Piglet Losses in Free-Farrowing Pens: Influence of Litter Size

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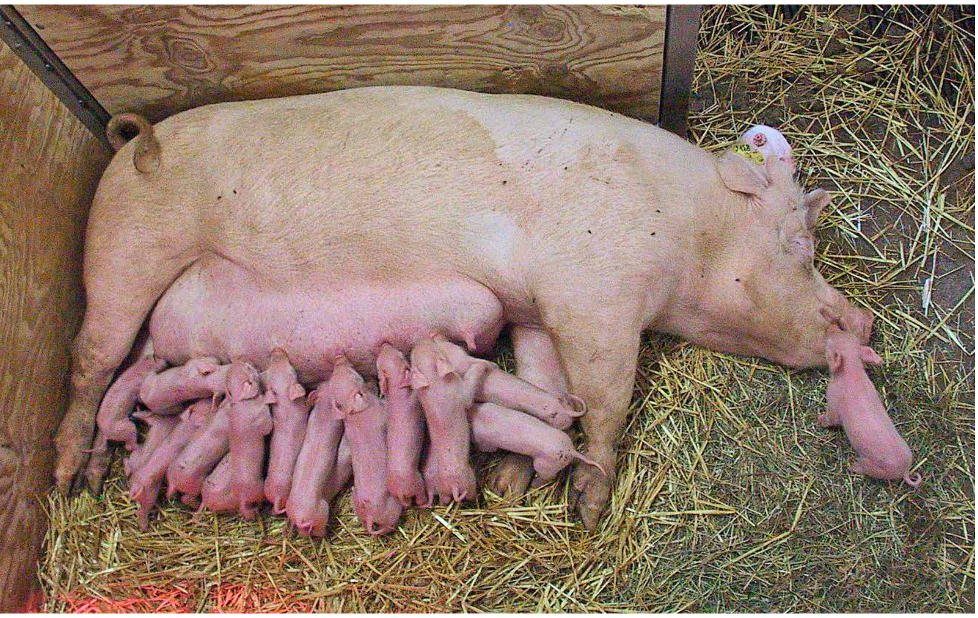

A large litter in a free-farrowing pen. (Photo: Sabine Münch, Agroscope)

Abstract

In Switzerland, free-farrowing pens have been used exclusively since 2007. Based on a large quantity of litter data from 2003 (9714 litters on 96 farms) and from 2008 to 2017 (331,820 litters on 255 farms), the trend in piglet losses over the years was determined. Also of interest was whether breeding for larger litters has had a negative impact on piglet losses. From 2008 to 2017, the number of live-born piglets per litter increased from 11.9 to 12.9, and the number of weaned piglets per litter from 10.3 to 11.3. Over these years, the total losses ranged between 11.5 % and 13.4 %. Losses through crushing rose only slightly and linearly in line with the number of live piglet births, whilst total losses and other losses increased strongly. A direct comparison of 2003 and 2017 reproductive performance revealed no differences for all causes of loss (total losses, crushing losses and other losses). All in all, the present analysis of a large quantity of litter data shows that piglet losses in free-farrowing pens have not risen, despite breeding for larger litters. Since breeding for more live-born piglets per litter results in a flattening out of the number of weaned piglets per litter, further increasing litter size through breeding is not recommendable.

Key words: free farrowing, piglet mortality, crushing, litter size.

Introduction

The Swiss Animal Protection Ordinance stipulates that farrowing pens in new and refurbished buildings since 1997 are to be designed so that the sow can turn freely. This specification enables the sow to choose a nest site, to express nest-building behaviour, and to interact with the piglets whenever she wants to do so. There was a transition period running until the end of June 2007 to allow for the adaptation of existing farrowing pens with crates. For economic reasons, it is crucial for livestock farmers that piglet losses in free-farrowing pens not be higher than in those with crates, which are still in use in many other countries.
In order to compare piglet losses between the two types of housing, Weber *et al.* (2007) analysed a dataset from the UFA2000 evaluation programme containing the litter data from 173 farms with free-farrowing pens (18,824 litters) and 482 farms with farrowing pens with crates (44,837 litters) from the years 2002 and 2003. The study showed that live-born piglet mortality did not differ between the two housing systems. In the present study and based on data from farms with free-farrowing systems, we also investigated what factors influence piglet losses. Previously, Weber *et al.* (2009) had shown that neither the option of crating the sow for a maximum of 3 days, nor protective bars fixed along the walls of the pen, nor pen size, had a significant effect on total losses or losses due to crushing.

Intensive breeding to improve the reproductive performance of the sows has resulted in significantly larger litters. In Switzerland, the number of live-born Large White piglets per litter rose from 11.1 in 2002 (SUISAG 2003) to 13.1 in 2017 (SUISAG 2018). However, this improvement could also have negative effects, since piglet mortality increases along with litter size (Andersen *et al.* 2011). In the present study, we therefore analysed, on the basis of a dataset from the UFA2000 evaluation programme, how the increase in litter size in Switzerland from 2008 to 2017 influenced piglet losses in free-farrowing pens. In addition, we compared piglet mortality in such pens in 2003 (with the smaller litters) and 2017 (with the larger litters).

Materials and Methods

For the analysis, the litter data from 2003 used in the study of Weber *et al.* (2009) as well as the litter data from a large number of farms, collected between 2008 and 2017 by the farmers and transmitted to the UFA2000 evaluation programme, were taken into account. In an initial step, we removed both incorrect and implausible data from the dataset. For this, farms supplying data on fewer than 20 litters or having piglet losses of less than 4 % per year were excluded. Furthermore, only data on litters in which the piglets exhibited no abnormalities, with a size at birth of between 4 and 19 piglets, a gestation length of 111 to 119 days, and a lactation length

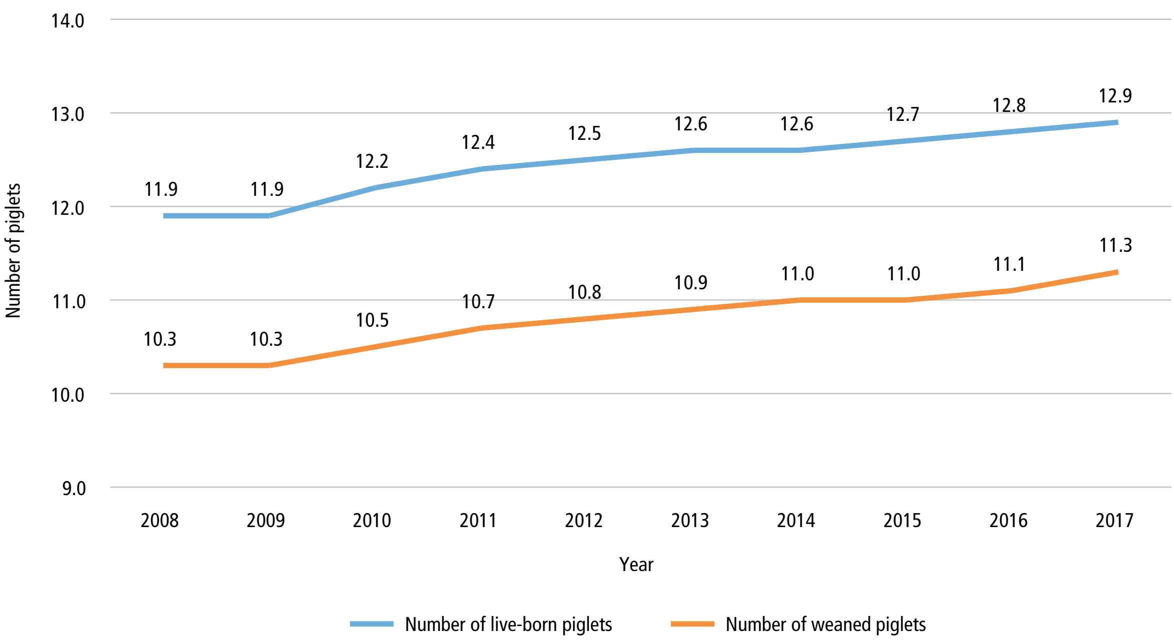

Fig. 1 | Number of live-born and weaned piglets per litter (average values per year) between 2008 and 2017.

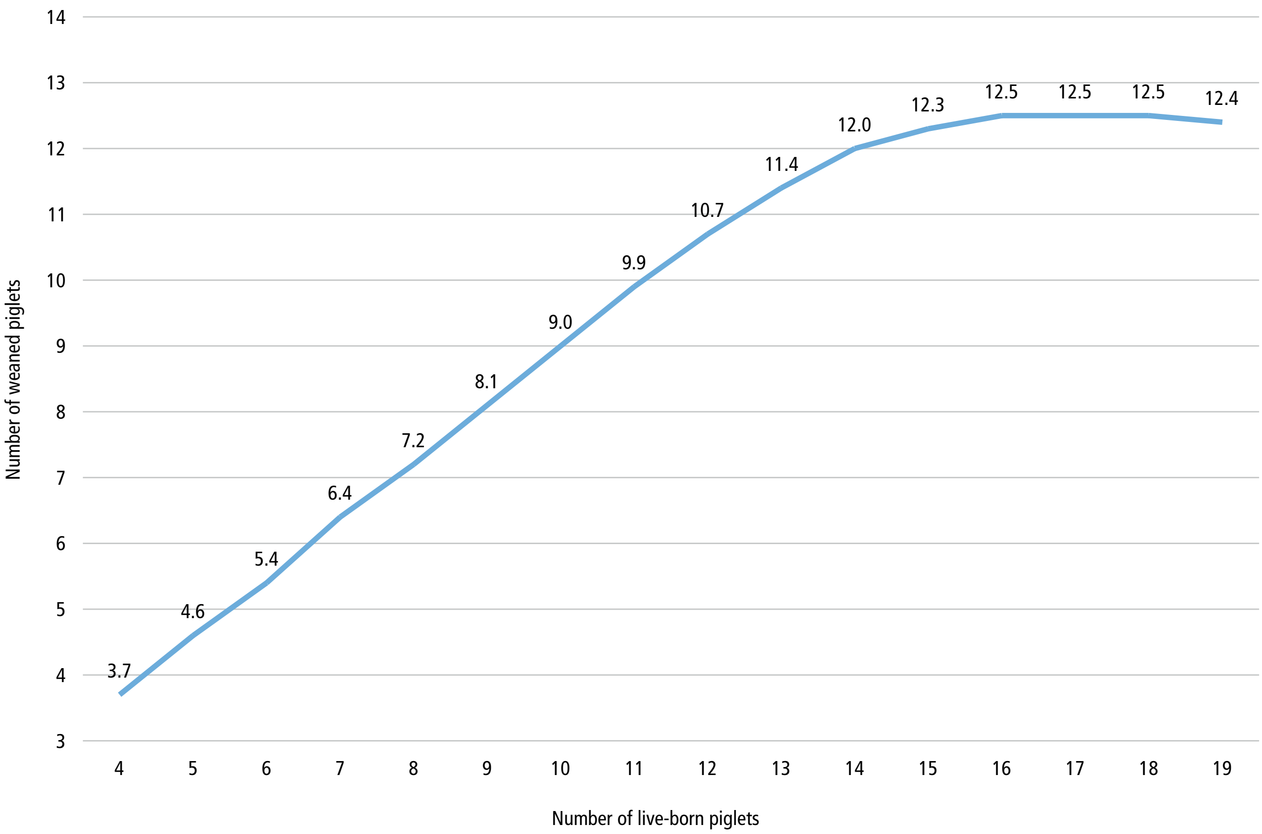

Fig. 2 | Number of weaned piglets in relation to the number of live-born piglets per litter (data from 2008 to 2017).

of between 19 and 51 days were considered. Since the assignment of piglet losses to specific causes of loss enumerated in the UFA2000 evaluation programme is done by the farmers and may be somewhat imprecise, but crushed piglets are generally recognisable as such, all causes of loss apart from "crushed" were lumped into the category of "other losses" for the present analysis.

Trend in Piglet Losses from 2008 to 2017

To investigate the influence of litter size on piglet losses in free-farrowing pens, only data from the farms whose datasets contained data for each year of the period in question (2008–2017) were considered. A total of 331,820 litters from 255 farms were evaluated. For the calculation of the number of weaned piglets in relation to the number of live-born piglets, all litters with added or removed foster piglets were excluded. At the end of this screening, the number of litters available for the evaluation was 173,198.

The statistical analysis was conducted with linear mixed-effects models in R. Outcome variables were the number of live-born piglets, the number of weaned piglets, the total number of piglet losses, the number of crushed piglets, and the number of other losses. To analyse the evolution of the number of live-born piglets, the fixed effect was year (2008 to 2017). For the other outcome variables, the fixed effects were year (2008 to 2017) and number of live-born piglets (4 to 19). The random effect was farm nested in year. Model assumptions were checked by graphical analysis of residuals for normal distribution and homoscedasticity of errors, and outcome variables were square-root-transformed if necessary.

Comparison of Piglet Losses in 2003 and 2017

For the comparison of piglet losses in free-farrowing pens in 2003 and 2017, the data from 2003 of the study of Weber *et al.* (2009) and the litter data from the UFA2000 evaluation programme for 2017 were used. Only farms whose datasets contained data for both years were taken into account. Altogether, data from 96 farms with 9714 litters in 2003 and 11,273 litters in 2017 were evaluated.

The statistical analysis was conducted with linear mixed-effects models in R. Outcome variables were number of live-born piglets, number of weaned piglets, number of total piglet losses, number of crushed piglets, number of other losses, gestation length, and duration of the lactation period. The fixed effect was year (2003 or 2017) and, for gestation length only, the interaction between year and number of live-born piglets. The random effect was farm nested in year. Model assumptions were checked by graphical analysis of residuals for normal distribution and homoscedasticity of errors, and target variables were square-root- or log-transformed if necessary.

Results and Discussion

Trend in piglet losses from 2008 to 2017

From 2008 to 2017, the number of live-born piglets per litter increased steadily from 11.9 to 12.9 ($p < 0.001$; Fig. 1), and the number of weaned piglets per litter, reared in free-farrowing pens, rose from 10.3 to 11.3, influenced significantly by year ($p < 0.001$) and the number of live-born piglets per litter ($p < 0.001$).
The number of live-born piglets per litter also had a significant effect on the number of weaned piglets per litter ($p < 0.001$; Fig. 2). From 15 live-born piglets per litter onwards, the number of weaned piglets scarcely increased, and this trend flattened out from the 13th live-born piglet onwards. With the 14th and 15th live-born piglet, the increase in the number of weaned piglets amounted to only 0.6 and 0.3 piglets, respectively. Thus, these additional piglets had a probability of dying before weaning of 40 % and 70 %, respectively.

An analysis with data from about 50,000 litters reared on herd-book farms of the Swiss pig-breeding organisation SUISAG yielded similar results (Luther 2009). With litter sizes above 14 piglets, the number of weaned piglets scarcely increased. This is due to the fact that, with increasing litter size, more low-weight piglets are born, characterised by a considerably lower survival rate at weaning compared to normal-weight piglets (Akdag *et al.* 2009). Taking this evidence into account, the Swiss pig-breeding organisation decided back in 2003 to weight litter size at birth less heavily as a selection trait for breeding and to include rearing performance of the sow and the percentage of underweight piglets as new selection traits in the breeding programme (Roggli 2011).
As shown in Figure 3, the number of live-born piglets had a significant influence on total losses ($p < 0.001$), losses due to crushing ($p < 0.001$) and other losses ($p < 0.001$). What is striking, though, is that from a litter size of 15 piglets upwards, the number of "other losses" rose markedly, whilst the increase in the number of crushed piglets was still linear for large litters. A similar pattern was observed in the study of Weber *et al.* (2006) with the UFA2000 reproductive data. The "other losses" increased clearly from a litter size of 12 piglets upwards, whilst losses due to crushing rose only slightly with increasing litter size.
The observed increase in piglet mortality with increasing litter size is explained by the fact that more under-

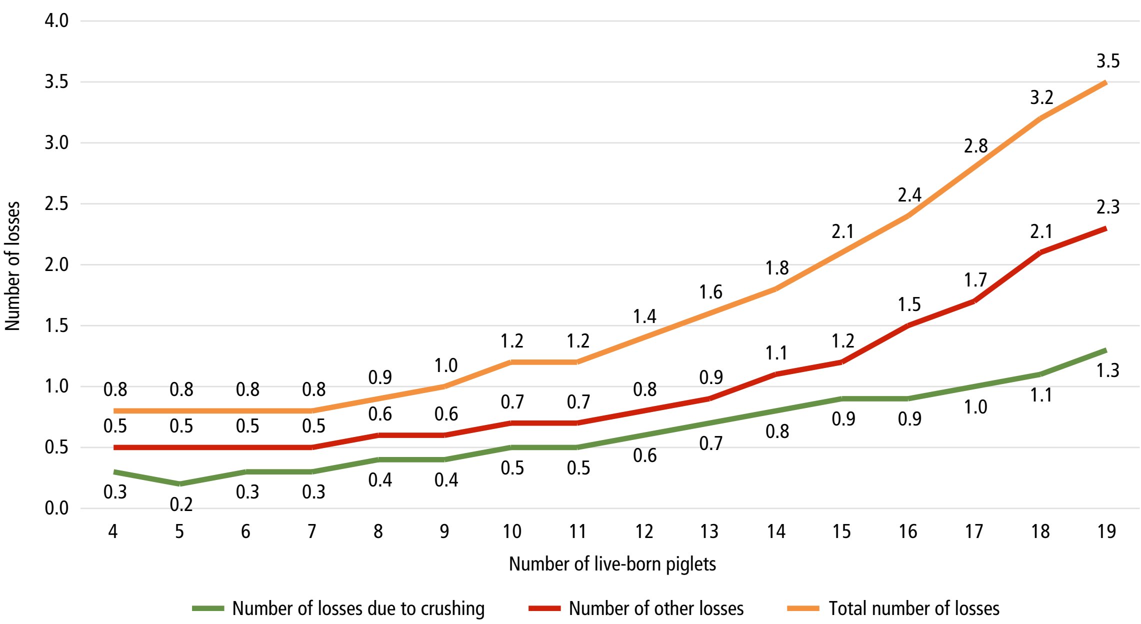

Fig. 3 | Total losses, losses due to crushing and other losses (no. of piglets per litter) in relation to the number of live-born piglets per litter from 2008 to 2017.

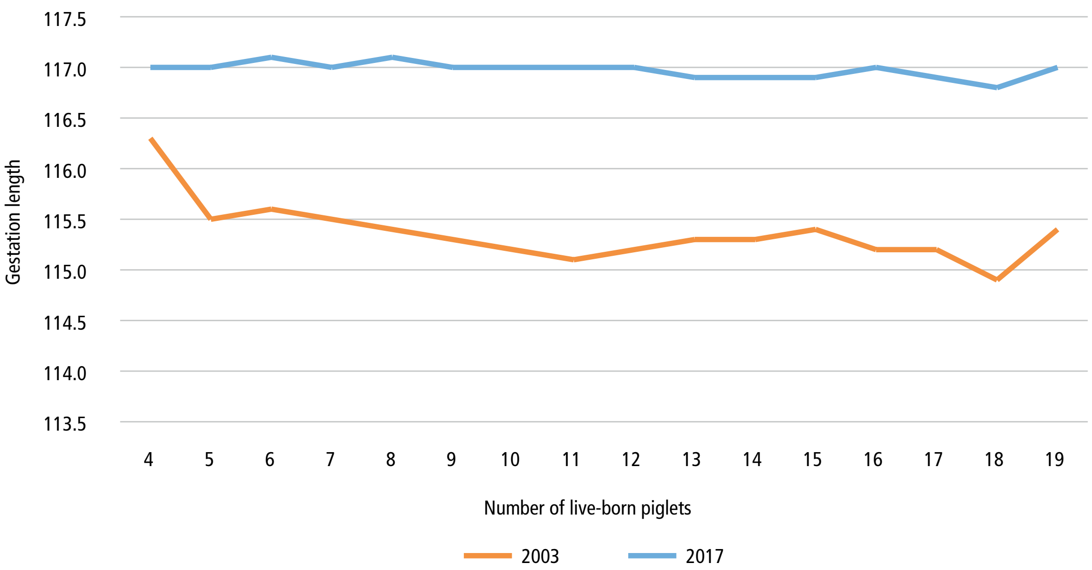

Fig. 4 | Gestation length of sows in relation to the number of live-born piglets in 2003 and 2017.

weight piglets are born in larger litters (Akdag *et al.* 2009) and that, in large litters, not all piglets are able to suckle simultaneously and lighter piglets in particular may miss a suckling event (Weber *et al.* 2019). In Switzerland, the average number of teats was only increased from 15 (Luther 2009) to 16 (SUISAG 2018) from 2008 to 2017 by selective breeding. Consequently, more piglets than available teats are present during suckling events in larger litters, unless cross-fostering is applied, and weak piglets are therefore likely to die within the first three days of life (Fraser *et al.* 1995).

Comparison of piglet losses in 2003 and 2017

Both the number of live-born piglets and the number of weaned piglets were significantly higher in 2017 than in 2003 (Tab. 1). By contrast, there was no difference in the number of piglets that died, either in the case of overall losses, or in the case of losses due to crushing and "other losses". With regard to litter size at birth (i.e. live-born piglets), total losses in 2003 and 2017 amounted to 11.7 % and 11.1 %, respectively.

Between 2003 and 2017, the duration of the lactation period decreased significantly. With an average duration

Tab. 1 | Performance parameters (average values with standard deviations in parentheses) measured in sows housed in free-farrowing pens in 2003 and 2017.

	2003		2017		p-Value
No. of farms	96		96		–
No. of litters	9714		11,273		–
Duration of the lactation period (in days)	34.7	(5.1)	32.7	(5.2)	< 0.001
No. of stillborn piglets	0.6	(1.1)	1.0	(1.5)	< 0.001
No. of live piglets					
at birth	11.1	(2.5)	12.8	(2.8)	< 0.001
at weaning	9.8	(2.0)	11.3	(2.1)	< 0.001
No. of piglet losses					
total	1.4	(1.6)	1.5	(1.7)	0.504
crushed	0.7	(1.0)	0.6	(1.1)	0.794
other	0.7	(1.2)	0.8	(1.4)	0.643

of 32.7 days, however, it was still longer than in other European countries in 2017. According to recent surveys, lactation lasts for 27.8 days in Denmark (Bruun *et al.* 2016), 24.8 days in Germany (Topigs Norsvin 2018) and 26.9 days in Lower Austria (Sterkl 2018).

For gestation length, an interaction between year and number of live-born piglets was observed (Fig. 4; $p = 0.047$). Whereas in 2003 the gestation length decreased with an increasing number of live-born piglets, in 2017 it was generally longer, and not influenced by litter size. Both Sasaki and Koketsu (2007) and Rydhmer *et al.* (2008) likewise noted a negative correlation between the number of live-born piglets and gestation length. The fact that gestation length was longer in 2017 and had no influence on litter size might have been a side effect of breeding for another trait.

Conclusions

The analysis of a large data set containing litter data from 2003 and from 2008 to 2017 clearly shows that piglet losses in free-farrowing pens did not increase over these years, despite the increase in the number of live-born piglets per litter. Since breeding for more live-born piglets per litter results in a flattening out of the number of weaned piglets per litter, further increasing litter size through breeding is not recommendable. ■

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