THE EFFECT OF FARMING SYSTEM TYPE ON PIGLET PRODUCTION

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Abstract

Reproductive performance of sows is the main factor influencing the profitability of piglet production, and simultaneously it is a basic indicator of farm management quality. The aim of this study was to compare reproductive performance of sows from intensive and extensive feeder pig operations and the costs on those farms. Evaluated were 42 sows from extensive pig farming and 464 sows from intensive pig farming. Lifelong performance was determined for all sows. The study's results show that sows from intensive pig farming achieved a mean 2.04 fewer lactations per lifetime and were culled earlier (P < 0.0001). The mean total number of live-born piglets was 11.59% lower among sows from intensive pig farming, but these sows achieved 23.35% (P < 0.0001) higher mean number of piglets per litter. Despite shorter mean productive life, sows from intensive pig farming were more profitable. Maximizing the reproductive potential of sows has positive effect on farm profitability, and simultaneously it has no negative effect on sows' reproductive performance.

Keywords: profitability, reproduction, herd, sow, litter size, intensive farming, extensive farming

INTRODUCTION

Reproductive performance of sows is one of the most important factors influencing the profitability of feeder pig production. Number of piglets per sow per year is a basic indicator determining the quality of farm management. Many factors – both external and internal – influence reproductive performance of sows, and, at the same time, farm profitability. Among these factors, for example, is age at first insemination. Very early insemination of gilts influences their lifelong performance (Babicz *et al.*, 2011). Recommendations for first insemination include that gilts should be inseminated for the first time at age 221–240 days (Babot *et al.*, 2003), if their weight is 135–150 kg (Williamse *et al.*, 2005), and when backfat thickness reaches 18–23 mm (Roongsitthichai and Tummaruk, 2014). Gilts' age at first insemination greatly influences farm profitability (Babot *et al.*, 2003). That impact may be especially important in the case of intensive feeder pig farming, where the very continuing existence of the farming operation may depend crucially on sufficient profitability. Age at first insemination affects especially the number of live-born piglets per first litter (Babicz *et al.*, 2011). As reported by Brzobohatý *et al.* (2015), a higher number of live-born piglets per first litter was achieved by sows inseminated at age 220–240 days and the number of live-born piglets also rose when the animals' backfat thickness was increasing at the same time. This information is very important for farmers seeking to maximize their sows' reproductive potential and

the profitability of their farms. Inseminating gilts at the wrong age will have negative effects on the animals' lifelong reproductive performance, and this has negative impacts on farm profitability (Szulc *et al.*, 2011).

It has been confirmed that sows have higher numbers of live-born piglets in their second litters (Beyga and Rekiel, 2010), and this number continues increasing until the fourth litter (Wähner, 2009). In the case of intensive pig farming, sows are most often culled after the third farrowing and sows are regarded as being at the top of their reproductive performance at the time of the third litter (Szulc *et al.*, 2011). Fifth and later litters typically have lower numbers of live-born piglets and unbalanced litters (Knecht and Duzinski, 2014), which characteristics are accompanied by lower profits and higher costs for measures to increase piglets' survival. It has been confirmed that piglet survival is lower in unbalanced litters. Piglets from sows in their sixth and later litters have the smallest probabilities of survival (Milligan *et al.*, 2002). An important rule for farmers is that no more than 20–25% of the total number of litters should be from sixth and later farrowings (Hellbrügge *et al.*, 2008).

Birth weight is an important factor influencing reproductive performance of sows and farm profitability. Piglet birth weight is influenced primarily by number of piglets per litter (Nogaj *et al.*, 2006). Škorput *et al.* (2018) observed that in large litters produced by prolific sows the variability of birth weight among the piglets increases together with the number of lighter piglets. This poses a substantial challenge for farmers. According to Nevrkla *et al.* (2017), pigs with higher birth weight reach slaughter weight earlier. That means it is economically more beneficial to have balanced litters with good birth weights. If a litter includes more than 13 piglets, piglet weights are lower and smaller piglets do not survive. This is primarily a problem in intensive pig farming.

The number of piglets per litter is one of multiple factors influencing sow longevity and recovering the costs for their rearing. Among the others are age at first farrowing, size of first litter, number of stillborn piglets per first litter, and backfat thickness. It has been reported that sows from extensive pig farming operations are culled later from the breeding herd because the animals receive more individual care from farmers and a longer period is required to recover their costs of rearing and maintenance (Hoge and Bates, 2011). Based on the literature, it was hypothesized that sows from intensive pig farming would result in earlier cost recovery than would sows from extensive pig farming and that they would be culled earlier from the breeding herd. The aim of this study was to compare reproductive performance of sows from intensive and extensive feeder pig operations and to model the costs of these farms.

MATERIALS AND METHODS

Evaluated were 506 sows from two different types of pig farming operations. The first type was extensive, and 42 sows were evaluated from that group on a single farm. This farm keeps an open herd. The second type of pig farming was intensive, and 464 sows evaluated from that group on another single farm. This farm keeps a closed herd. All evaluated sows were Czech Landrace × Czech Large White hybrids. Sows from both farms were fed a complete compound feed twice daily. So that their lifelong performance would be known, sows were selected based on their dates of culling from the farm. Only sows having had at least one litter were included. Information about reproductive cycles of sows was recorded in the farm system. The study also examined information about every insemination, farrowing, number of live-born piglets, number of stillborn piglets, and number of weaned piglets. Piglets were weaned at 28 days of age on both farms. Economic indicators for both farms were evaluated. Other indicators (purchase prices for gilts, costs per sow per year) were taken over from current costs as reported by the Costs of Agricultural Products database at the Czech Republic's Institute of Agricultural Economics and information (IAEI, 2018). The evaluation of economic indicators served only to model the influence of farm type on profitability. Cost assumptions were taken from the database.

Statistical evaluation was performed using SAS statistical software (Statistical Analysis System, version 9.4, 2012, SAS Institute, Cary, NC, USA). A generalized linear model procedure was used to evaluate the influence of individual effects for type of pig farming's effects on age at culling, total number of live-born piglets, age at first insemination, and number of live-born piglets per litter).

To evaluate these indicators, their values were calculated and evaluated as least squares means. Also calculated were standard errors of the mean (SEM), and P-values indicating statistical significance at level α = 0.05.

RESULTS

Tab. I shows reproductive performance of sows from the first to third litters. Sows from extensive pig farming achieved 29.57% lower mean number of live-born piglets per first litter (P < 0.0001) and 16.12% (P < 0.0001) fewer weaned piglets. Sows from extensive pig farming had 80.23% (P < 0.0001) higher mean number of stillborn piglets per first litter. The first weaning to estrus interval was 5.15 days (P < 0.0001) longer for sows from extensive pig farming. It is apparent from Tab. I that reproductive performance at the second litter was similar to reproductive performance at the first litter. Sows from intensive pig farming achieved

24.54% (P < 0.0001) higher mean number of live-born piglets and weaned 9.32% more piglets. Sows from extensive pig farming had 75.26% (P < 0.0001) higher mean number of stillborn piglets. The second weaning to estrus interval was 1.55 days longer for sows from extensive pig farming. At the third litter, sows from intensive pig farming achieved 20.89% (P < 0.0001) higher mean number of live-born piglets and weaned 13.58% (P < 0.0001) more piglets. The mean number of stillborn piglets at the third litter was 68.7% (P < 0.0001) higher for sows from extensive pig farming. The third weaning to estrus interval was 4.54 days longer for sows from extensive pig farming. These results show that the extensive farming operation produced litters with more variable number of piglets. Under intensive

farming, by comparison, stricter selection and earlier culling of sows from the farm ensure that sows produce more balanced litters.

Tab. II shows the lifelong reproductive performance of sows from the two types of feeder pig operations. Sows from both farms were inseminated for the first time at approximately the same age. Sows from extensive pig farming were inseminated at mean 2.63 days later. These sows achieved 2.04 (P < 0.0001) higher number of lactations and they were culled later from the breeding herd. Sows from extensive pig farming reached an 11.59% (P < 0.0001) higher mean number of total live-born piglets. They produced higher numbers of piglets from their mean 6.29 lactations. Although sows from intensive pig

I: *Reproductive performance of sows from first to third litters*

	Extensive pig farming		Intensive pig farming		
Item	Mean	SEM	Mean	SEM	P-value
Number of sows (n)	42		464		
Reproductive performance at first litter					
Live-born piglets (n)	10.24	0.45	14.54	0.13	< 0.0001
Stillborn piglets (n)	0.86	0.16	0.17	0.02	< 0.0001
Weaned piglets (n)	10.67	0.24	12.72	0.10	< 0.0001
Weaning to estrus interval (days)	11.35	2.82	6.20	0.25	< 0.0001
Reproductive performance at second litter					
Number of sows	34		378		
Live-born piglets (n)	12.18	0.52	16.14	0.17	< 0.0001
Stillborn piglets (n)	0.97	0.25	0.24	0.05	< 0.0001
Weaned piglets (n)	11.00	0.31	12.13	0.14	0.0209
Weaning to estrus interval (days)	7.25	1.58	5.70	0.44	0.3085
Reproductive performance at third litter					
Number of sows (n)	33		337		
Live-born piglets (n)	13.33	0.63	16.85	0.19	< 0.0001
Stillborn piglets (n)	1.15	0.18	0.36	0.06	< 0.0001
Weaned piglets (n)	10.82	0.37	12.52	0.09	< 0.0001
Weaning to estrus interval (days)	9.00	2.41	4.46	0.51	0.0105

SEM – standard error of the mean

II: *Lifelong reproductive performance of sows from two different types of pig farming*

	Extensive farming		Intensive farming		
Item	Mean	SEM	Mean	SEM	P-value
Sows (n)	42		464		
Age at first insemination (days)	233.76	6.44	231.13	0.64	0.3606
Lactation (n)	6.29	0.55	4.25	0.10	< 0.0001
Live-born piglets total (n)	77.24	7.04	68.29	1.78	0.1543
Live-born piglets per litter (n)	11.95	0.34	15.59	0.11	< 0.0001

SEM – standard error of the mean.

III: *Profitability of two different types of pig farming*

	Extensive farming	Intensive farming	
Item	Mean	Mean	Dif.
Purchase of gilt (CZK)	8,000	8,000	0
Costs of sow per year (CZK)	30,000	30,000	0
Litters (n)	6.29	4.25	-2.04
Turnover rate (litters/year)	2.39	2.46	0.06
Years in production (n)	2.62	1.73	-0.89
Lifetime costs of sow (CZK)	78,685	51,857	-26,828
Costs total (CZK)	86,685	59,857	-26,828
Piglets per sow per year (n)	28.58	38.95	10.37
Live-born piglets total (n)	77.24	68.29	-8.95
Revenue from pig sales (CZK)	77,240	68,290	-8,950
Profit total (CZK)	-9,445	8,433	17,878

Dif. = difference

farming produced 11.59% fewer piglets, they did so in a substantially shorter time (4.25 lactations) and simultaneously had 23.35% (P < 0.0001) higher mean number of piglets per litter.

Tab. III shows economic measures and profitability for the two different types of pig farming. The purchase price for a gilt was assumed to be 8,000 CZK (IAEI, 2018), and this was the same for both groups. The mean costs per sow per year were calculated at 30,000 CZK (IAEI, 2018), and this also was the same for both groups. The numbers of lifetime litters per sow were different, as sows from extensive pig farming achieved 2.04 (32.43%) more lactations. Turnover rate differed by 0.07, with sows from extensive pig farming achieving a mean 2.39 litters per year and those from intensive pig farming 2.46 litters per sow per year. Sows from extensive pig farming had mean production life longer by 0.89 year. They remained a mean 2.62 years on the farm and represented lifetime costs of 78,685 CZK per sow. The mean productive life of sows from intensive pig farming was a shorter 1.73 years, and lifetime costs per sow were 51,857 CZK. Total costs here refer to lifetime costs attributable to the sow plus the gilt purchase price. For sows from extensive pig farming, these costs were a mean 86.685 CZK. That was 26,828 CZK more than for sows from intensive pig farming. Sows from extensive pig farming achieved 8.95 more total live-born piglets, which is 11.59% higher. This higher number of live-born piglets resulted in higher revenues from feeder pig sales. Feeder pigs after weaning were sold for 1,000 CZK. It was assumed that mean piglet weight at weaning was 8 kg and so the price per kilogram was 125 CZK (IAEI, 2018). Sows from extensive pig farming achieved 77,240 CZK in revenues from piglet sales, which was 8,950 CZK more per animal. Total profit, however, which means revenues from feeder pig sales minus total costs, was higher for sows from intensive pig farming. This profit was 8,433 CZK for every sow from intensive pig farming. By contrast, every sow from extensive pig farming brought a loss of -9,445 CZK.

DISCUSSION

Reproductive performance of sows is very important for the economics of feeder pig production (Aasmundstad *et al.*, 2014). Important targets for every producer are to minimize the unproductive days of sows and to maximize profit (Madej *et al.*, 2016). Sows that are culled earlier from the breeding herd have approximately 2.4 times higher litters than do sows that are culled later (Engblom *et al.*, 2009). The results of the present study accord with that earlier finding. Sows from intensive pig farming produced higher mean number of piglets per litter, and these sows were culled from the herd earlier than were sows from extensive farming. This could reflect the high reproductive potential of sows, due to which they are able to recover their own costs in less time. On the other hand, early culling of sows from the herd could be related to the high proportion of sows in their first litters, which can be hazardous to those animals. Already at first litter sows from the intensive farming operation had a high number of piglets, and this could be problem for subsequent reproductive performance and the sows' future profitability (Soede *et al.*, 2013). This was not confirmed by our results to be the case, however. A suitably chosen system for culling sows from the breeding herd causes balanced production (Beek *et al.*, 2014). In the present study it was observed that in extensive pig farming balanced production is ensured by retaining prolific sows in the breeding herd for a longer time. Sows from extensive pig

farming reached a mean 6.29 lactations per sow. In some unique cases, sows from extensive farming achieved as many as 12 lactations. A high number of lactations could reflect that such sows are producing large litter sizes and thereby ensuring sufficient profit for farmers. Sows from extensive pig farming had a mean 2.62 years in production. During this time, they accumulated costs of 86,685 CZK. The higher costs of these sows relate to the longer periods that they remained in the herd. On the other hand, sows from intensive pig farming had a mean 1.73 years in production and embodied costs lower by 26,828 CZK and totaling 59,857 CZK. Sows culled later than at the seventh litter could be poor mothers, have problems with milkiness, produce unbalanced litters, and more frequently crush their piglets, and all these aspects negatively influence farm profitability (Čeřovský, 2002). The sows evaluated in this study that achieved higher numbers of litters also had higher numbers of stillborn piglets, lower numbers of live-born piglets, and lower numbers of weaned piglets. This could reflect more frequent crushing of piglets, poorer milkiness of sows, or their production of unbalanced litters. Sows should be culled from the breeding herd after a maximum of six lactations. Most often, sows are culled after their fourth farrowing (Dourmad *et al.*, 1994; Koketsu *et al.*, 1999). This was confirmed by this study only in one case. This statement is true for intensive pig farming, which aims to maximize the reproductive potential of sows already from their first litters. Such a breeding plan is economically advantageous for the farm. Serenius and Stalder (2004) have reported that higher numbers of piglets per litter have positive effect on the longevity and profitability of sows. It is apparent from this study that sows from intensive pig farming have higher numbers of piglets per year and are culled earlier. Sows from extensive pig farming, by contrast, have fewer piglets per litter and are culled later. It is also true, however, that lower numbers of piglets can mean those piglets born have higher birth weights, and Nevrkla *et al.* (2017) report that piglets with higher birth weights reach slaughter weight earlier. This could be a big advantage for farm profitability. Our results show that sows from the intensive pig farm achieved a mean lifetime profit advantage of 17,878 CZK over sows from the extensive pig farm. This higher profit is what matters decisively for the farms.

CONCLUSION

Sows from intensive farming had better reproductive performance and greater profitability than did sows from extensive farming, despite that their reproductive potential was maximized and they were culled earlier from the herd. This earlier culling under intensive versus extensive pig farming was possible because maximizing the animals' high reproductive potential brought earlier recovery of the costs of rearing and maintaining those animals in the breeding herd. This is important for all pig farms. Maximizing sows' reproductive potential can positively affect farm profitability without negatively impacting reproductive performance. Farm profitability is very important today, and, regardless of the farming system in use, it is important to have excellent knowledge of the biological principles of sows' reproductive potential and properly to use that knowledge to avoid negatively affecting sow health and reproductive performance. Particularly in the case of extensive pig farming, it is economically very important to practice good management to minimize pig losses.

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