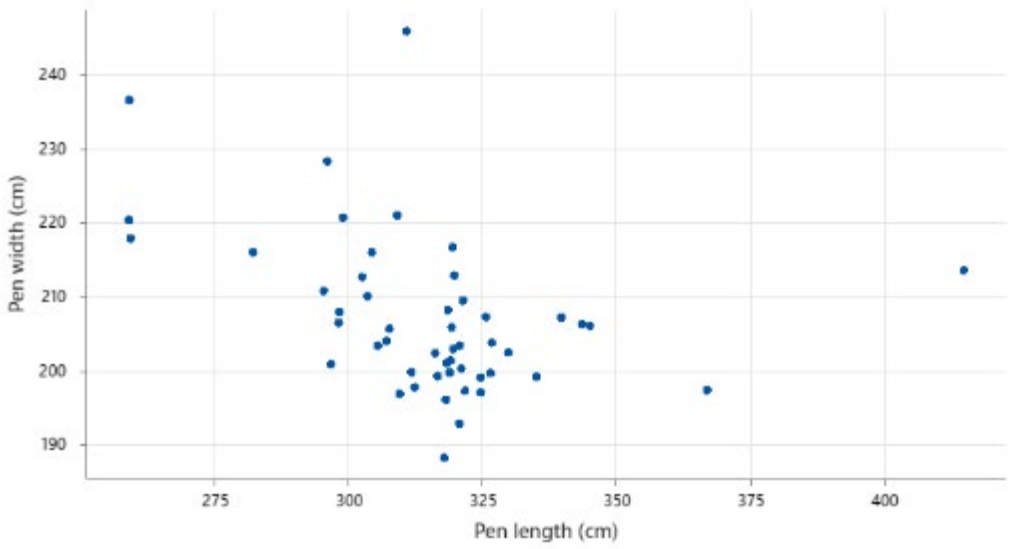

Figure 6. Length and width measurements of each farrowing pen (n=51).

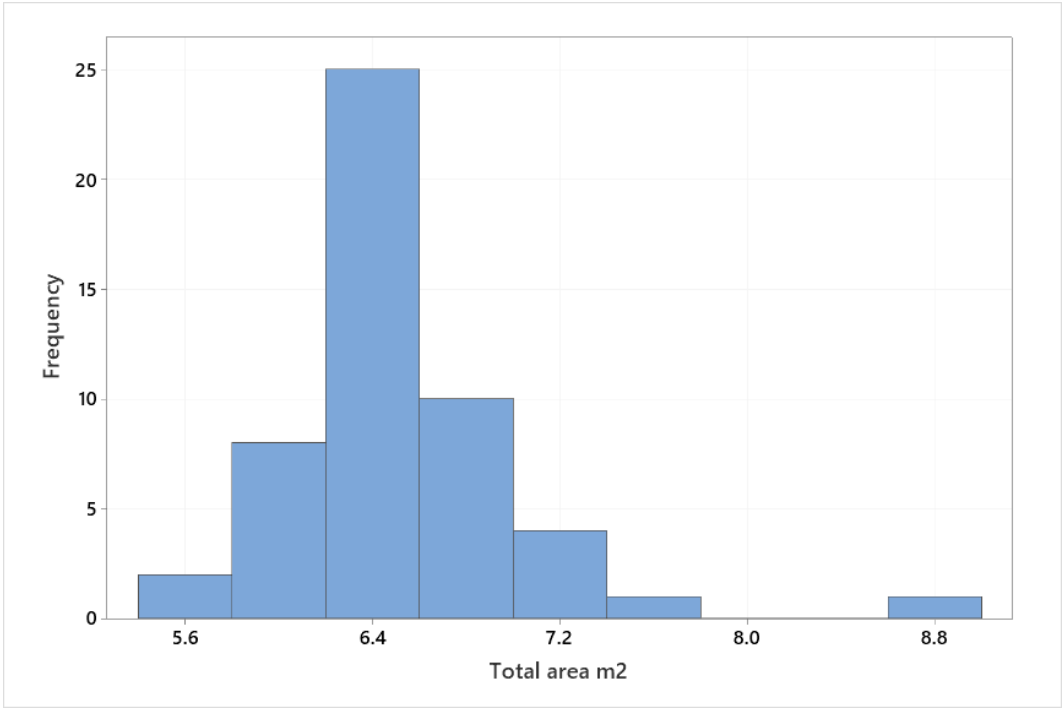

Figure 7. Variation in farrowing pen length and width (cm) among the pen types analysed in this study (n=51).

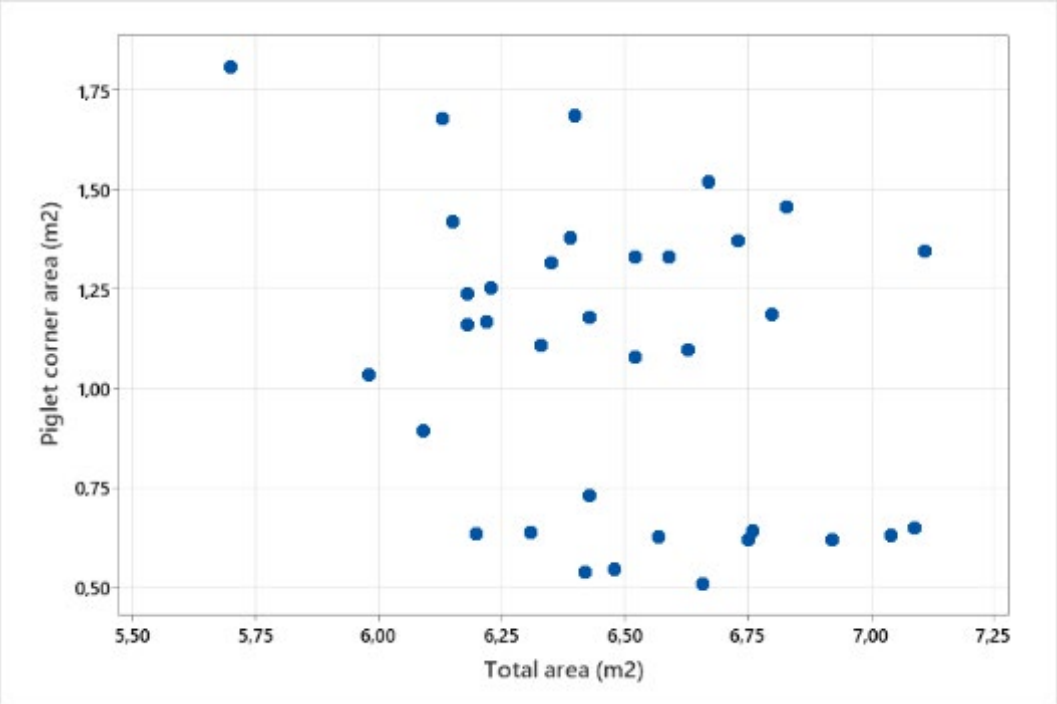

Figure 8. Total pen area and connected piglet corner area (n=35).

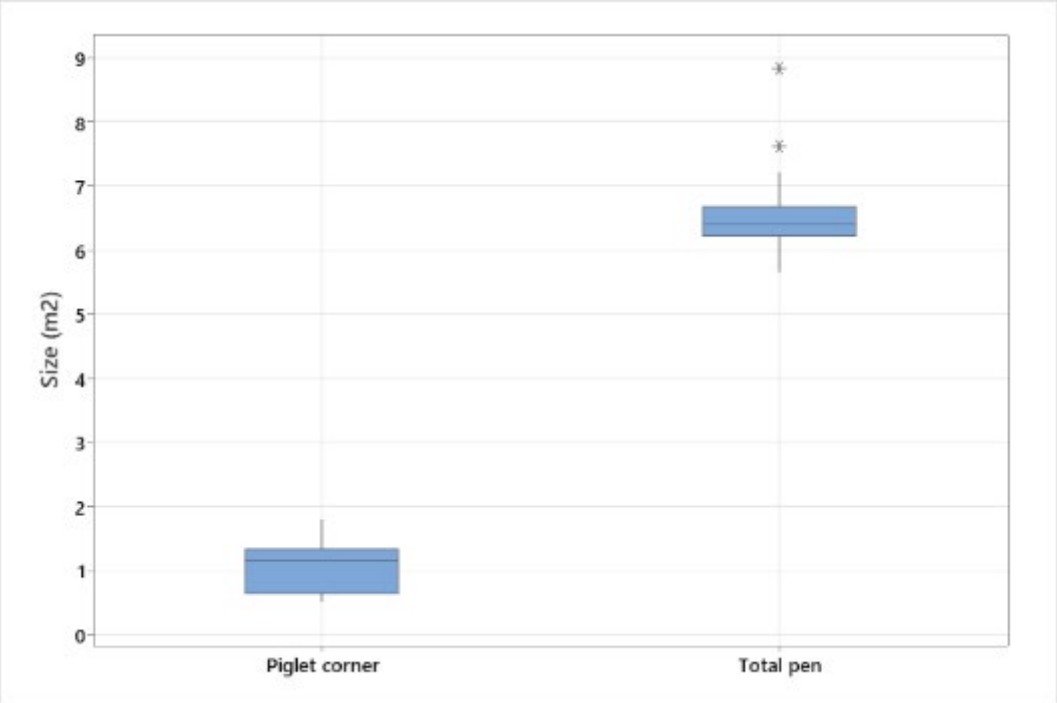

Figure 9. Sizes of the piglet corners and the total pens in square meters (n=35).

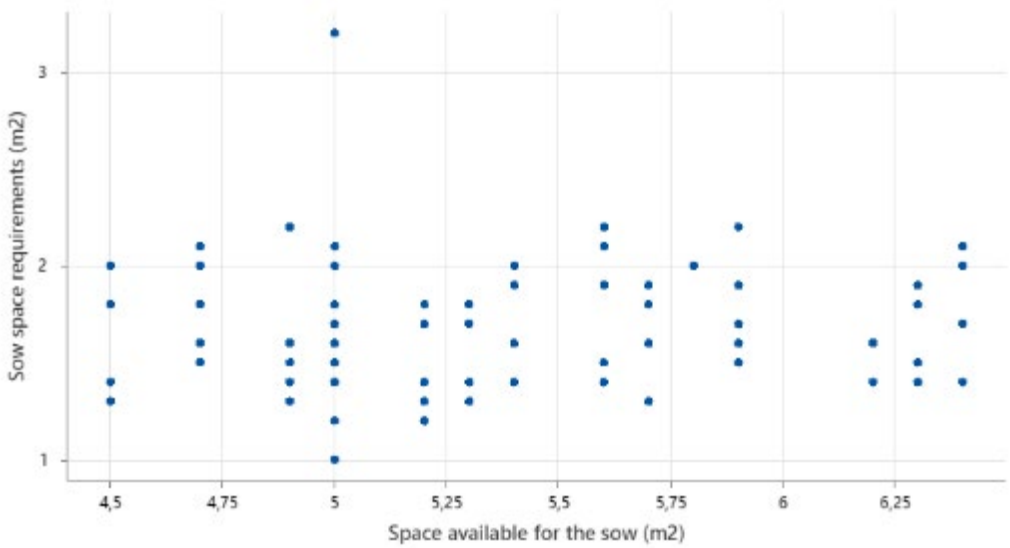

Figure 10. Individual measurements of the sows required space when lying on the side, connected to the pen they were housed in (n=62). All pens are not represented here since most farms had several stables, and the sows were usually measured from only one of the stables.

The interior placement, design and occupied space varied between pens (figure 13-24). A total of 35 piglet corners were measured. The piglet corners are of varying size, from 0.5 m^2 to 1.7 m^2 (figure 8). The smallest pen had the largest piglet corner for example (figure 7). The piglet corners also differ in shape (figure 10).

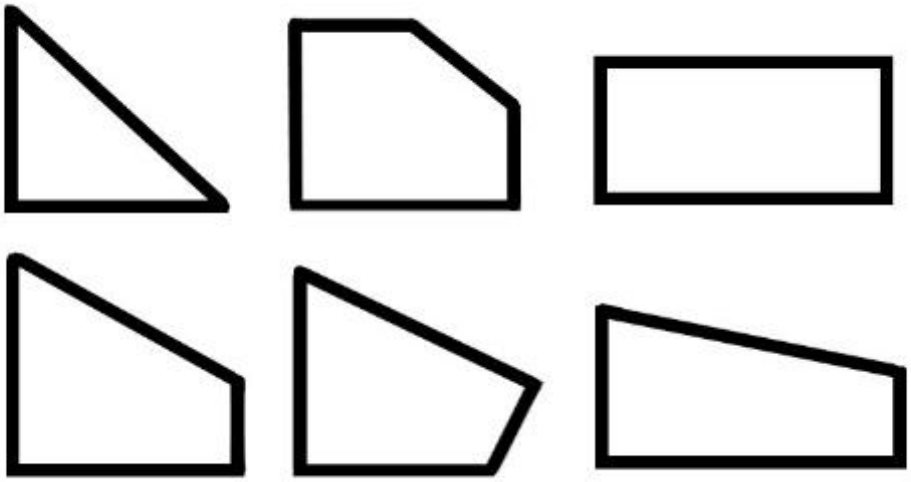

Figure 11. The different shapes of the piglet corners.

4.2.1 Examples of pen size and design

Figure 12. The smallest pen in the study was less than 5.7 m^2, with the largest piglet corner in the study, 1.8 m^2.

Figure 13. The largest pen in the study were almost 8.9 m^2.

Figure 14. One of the largest piglet corners, almost 1.7 $m^{2.}$

Figure 15. The smallest piglet corner in the study, 0.5 $m^{2.}$

Figure 16. One of the smallest piglet corners in the study, 0.6 $m^{2.}$ All piglets could not fit at the same time.

Figure 17. All piglets did not fit in their piglet corners.

Figure 18. Some pens had rails to control were the sow laid down.

Figure 19. Some pens had rails to control were the sow laid down.

Figure 20. In many of the pens the sow could not fit on the solid floor when lying down. See more examples in the appendix.

Discussion

5.1 Sow sizes

The results of this study show a large variation in the size of the sows, mainly depending on the parity, and thus also the age of the sow. The smallest sow in the study covers 1.0 m^2 of lying surface when lying down, while the largest sow covers 3.2 m^2 of lying surface when lying down. With this variation in size it is a challenge to build pens that are suitable for all sow sizes. To ensure that the space is enough it is important to design pens taken the largest sow sizes into account, and also, a possible flexibility in pen design to be able to adapt the pen to small gilts. It might not be reasonable or even necessary that all individuals should be able to be accommodated in all pens, but the variation in size among sows in farm production is important to consider when developing future housing systems, and you may have to design stables with different sizes of pens in the same unit, or pens with flexible sizes.

The sows seem to continue to grow throughout their productive lives, possibly leveling off around parity 7, but then many sows are also worn out and taken out of production. Of the 153 sows that were included in this study, only 16 were in parity 8-10, even though the sows measured in this study included the oldest (and the youngest) sows in the farrowing batch. The Swedish sows in this study were larger than the Danish sows were in Nielsen and colleagues' study from 2018. Nielsen and colleagues (2018) did not report any maximum values but instead averages and 95^{th} percentile for the full-grown population, ≥ 5th parity. When comparing with the 95^{th} percentile of the sows in parity ≥ 5 in our study, the Swedish sows were on average 4 cm higher and 27 cm longer than the Danish sows. Girth is not comparable with Nielsens study since the measurements were made differently. The genetic material used in Denmark (breeds and lines from Danbred) and Sweden (the majority uses TopigNorsvin, some Danbred) partly differs, which could be one reason for the larger average sizes in the present study. However, the genetic background of the individual sows in this study and in Nielsens study was not known, so it is not possible to draw any conclusions on the topic. Another difference between the studies is that the Nielsens (et al., 2018) study was carried out in 2017

and the present in 2023. Regardless of which genetic material that is used, a considered amount of genetic progress towards improvement of the traits in the breeding program has been realized during those 5 years. Even though sow size is not one of the breeding traits aimed to increase, it is likely that increased adult sow size is genetically correlated to pig growth, which is one of the main goals of modern pig breeding (SLUs vetenskapliga råd för djurskydd 2021). It is also likely that sow size is affected by selection for large litters since larger sows have the physical ability to carry and feed larger litters.

The results of the present study indicate that if sow size has changed over time in the population, it has increased. More thorough studies of sow size including information on sow genetic background would be interesting to look at. Studying the change in size of individual sows throughout their productive life would give more detailed information that could help predict future changes in sow sizes in the pig populations that will be kept in farrowing pens in the future. This is an important discussion when formulating new legislation around pen sizes. If the sizes of the sows, the piglets and/or the litters continues to increase, the legislation needs to be adapted to future scenarios as well as to the current situation.

5.2 Pen size, pen design and space requirements

The sizes and the shapes of the pens included in the present study varied greatly between the farms and also between different stables. The width of the pens ranged from 188-245 cm and the length of the pens varied from 259-415 cm. The smallest farrowing pen was 5.7 m^2 while the largest pen was almost 8.9 m^2. The piglet corners were from 0.5 to 1.7 m^2 and the area available to the sow varied from 3.9-6.4 m^2. In this study we have called it "the area available for the sow" but this is a bit misleading as the area often houses furnishings and also has slatted floors on a large percentage. In the legislation, the emphasis is on the total pen area, which is not functional since the disposition of the 6 square meters can differ significantly and there is a great risk that the functional parts will be either too small or too large. It is important to have in mind that the farrowing pen always must be a compromise between the needs of the sow and the needs of the piglet, and that is really challenging.

As mentioned, according to Swedish legislation the farrowing pen must have at least 4 m^2 of lying surface, and no more than a quarter of it are allowed to be a slatted floor. The solid floor must be a coherent rectangular space as wide as the pen (SJVFS 2019:20). In a Swedish study from 2021, farrowing pens that met the legal requirement regarding the size and design of the slatted floor were compared with pens with a different design on the slatted floor, where the solid surface was

instead a square in the middle of the pen (Lindblad 2022). No significant differences regarding litter results, feed consumption or animal condition were seen. The sows choose the same lying position to the same extent regardless of the design of the floor (Lindblad 2022). In this study, we have not studied slatted floors, nor have we taken any measurements regarding how large an area the slatted floor fills in the pen. However, it is clear from observations and photographs in this study that many sows cannot fit on the fixed lying surface and that the slatted floor occupies a larger area than a quarter of the sow's available surface. It is important to do a survey of slatted floors in commercial production in future studies, to be able to know how much space it actually fills in the pen and how the animals are using it.

If the largest sow in this study was kept in the smallest pen, the area left for the piglets when the sow was lying down would be only 0.7 m^2 (3.9 - 3.2 m^2), and reasonably even smaller considering that rails and feed troughs are not included. In addition to the area the sow occupies the piglets must also have enough space, and the area they need depends on the size of both the litter, the individual piglets and also their age. If the sow occupies the majority of the floor area it will be very difficult for the piglets to get to the udder and it can also make it hard for the sow to find available space to lie down to.

Keeping the sows in loose housing systems during farrowing are not the norm in Europe, and a common argument to confine the sow during farrowing is the belief that this prevents the sow from crushing the piglets. However, as Pedersen and colleagues (2011) concludes, no evidence exists from larger studies to support the view that penned sows have a greater mortality rate than crated sows (Moustsen & Poulsen 2004; O'Reilly et al. 2006; Weber et al. 2007; KilBride et al. 2012) although some studies have indicated that the causes of pre weaning piglet mortality may differ, depending on the housing system (Cronin et al. 2000; Moustsen & Poulsen 2004; Weber et al. 2007). Thus, piglets may encounter different challenges in different environments, suggesting that the same piglet trait would not be equally important for survival in all environments (Pedersen et al., 2018). For example, Malmkvist and colleagues (2006) showed that floor heating at the birth site in farrowing pens could reduce mortality considerably, suggesting that thermoregulatory ability is very important for neonatal survival in farrowing pens.

Pedersen and colleagues (2011) showed that the microclimate in the pen for newborn piglets and its heat-preserving properties are more important for survival than whether the sow is crated or penned. As Damm suggests in a presentation from 2008, different pen sizes (and their consequences for pen design) may be the explanation to why some studies show no differences in piglet mortality, when crates and pens are compared, whereas others do. Instead of arguing that the sow's

movement should be limited, it is time to look the other way and investigate how large a surface a loose housed sow needs in order not to risk crushing the piglets.

The piglet corners were of varying sizes, from 0.5 m^2 to 1.8 m^2, which is equal to the results that Sonesson had in 2003 (0.53 m^2-1.72 m^2). The variation in size and shape of the piglet corners indicates that there can be variation in the function of the piglet corner in different pens, which can lead to differences in piglet performance (Sonesson 2003). However, that was not assessed in the present study. If we go by the calculation that 15 piglets of weaning age need 0.9 m^2-2.2 m^2 for all piglets to fit, we can state that many of the piglet corners are too small to fit the entire litter. However, there is a risk that the piglet corners are instead too large when the piglets are newborns and use significantly less space. Is might not be possible to find a size that works throughout the period from birth to weaning. It is fair to state that the size of the piglet corner needs to be regulated over time, just as, for example, the temperature does.

5.3 Improvements and further research

To improve or develop this study it had been interesting to collect more data in the farrowing pen, to get even more precise measurements on how much space that is available to the sow and the piglets. In some of the pens they had protective rails to control where the sows laid down. The rails often went diagonally or straight through the pen and therefore greatly reduced the sow's lying surface. It would be interesting to know more about how these railings affect the sow and the piglets. Further research is needed in many areas connected to this, for example it would be useful to compare pens with a wider range of sizes and connect them to both production results and welfare parameters. It is important to examine how the interior affects the available space and the use of the pen. It would be interesting to look at welfare related factors connected to the size of the farrowing pen and the sows to provide more tools in welfare assessments and to get even more knowledge and guidance about how welfare and production results in loose housed farrowing systems can be further improved. Regarding the data collection on the size of the sows, it would be preferable to have a larger and more randomized sample on each farm to get a more representative picture of how common it is for the sows to become very large and whether it is a major problem or a minor deviation. A randomized sample is more easily comparable to other results and future and would be helpful to gain insight into how the sizes differ between genetic lines, farms, age, etc.

It is important that the pens must be adapted to the size of the sows and the piglets so that their behavioral and physiological needs can be met. The Swedish legislation

is inexplicit and not adapted to the size of the sows, their litters or piglets. As a suggestion, the dimension of space can advantageously be expressed as a function of the size of the animal and the size of the litter and piglets. A function of pen size based on animal size and number would provide more permanent guidelines, if the size of the animals or litters changes (SLUs vetenskapliga råd för djurskydd 2021) and it would also ensure an adaption to differences between herds. Another option is to take support from the regulations regarding other animal species and set a measure of the maximum permitted degree of occupancy in the pen, how much of the available surface the animals are allowed to occupy. For example, if a pen has 4 m^2 available space for the sow, a sow with a maximum of 2 m^2 required lying space are allowed to be kept there. In Swedish legislation there are requirements for different pen sizes for horses based on the height of the mare's withers and different pen sizes for sheep based on the weight of the ewe. It would be a suggestion to regulate in a similar way when it comes to sows with piglets. It is also necessary to regulate the allowed space and distribution of the interior i.e. the available space to the sow and the piglets, to ensure that the surfaces become functional and large enough for the animals. We can't say in detail what various things are due to, but we can state that it seems unlikely that the sows, piglets and litters will become smaller, and we have to take that into account in the future as the pens we build now must last many years.

5.4 Conclusion

With the collected data we can conclude that there is a wide range of sow sizes, loose housed farrowing pen sizes and piglet corner sizes in Swedish herds today. We can also conclude that the sow size increase with parity. Moreover, it shows the difficulty in designing a pen that works for all sow sizes, litter sizes and piglet sizes from farrowing to weaning, and the need for further research on the needs of the sows and her piglets. Current legislation regarding pigs does not take into account that there is such a large variation in the size of sows, litters or piglets. It would be beneficial to have a more flexible legislation in the future, which already exists for other animal species.

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Popular science summary

Det finns ett ökat internationellt intresse för suggor som hålls lösgående under perioden när de föder och ger di till sina smågrisar. I Sverige har suggorna hållits lösgående i årtionden, vilket gör att svenska grisproducenter har unik kunskap inom det området. Däremot finns det flera EU-länder som håller sina suggor fixerade innan, under och efter grisning. Det betyder att suggornas rörelseyta begränsas kraftigt med exempelvis väggar eller grindar. Inom EU förs samtal om det ska ställas nya krav på grisuppfödarna och om det ska införas ett totalförbud mot att hålla suggor fixerade.

En uppfattning som råder inom grisuppfödningen är att både suggorna, och smågrisarna blir allt större. Samtidigt har kullstorleken ökat. Sammantaget kan detta skapa problem i djurhållningen eftersom det finns begränsningar i stallarnas utformning. Idag vet vi inte om det stämmer att suggorna blivit större och vi vet heller inte hur stora suggorna och deras grisningsboxar faktiskt är ute på gårdarna.

Syftet med detta examensarbete var att kartlägga och beskriva sugggornas storlek och storleken på grisningsboxarna i kommersiella smågrisproducerande besättningar i Sverige. Detta examensarbete inkluderar data från 35 medelstora och stora svenska smågrisproducerande gårdar, insamlade från juli 2022 till september 2023. Totalt mättes 153 suggor, 51 typer av grisningsboxar och 35 smågrishörnor. En registrering av det totala antalet boxar på grisningsavdelningen och antalet boxar där smågrisar låg ovanpå varandra i en hög och troligen frös gjordes också.

Resultaten visar att det finns en stor variation i suggornas storlek. Suggornas längd varierade från 129 till 238 cm, höjden varierade från 74 cm till 133 cm och omkretsen varierade från 107 till 184 cm. Alla storleksvariabler ökade signifikant med antalet kullar som suggan fått. Suggorna upptar 1,0-3,2 m^2 golvyta när de ligger ned på sidan.

Resultaten visade också att boxstorleken varierade stort, där den minsta va 5,7 m^2 och den största var nästan 8,9 m^2. Det var också en stor variation i hur mycket yta i boxen som var tillgänglig för suggan, 3,9-6,4 m^2. Det betyder exempelvis att om den största suggan i studien varit i den minsta boxen hade endast 0,7 m^2 yta funnits

kvar till smågrisarna att röra sig på. Det kan skapa problem för dem att ta sig till juvret eller till värmekällan i boxen..

Resultaten visar exempel på svårigheten med att designa en box som fungerar för alla suggor, kullstorlekar och smågrisstorlekar från födsel till avvänjning, och behovet av ytterligare forskning om suggornas och deras smågrisars behov, för att vi ska veta hur variationerna påverkar djuren och produktionsresultaten.

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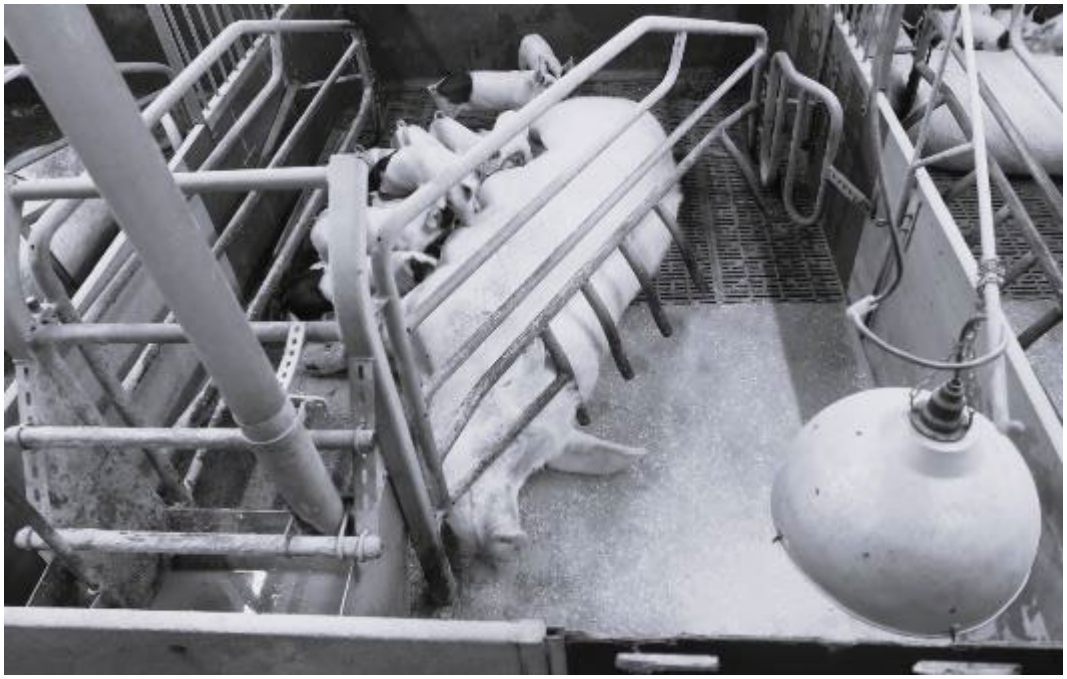
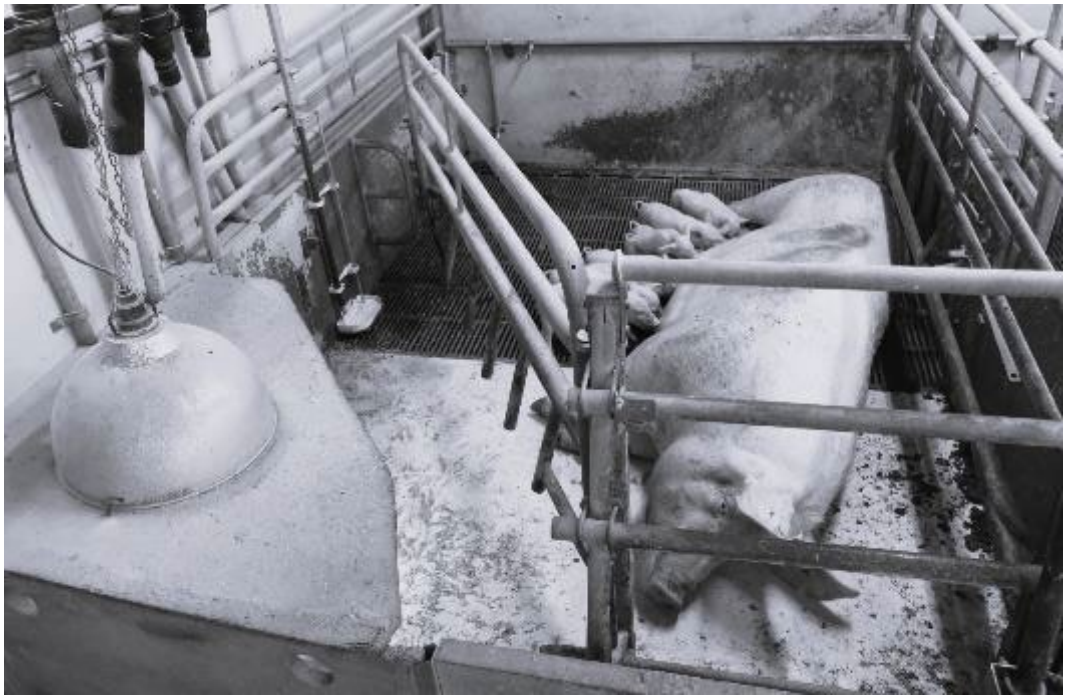
Appendix 1

There are many examples where the sows could not fit on the solid floor.





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