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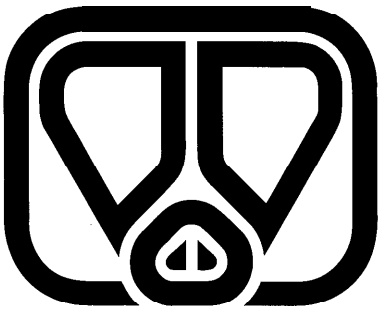
Comparison of four housing systems for non-lactating sows



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1 INTRODUCTION

In the late eighties, a comparative study of different housing systems for pregnant sows, including the electronic sow feeding system (ESF), was conducted at the Rosmalen Institute. One of the main conclusions of the study was that the ESF system needed to be further developed, before practica1 use could be stimulated. Moreover, it was expressed that recent developed group housing systems should also be evaluated. As a follow-up of this study, the Rosmalen Institute was asked to install and compare three operational group housing systems for non-lactating sows with the commonly used individual stall system.

In 1991 and 1992, the three group housing systems were planned, construction took place and management protocols were developed for each of the four housing systems.The mechanics and the management protocol of each of the four housing systems were tested and optimised in 1993. From January 1994 to March 1996, a comparative study was conducted to determine whether group housing of dry sows can be advised as an alternative for individual housing. In the study three group housing systems (free access stalls, trickle feeding and the electronic sow feeding) and one individual housing system (stalls) were considered.

2 MATERIAL AND METHODS

2.1 Animals, housing and feeding

In 1993 the (closed) Rosmalen sow herd was split up in four herds of each 90 sows. The present sows were allocated to one of the four housing systems based on parity, previous housing system (tethers, individual stalls or ESF) and breed origin. At Rosmalen a rotation cross-breeding program is used with the breeds Dutch Land Race (NL), Finnish Land Race (F), and Great Yorkshire sow line (Vz). Sows that could not be maintained within the system were culled. Voluntary replacement of sows was standardised across the four housing systems using a replacement index that expressed the expected replacement value.

During the study, a surplus pool of replacement gilts was maintained. Replacement gilts were randomly allocated to one of the four systems to stay there either until the end of the study or culling.

Each system had it's own room for dry sows. The separate rooms had partially slatted floors without bedding. In the individual stall system, the available area per crate was 2.00 x 0.65 m, of which 0.6 m^2 concrete solid floor and 0.7 m^2 slatted floor. In the free access stall system, the available area per crate was 2.05 x 0.65 m, of which 0.9 m^2 concrete solid floor and 0.4 m^2 slatted floor. Furthermore, two walking areas of 2.60 x 13.28 meter, each between two rows of 20 crates, were available for 74 sows. In the trickle feeding system, a floor area of 18.00 x 13.28 m was divided in 14 different size pens with 84 feeding places. The room with the ESF system contained two small and two large pens. In the small pens, replacement gilts and early pregnant sows were housed. At mid-pregnancy the gilts and sows were moved to the large pen and mixed with a similar size group of late pregnant sows.

The four housing systems were mechanically ventilated. During the farrowing period, all sows were housed individually in conventional crates. The sows were weaned at 4 wk after farrowing. At weaning, a special constructed outside outlet was used to allow for group formation. Group size was 10 - 14 in the free access stall, 13 - 26 in the ESF system, and 6 - 8 in the trickle feeding system. The sows were kept together from weaning until farrowing in stable groups, except in the ESF system in which two groups of similar size were mixed after 6 - 9 weeks in gestation. To enable working with stable groups, a three weekly production system was applied. The systems were managed by the same animal care takers and health management was the same for all four systems.

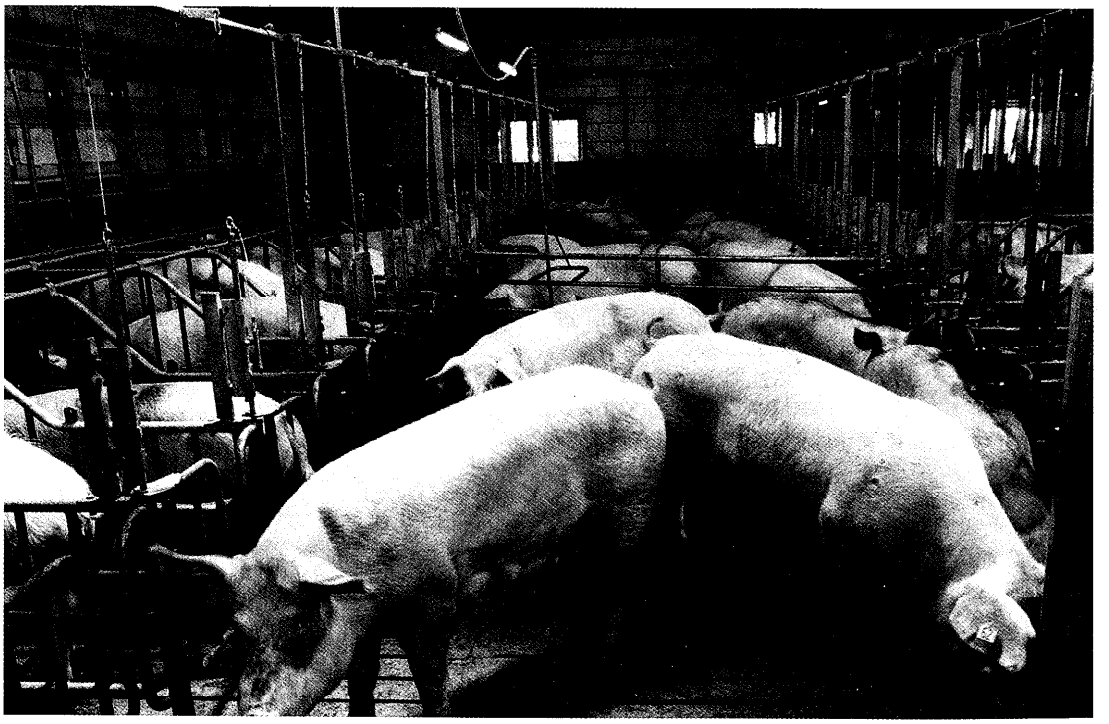
In the systems with simultaneous feeding (stalls, free access stalls, and trickle feeding systems) sows were fed twice a day at 7.30 and 14.30 h. In the ESF system, the sows had access to feed at 15.30 h. The sows were free to consume their daily portion at once, or to split up their ration over several visits to the station. Sows in stalls had limited access to water twice a day for one hour immediately after feeding. In addition to a limited water amount from the nipple above the through, all group housed sows had free access to water from a drinking reservoir.

2.2 Measurements

The four systems were compared on different aspects: i.e. animal behaviour, reproduction and replacement, health, feeding, labour and control, and economics. The following measurements were agreed among a group of experts: oral activities as a measure for stereotypies, cortisol rhithmic, skin lesions, hoof lesions, reproductive traits, veterinary treatments, usage of feed and water, dust concentrations, noise exposure levels, physical and mental work load, and working time for specific animal care taking activities.

During three 24 h periods in March, July, and November 1994, sow behaviour was determined by personal observation. From October 1994 to January 1996, monthly observations of individual dry sow behaviour were registrated: in the three systems with simultaneous feeding (stalls, free access stalls, and trickle feeding) during 1.5 h after

Picture 1: The individual stall system



Picture 2: The free access stall system

Picture 3: The electronic sow feeding system

Picture 4: The trickle feeding system

afternoon feeding, and in the ESF system from 17.00 to 20.00 h. From December 1994 to March 1995, saliva cortisol rhithmic of all empty and pregnant sows was determined. Of all sows, saliva samples were taken twice a day, between 12.30 and 13.30 h and between 15.30 and 16.30 h.

Veterinairy treatments and reproductive traits of individual sows were registrated routinely. Feed and water usage were registrated per room. All sows were inspected for skin lesions at weaning and at 4 days and 12 weeks after weaning, and classified on a scale ranging from 0 (no lesions) to 5 (severe lesions). The hooves of individual sows were inspected for lesions at 4 days and 12 weeks after weaning, and classified on a scale ranging from 0 (no lesions) to 4 (severe lesions). Both respirable and inspirable dust concentrations (mg dust per m^3 air) were calculated as monthly averages, based on 24-hour average dust concentrations per room. Noise levels were measured in the winter period after shutting of the room fans. Based on the required time per work activity and the associated noise level, noise exposure levels per day and per week were determined for each system. Physical work load, safety aspects, flexibility and controlability were subjectively determined based on a questionnaire answered by the animal care takers. Required time for system related work activities was determined by both direct observation and time studies. The data were statistically analysed using variance analysis, Chi square test, and the Friedman test (SAS Institute Inc., 1989). The sow or group of sows was considered the experimental unit.

3 RESULTS AND DISCUSSION

An overview of the results with respect to behaviour, health, reproductive traits, feed and water intake, animal weights, controlability, labour and labour circumstances, investment costs, and an economic evaluation is presented in table 1.

3.1 Behaviour

Compared with the free access stall system, sows spent more time on oral activities in the stall system and the trickle feeding system, and less in the ESF system. However, this behavioural trait is closely related to the feeding regime; i.e. once a day in the ESF system and twice a day in the three other systems. No differences were observed in saliva cortisol rhithmic among the four systems.

3.2 Health

The percentage of sows with hoof lesions at 12 wk after weaning was low in stalls and free access stalls, compared with the ESF and trickle feeding systems. It is noteworthy, however, that the number of sows with hoof lesions in the present ESF system was only two-thirds of the number observed in the first comparative study.

At 12 wk after weaning, the percentage of sows with skin lesions (forehand) was high in the trickle feeding and especially in the ESF system, compared with the stall and the free access stall system. The high percentage of sows with skin lesions in the ESF system was partly due to the mixing of two groups during pregnancy. The groups were mixed to obtain a sufficient number of sows per group, and is, therefore, farm size related but not system related. The high percentage in the trickle feeding system was partly due to agressive interactions around feeding.

3.3 Productivity

The interval weaning - 1st insemination was, especially in 1994, highest in the trickle feeding system and in the ESF system. In the ESF system, also a high loss of backfat thickness during the farrowing period was found. In 1995 both the interval weaning - 1st insemination and the percentage non-returns in the trickle feeding system and the ESF system were markedly improved. This suggests that sows require time to adjust to the new housing system.

The average number of live-born pigs per litter only showed a numerical variation from 10.7 for the stall and trickle feeding system, 10.9 for the free access stall system, and 11 .O for the ESF system. Also the realised percentages of non-returns did not differ significantly. The live-born pigs from group housed sows with an electronic feeder station had the lowest average weight at birth. However, the piglet weight at weaning was highest in the ESF system and in the trickle feeding system. Overall productivity level was satisfactory in all four housing systems: over 22 weaned piglets per sow per year.

3.4 Feed and water usage

The mean feed intake of young sows (first pregnancy) was higher in the free access stall and trickle feeding system than in the individual stall and ESF system. All sows were restrictively fed with the same feeding scheme. However, in free access stalls and trickle feeding systems sows were not fed individually but as a group. Therefore, young sows and multiparous sows were fed on the same feeding scheme.

At the end of pregnancy, the weight of the young sows was highest in the free access stalls. But in the trickle feeding system, where the young sows were on the same feeding scheme, sows weighed less compared with sows in free access stalls.

Backfat thickness of multiparous sows in group housing was higher than of sows in the individual stalls. The high backfat thickness of sows in the ESF system is not related to realised room temperatures or levels of feed intake. In the ESF system, sows were fed consequential with a frequency of once a day. To which extent the feeding regime plays a role can not be determined from this research.

The level of water usage was lowest in the ESF and trickle feeding systems. In stalls, the water usage of sows was highest. Since

Table 1 Results of a comparison among three group housing systems (free access stalls, trickle feeding and the electronic sow feeding) and the individual stall system for non-lactating sows.

	Stalls	Free access stalls	ESF	Trickle feeder
Average present sows (1994 - 1995)*	86	85	89	88
Reproductive performance				
Number of cycli	377	373	395	401
Interval weaning-insemination	6.6[a]	6.2[a]	7.3[b]	7.3[b]
Percentage non-return	88.9	87.6	87.4	88.7
Live born piglets per litter	10.7	10.9	11.0	10.7
Weaned piglets per sow per year	22.1	22.5	22.1	22.2
Birth weight live born piglets (kg)	1.45[a]	1.44[a]	1.40[b]	1.45[a]
Piglet growth: day 1-28 (g/day)	221[a]	221[a]	227[b]	227[b]
Animal characteristics				
Weight of the sow: end of pregnancy (kg)	222[a]	226[b]	219[a]	221[a]
Backfat thickness of the sow; end of pregnancy (mm)	18.0[a]	19.3[b]	20.8[c]	18.9[b]
Behaviour				
Oral activity 1st pregnancy after feeding (%time)	32.4[a]	20.4[b]	9.4[c]	26.7[ab]
Health				
Sows with locomotion disorders (%)***	8.4[a]	10.4[a]	19.5[b]	17.8[b]
% Sows with forehand skin lesions (12 wk pregnancy)	0[a]	6[b]	33[c]	19[d]
Feed and water usage				
Feed level (kg/day)				
- primiparous	2.5[a]	2.7[b]	2.5[a]	2.7[b]
- multiparous	2.8[a]	2.8[a]	2.7[b]	2.8[a]
Water usage (ltr/sow/day)	10.2	11.8	8.4	8.7
Labour and control				
Labour time room for 170 pregnant sows (hrs/yr)	287[a]	285[a]	207[b]	293[a]
Labour time whole farm with 210 sows (hrs/yr)	3,050[a]	3,048[a]	2,970[b]	3,056[a]
Respirable dust (mg/m^3)	0.16[a]	0.19[a]	0.44[c]	0.28[b]
Noise exposure level whole farm (dB(A))	88.5	88.5	88.6	88.5
Physical load score (ranking)**	1.00	2.21	3.29	3.50
Controlability score (ranking)**	1.00	2.17	3.67	3.17
Distortion score (ranking)**	1.00	2.36	3.29	3.36
Observed sows with locomotion disorders	20.0	26.7	11.1	38.1
Economic aspects				
Investment room for 170 pregnant sows (Dfl/sow)****	1,535	1,976	1,503	1,601
Economic evaluation (Dfl/sow/year compared with stalls)		-30.51	+47.83	+5.81

* The average number of present sows includes lactating sows. A sow is defined as a sow from the first insemination on the farm until the (registrated) departure from the farm.

** 1 = favourable; 4 = unfavourable

*** % of all sows

**** 1 USD = 1.70 Dfl.

[a,b,c] Data in a row with a different superscript differ significantly ($p < 0.05$).

January 1996, the drinking time via the through nipple in free access stalls was reduced from 2 x 60 minutes per day to 2 x 20 minutes per day, the same time period as in the trickle feeder system. After the change, the daily water intake per sow in the three group housing systems varied from 8.4 to 8.7 ltr. This is 1.5 - 1.8 ltr water per sow per day less than the water usage of individual housed sows.

3.5 Controlability

Total controlability and the overview on feed intake and health were perceivèd by the animal care takers as best in the stall system, except the control of hoof lesions. The latter was perceived as best in the free access stall system.
During intensive control by the researcher, the highest percentage of cripple sows were observed in the ESF system and the trickle feeding system. During the routinely daily control by the care taker, the largest fraction of these cripple sows was registrated to be cripple in the trickle feeding system and the lowest fraction in the ESF system. In the trickle feeding system, the stall system and the free access stall system, all sows are aroused during feeding. This makes observation of cripple animals easier. Futhermore, sows have more freedom to move in group housing systems, which makes it easier to observe them from different sides. However, other health parameters are more difficult to relate to individual sows in group housing systems.

3.6 Labour and labour conditions

Working time in the ESF system was shorter than in the three other systems. Expressed in total working time, this difference accounted for only 3%, because working times in rooms for dry sows contribute to less than 10% of total working time on sow farms. Measured noise exposure levels in the four housing systems differed hardly, but were too high. Ear protective devices are recommended in all four systems. Concentrations of respirable dust in the trickle feeding system, and especially in the ESF system, were higher than in the stall system and the free access stall system. Subjective evaluation by the animal care takers of both the physical and mental work load was ranked from more to less favourable for the stall system, the free access stall system, and finally both the trickle feeding system and the ESF system. Group housing requires changes in work methods and routines. A condition, therefore, is that the sow farmer is able to make this change.

3.7 Investment costs

For both small and large farms, (annual) investment costs are highest for the free access stall system. Investments for the trickle feeding system are somewhat higher than for the individual stall system, but the annual costs are lower. This is due to the relative small fraction of equipment in total investment for the trickle feeding system. With increasing farm size, annual investment costs decrease. This procentual decrease is highest for the ESF system due to the decrease in the required floor space per sow. For the three other systems, the decrease in investment cost is similar with increasing farm size.

3.8 Economic evaluation

In the economic evaluation of the four housing systems, the following aspects were quantified: feed usage, water usage and associated manure disposal costs, energy usage, interval weaning-insemination, required labour, and required investment.
The economic performance of the ESF system and the trickle feeding system were respectively 47.83 and 5.81 Dutch guilders per sow per year higher than in the stall system. In contrast, the annual economic performance per sow in the free access stall system was 30.51 Dutch guilders lower than in the stall system.
The economic evaluation did not cover all aspects. For example the investment costs to meet Dutch environmental standards for ammonia emission and the impact of the different housing systems on the marketing perspectives of meat could not be quantified. The number of weaned piglets per litter was not taken into account in the economic evaluation, because the trait was not significantly different among the four housing systems. Lastly, the replacement rate of the sows was not analysed because the trait could not be assessed within the experimental period.

4 CONCLUSIONS

The technical performance of group housed dry sows was similar to individual housed sows. Stereotypic behaviour was more frequent in the individual stall system and in trickle feeding system. The percentage of sows with locomotion disorders was higher in the trickle feeding system and in the ESF system. Labour requirements were similar among the housing systems, but both the physical and mental work load in group housing systems were perceived as more strenuous than in the individual stall system. Except the free access stalls, group housing systems were favoured over the individual stall system in the economic evaluation. In conclusion, group housing of non-lactating sows is feasible in practice, but will require more of the management of the farmer, compared to individual housing.