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APPLIED RESEARCH ON NEW PIG HOUSING SYSTEMS

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Abstract

Development of pig housing during the last decade is in addition to economics strongly influenced by animal welfare and environmental regulations. Because the different requirements may cause conflicts on some aspects of pig housing, an integrated approach is necessary. Housing systems which partly or fully meet today's animal welfare and environmental regulations in the Netherlands are described.

Introduction

During the last decades pig production has been intensified in most European countries. Development of strawless systems and technological development in feeding and housing systems have led to an increase in number of pigs per production unit. In several countries, the intensive production of pigs is under increasing pressure of environmental regulation and legislation by government and local authorities. Furthermore, consumer and animal welfare organisations have called for husbandry systems that pay more attention to the welfare of the pig. This means that systems are in development that give pigs more floor space by adhering to regulations on, e.g., minimum values for floor space per pig, length of stalls for sows, and proportion of slatted floor per pen. In some countries, individual housing of pigs is also debated as well as the enrichment of the surroundings of the pig. Due to environmental issues, systems are in development that prevent part of the gaseous emissions (e.g. NH_3) by reducing the emitting surface, lowering the slurry temperature and reducing the pH and/or N content of the slurry. An integrated research approach is necessary in order to solve the contradicting requirements of environment, animal welfare and farm economics.

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Animal welfare regulations

The EU introduced rules on animal housing and animal care-taking in 1991 (EU-publication, 1991). These rules set the minimum requirements for all EU-member states. In addition, each country is free in enacting their own national regulations. In the Netherlands, national regulations originate from 1994 (Staatsblad, 1994). In Table 1, the minimum required floor space in EU and Dutch legislation are presented. In addition to floor space, the EU has prohibited tethering of sows starting, 1 January 1996 in newly built facilities and starting 1 January 2006 in all pig facilities. In the Dutch legislations, pig housing regulations are described in more detail. Individual stalls, for example, must have a length of at least 2.0 m. The solid floor must extend at least 1 m behind the trough. Suckling piglets must have a solid floor available (or covered slatted floor) in the farrowing pen of at least 0.6 m^2.

Weaned piglets and lactating sows may be housed on fully slatted floors as long as this floor is not a concrete slatted floor. In the farrowing, pen the slots may not be wider than 10 mm for concrete slatted floors and less than 12 mm for other floors; for growing finishing pigs and dry sows the maximu slot width is 20 mm and for weaned piglets 15 mm.

Table 1. - MINIMUM FLOOR SPACE REQUIREMENT (m^2 PER PIG) IN THE EU AND THE NETHERLANDS ENACTED ON 1 JANUARY 1998

Body weight (kg)	EU	The Netherlands	
	total floor area (m^2)	total floor area m^2	solid floor m^2
< 30	0.30[1]	0.30	0.12
30- 35	0.40	0.50	0.20
50- 85	0.55	0.60	0.25
85-110	0.65	0.70	0.30
> 110	1.00	1.00	0.40

[1] 0.15 m^2 for pigs < 10 kg and 0.20 m^2 at 10-20 kg bodyweight.

With regard to animal care-taking, the EU-requirements are similar to the Dutch requirements. Weaning of piglets before 3 weeks of age is not allowed. There must be some bedding material in a farrowing pen or at least a rubber mat for the piglets. Most common is the use of some saw dust. The light intensity in the barn must be at least 12 lux at animal level from 9.00 – 17.00 h. Dry sows should get some roughage. All pigs should have access to straw or other materials or objects to satisfy their behavioural needs.

Environmental regulations

The government of the Netherlands has stated within a set of environmental regulations for agriculture that the ammonia emission from animal facilities must be reduced with 50% in 2000 and with 70% in 2005 compared with the calculated emmission in 1980. To realize this, adaptations in pig houses are necessary. The emission of ammonia can be diminished by reducing the emitting surface, the slurry temperature, the air movement above the emitting surface, the N content and the pH of the slurry. Except the pH in slurry, the same measures can be used to reduce odour emissio. The amount of slurry and also the mineral excretion in intensive pig producing areas have to be minimized to reduce costs for storage and transport. Based on the environmental measures, pens for growing-finishing pigs, piglets, dry and lactating sows were redesigned (Voermans and Verdoes, 1995). All new pen disigns meet the requirements as put in the animal welfare regulations.

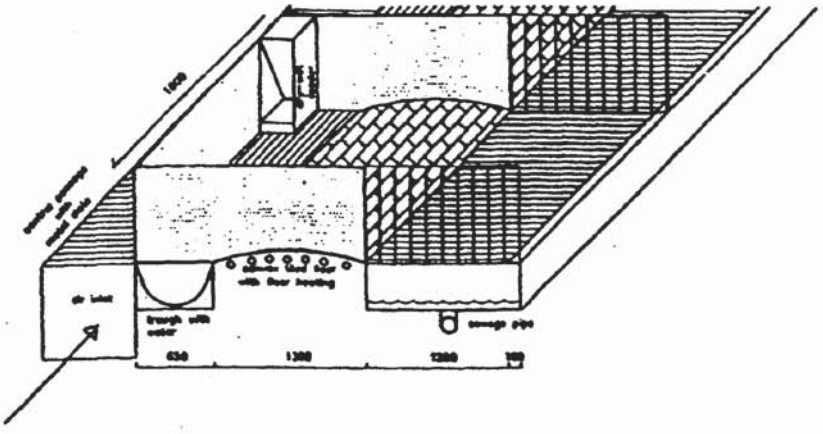
New pen designs

Verdoes et al. (1996) has described new housing systems for each pig category that meet both environmental and animal welfare requirements.

Growing-finishing pigs

The pens are designed for 8 pigs (figure 1). The surface per pig is 0.7 m^2. Each pen consists of a slatted area for feed and water consumption, a heated solid area for resting and a slatted area for defaecating.

Figure 1. - CROSS SELECTION OF THE NEW ROOM FOR GROWERS/FINISHERS

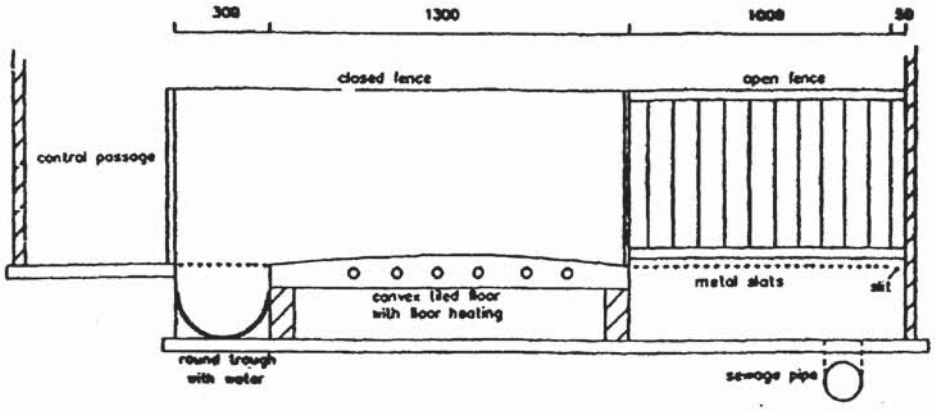


The partitions are partly solid (1.95 m) and partly open (1.30 m). The solid part is made from smooth plastic. The open part is constructed with vertical metal bars. The contacts between pigs from two pens make this area less suitable for lying, so defaetion takes place in this area. The pens are 1.80 m wide and 3.25 m deep. The floor, seen from the passage corridor, has a 0.65 m tribar steel slat, a 1.30 m round tiled floor and a 1.20 m tribar steel slat. Against the back wall a 0.10 m open space is created to attenuate removal of pig manure from the pen surface. Beneath the slatted areas, slurry is discharged from the facility by a sewage pipe system.

Piglets

For piglets a partly slatted floor and partly solid floor with heating can be used. The dimensions of the floor, seen from the passage corridor, can be as follows: 0.3 m slat, 1.3 m solid tiled floor, 1.0 m slat and a 0.05 m opening (figure 2). The surface per piglet is 0.3 m^2. The emitting surface in the pit is about 0.15 m^2/piglet. Beneath the slatted area, slurry is descharged from the facility by a sewage system.

Figure 2. - CROSS SECTION OF THE PEN IN A NURSERY ROOM



Lactating sows

In units for lactating sows both partly or fully slatted floor systems can be used. In order to prevent amonia emission in a fully slatted floor system, the slurry pit is divides in two parts. In the front part a layer of about 5 cm cleaning water is left in the pit. The rear of the pen part is used as the manure canal. Slurry is discharged by a sewage pipe system.

Figure 3. - NEW PEN DESIGN FOR LACTATING SOWS

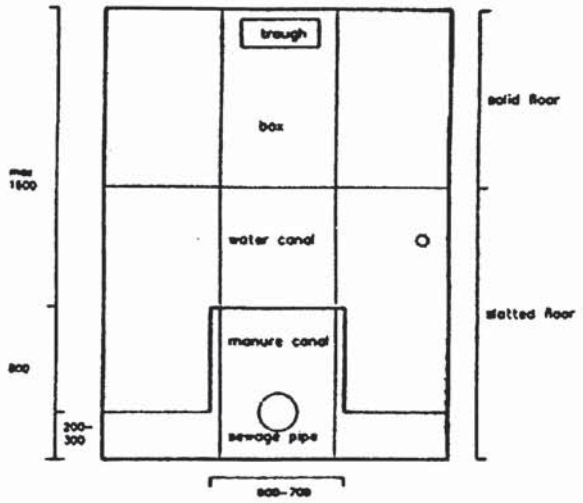
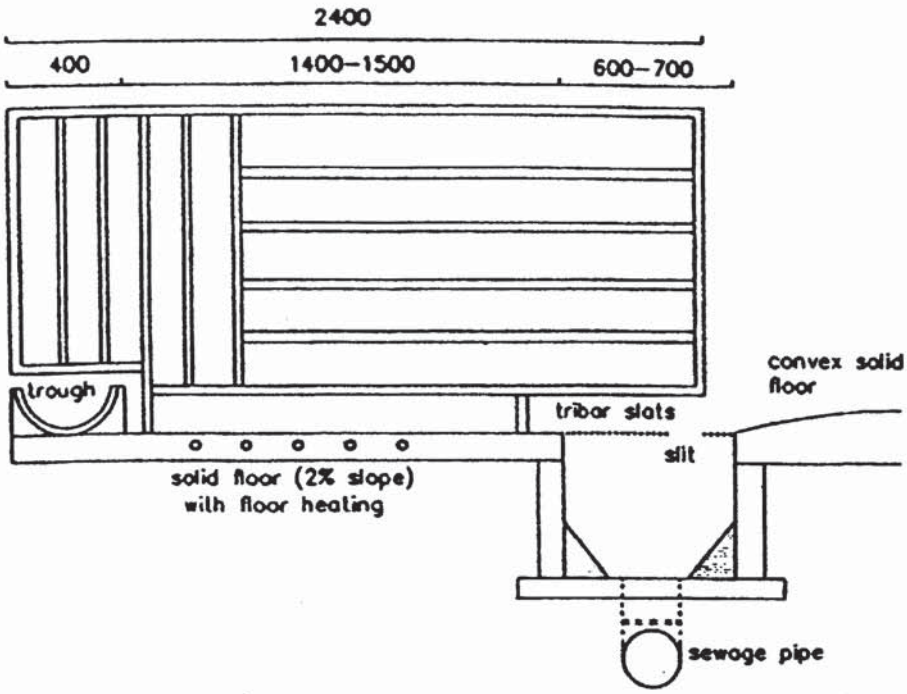


Figure 4. - CROSS SECTION OF THE NEW PEN DESIGN FOR PREGNANT SOWS



Pregnant sows

For better environmental control, pregnant sows should be housed in individual stalls. These stalls are 2.40 m long if the trough is built on the floor (figure 4). The solid floor behind the through is 1.40 – 1.50 m long and this floor has a 2% slope. When the trough is mounted about 0.3 m above the floor the length of the stall can be reduced to 2.00 m. Behind this floor there is a 0.6-0.7 m wide tribar steel slat (10 mm bars and 12 mm slots) with a sewage pipe system undemeath.

New pen design and ammonia emission

In table 2, the reduction in ammonia emission of the described pens are compared with the standards as published by the government of the Netherlands. Research is still ongoing to further optimize the pen design.

Table 2. - AMMONIA EMISSIONS FROM PIG PENS STANDARD AND NEW DESIGN

Room	Standard kg NH_3/place.y	New design kg NH_3/place.y	Reduction %
Dry sows	4.2	2.4	43
Farrowing rooms	8.3	4.0	52
Nursery rooms[1)]	0.6	0.26	57
Growing finishing pigs[1)]	2.5	1.8	28

[1)] partly slatted

New development in housing

A new aspect in the housing of pigs due to the consumers opinion is loose housing of sows. Last decade several experiments are carried out to examine the possibilities of group housing of sows. Housing systems of sows have to meet the requirements of the sow and the requirements of the producer. The requirements of the sow can be expressed in terms of the five freedoms described by Webster (1987): freedom from 1) malnutriton, 2) thermal and physical discomfort, 3) injury or disease, 4) suppression of normal behavior, and 5) fear and stress.

The following requirements for the pig producer were suggested by Edwards (1990): 1) high biological performance, 2) low labor input, 3) ease of management, 4) acceptable capital cost and 5) acceptable financial return. Several systems in which sows are kept in groups were recently developed. Systems can differe in terms of feeding (as a group or individually, simultaneously or sequentially), housing (straw, slats or concrete) and group management (stable or dynamic groups).

Backus et al (1991) and Den Hartog et al (1993) reported an experiment with 2840 litters in which group housing with electronic sow feeders was compared with tethering and individual stall housing. It was concluded that productivity was highest in the individual stall housed sows, whereas hoof quality and ease of namagement were worse in group housed sows. No differences in sham chewing, bar biting and apathy among systems was found.

Tethering of sows will be forbidden in the EU from 1996 onwards in new barns and from 2006 onwards for all sows (EU publication, 1991). Group housing systems for dry sows are still in development. Backus et al. (1996) calculated the investment costs of housing systems for a farm with 170, 340 and 680 pregnant sows (table 3). It can be concluded that a system with free access stalls for pregnatn sows requires the highest investment costs, whereas, a system with electronic sow feeder is cheapest.

Table 3. - ANNUAL HOUSING COSTS (DEPRECIATION, MAINTENANCE, INTEREST) SYSTEMS FOR INDIVIDUAL AND GROUP HOUSING

	170 sows	340 sows	680 sows
Stalls	100[1)]	96	93
Free access stalls	130	125	122
Biofix (trickle down system)	93	90	87
Electronic sow feeder	86	80	78

[1)] Set at 100

From 1994 to 1996, a comparison was made among sows housed from weaning until farrowing in stalls, free access stalls, in a group with trickle down feeding and in a group with electronic sow feeders. In Table 4, the results of the study are shown (Backus et al., 1996).

Table 4. - RESULTS OF A COMPARISON OF INDIVIDUAL HOUSED SOWS AND GROUP HOUSED SOWS

	Stalls	Free access stalls	Electronic sow feeder	Biofix
No of piglets born alive	10.7	10.9	11.0	10.7
Birth weight (kg)	1.45[a]	1.44[a]	1.40[b]	1.45[a]
Interval weaning-oestrus (d)	6.6[a]	6.2[a]	7.3[b]	7.3[b]
Sows with skin lesions (%)	0.3[a]	6.5[b]	33.0[c]	18.9[d]
Sows with locomotion disorders (%)	8.4[a]	10.4[a]	19.5[b]	17.8[b]
Oral activity (% of time)	32.4[a]	20.4[b]	9.4[c]	26.7[ab]
No of piglets per sow per year	22.1	22.5	22.1	22.2

Data in the same row with a different superscript differ significantly ($p<0.05$)

It can be concluded that despite of differences in, interval weaning oestrus and birth weight of the piglets the total number of piglets produced per sow per year did not differ significantly among the four housing systems. Oral activity was lowest in the sows with an electronic sow feeder, whereas number of sows with skin lesions and locomotion disorders was lowest in the sows housed in stalls.

In contrast to group housing of dry sows, little attention was paid to applied research on group housing during lactation. Group housing of lactating sows is more complicated than group housing of dry sows because of the need of the piglets expecially during the first week of lactation (Arey, 1993).

Conclusions

In applied research on new housing systems, the focus has to be on environmental and animal welfare aspects. More over, the cost of the new housing systems are important for the economic position of the farmer.

The last five years, low emission housing systems were developed for each pig category. These low emission housing systems adhere to the requirements as stated in the EU and Dutch legislation. In future research, the low emission housing systems can be further optimized by focusing on aspects that contribute to the enrichment of the surroundings of the pig.

In the development of loose housing systems for empty and pregnant sows, little attention was paid to environmental aspects. In the future, loose housing systems must be further optimized by integrating aspects that contribute to the reduction of gaseous (NH_3) and odour emissions.

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PRIMIJENJENO ISTRAŽIVANJE NOVIH SISTEMA NASTAMBI ZA SVINJE

Sažetak

Na poboljšanje smještaja za svinje osim ekonomije uvelike djeluju dobrobit životinja i propisi u vezi s okolišem. Zbog toga što razni zahtjevi mogu prouzročiti sukobe u nekim aspektima smještaja svinja potreban je jedinstveni pristup. U radu su opisani sistemi smještaja što djelomično ili potpuno odgovaraju današnjim propisima okoliša i dobrobiti životinja u Nizozemskoj.

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