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Overview of current sow housing systems

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Introduction

Pig husbandry in Europe, and especially in Germany, is marked by the desire to provide pigs with the most beneficial husbandry conditions possible. On the other hand, for the producer to be successful, pork production costs should be kept as low as possible. Finally, there is a desire to keep the production as environmentally friendly as possible.

Pig husbandry processes are, and will likely continue to be, designed in accordance with available information on animal well being, local and international laws based on this information, as well as the current market situation.

The following explains the relevant European legal and economic conditions affecting sow husbandry. The focus of the paper is appropriate husbandry practices for sows. Finally, the systems and processes described are evaluated from the perspective of the animal, the environment, the farmer, and the economy.

Basic legal and economic demands

Legal demands

The European Regulations for Pig Husbandry (91/630/EWG) are binding for all countries of the European Union (EU). Every EU country was required to translate these regulations into national law by 1994; since these guidelines offer only a minimum standard, some countries chose to add stricter requirements in their national laws.

At the European level, the following rules are particularly noteworthy in the area of sow keeping:

- Since 1996, it is illegal to equip new tether stalls.
- Pregnant sows should preferably be held in groups; pigs kept individually must have enough space to turn around at least once. The sows should also be kept as much as possible in permanent groups.
- In addition, the enrichment of crude fiber feed is recommended (for fullness and to satisfy the need to chew). Pigs weighing more than 110kg should have an area of at least 1.0 m² available to them.

The following table (**Table 1**) should give an overview of how the European-wide regulations have been converted into national law in three countries of the European Union.

Until 1998, Germany had the most extensive regulations promoting the well being of sows. Denmark (June 1998) and The Netherlands (September 1998) also implemented comprehensive regulations. Both in Germany and at the level of the European Union, further regulations can be expected in the near future. The most significant goal is to allow the sows to spend as much as possible time in a group environment. Since it is well known that not all sows are suited to group keeping, each country allows exceptions for such sows.

Husbandry technologies influence the living conditions for farm animals and, as such, are a determinant for good or poor hygiene, and can be a cause of injury or illness. In order to assess the most relevant effects of these technologies for the well being of animals, it is important to test the technologies before using them in practice (HESSE et al; 1999).

This principle is followed only in two European countries:

- In Switzerland (not part of the European Union), testing of technologies for animal husbandry is mandatory, and, technologies can only be brought to market if they receive required state approval, only granted on the basis of positive test results (TROXLER; 1998).
- In Germany, the testing of technologies is voluntary but crucial for their eventual implementation. Since 1953, the German Agricultural Society (DLG) has evaluated agricultural equipment, including husbandry equipment. This evaluation procedure is supported to a large extent by subsidies from the Federal German Ministry of Agriculture and Food (BML). The evaluation is also used as the basis for official consulting and extension work (BERTRAM and HERRMANN, 1998).

The DLG-Testing Center has conducted more than 4700 evaluations. Only about 80% of the tested systems were recognized as appropriate. Of the technologies with recognition, 80% were improved during the testing process (BERTRAM and HERRMANN, 1998). Improvements

Table 1: Regulations for sow husbandry in several European countries

	Germany	Denmark	The Netherlands
Yoke tying	illegal since 1989		illegal
Tether stall	Illegal in existing stalls as of 2006	Illegal since 1/1/96 in new stalls Illegal in existing stalls as of 1/1/2006	Illegal since 1/9/98 in new stalls Illegal in existing stalls as of 01/01/2002
Movement	Sows must be able to move freely for at least four weeks following farrowing	The sows must be held in groups from at least four weeks following the litter up to seven days before weaning	The sows must be held in groups from the fourth day following insemination up to seven days before weaning
Area	110–150kg requires >1.0m ² >150kg requires >1.6m ²	1–4 sows requires >2.8m ² 5–10 sows requires >2.2m ² 11–20 requires >2.0m ² each further sow requires >1.8m ²	2.25m ² per sow
Floor Design	The flooring in the lying area for breeding animals must not be fully perforated.	Pregnant sows must have 1.3 m ² and sows in heat must have 0.95 m ² solid floor with litter	At least 1.3 m ² per sow must be solid, the solid area may have openings up to five percent in order to release liquids
Opportunity for being active	Pigs must be able to be active for at least one hour per day with straw, crude feed, or similar appropriate substances	Sows must be able to reach straw or saturation feed	Sows must be offered crude fiber rich feed to increase their occupation
Thermo-regulation		A shower or cooling device must be available for the sows	

Source: SHV, (D); 1994; Lov nr 404 (DK); 1998; Varkensbesluit (NL); 1998

resulting from such testing are an advantage for the animal welfare and also an opportunity for companies to save money through the introduction of a new technique into practice since they preclude potential recalls.

The new §13a of the Animal Protection Law of Germany empowers the Ministry of Agriculture and Food (BML) to improve animal protection by laws concluded from the results of this voluntary testing of commercially available systems. Furthermore, the BML is authorized to set the standard for the testing procedures (HESSE et al; 1999).

To support the DLG in testing the animal welfare aspects of newly developed equipment and to develop the standards for the BML, the scientific committee "Animal Welfare" was founded under the rubric of the DLG.

There is an incentive to use this voluntary testing provided by §16 of the Animal Protection Law of Germany as follows: if equipment already used in practice is sus-

pected of not meeting the requirements of the animal protection laws, the company has to provide an expert opinion report, which is in most cases extremely expensive. If, however, the equipment in question had been subject of the voluntary testing prior to its usage, the company is not asked to provide the expert opinion (HESSE et al; 1999).

Comparison of production costs

A comparison of the costs of pig production for 1996 shows remarkable differences between the USA and Germany. While the costs for a 25kg piglet were in 1996 about US \$40 in Indiana and Illinois (basis: 150 sow herd), these costs were in Germany about 116 DM, which equals roughly US \$60 (ISERMEYER, 1998).

The composition of these costs differs in the two countries. Feed accounts for 49% of the costs in the USA and 35% in Germany. Buildings and equipment are the second largest cost factor, accounting for 29% of the US costs

and 30% of the German costs. The third largest factor, labor costs, show the most significant differences with only 12% in the US and with 26%, more than double, in Germany. The other variable costs make up 10% of the costs in the US and 9% in Germany (ISERMEYER, 1998).

The distribution of costs in Denmark is similar to that of the US costs. This shows that the relatively high labor costs in Germany are one of the main problems in the area of competitiveness. This is one of the main reasons that there is a strong tendency in Germany toward labor-reducing procedures (e.g., electronically controlled feeding and husbandry practices). On the other hand, a certain tendency to lower the costs of buildings is offset by the need to spend more time observing the animals.

Different husbandry systems

The husbandry practices described here are applicable to all farm and herd sizes. However, due to cost and management reasons, certain systems have become predominant.

In sow keeping, the floor is either covered with deep litter or is partly slatted. Basically, both types of flooring can be found in all systems. For different reasons, there are several preferred combinations. The partially slatted floor is more prevalent and is generally made of concrete elements. Fully slatted floors are not allowed at all for breeding pigs.

Individual keeping with the possibility of moving

As mentioned above, the individual keeping of sows will no longer be permitted in the future. However, in contrast to Denmark and The Netherlands that demand already today group keeping, present German national law requires "only" the possibility of free daily movement for every sow for four weeks during each reproductive cycle. Two technical solutions are known that permit the free movement of sows, although they are kept in individual crates (such solutions are needed anyway for aggressive and sick sows that cannot be assigned to sow groups without adverse effects, even if group keeping is mandatory).

In the mating area, it is good if sows are able to walk but it is important to do this without the risk of aggression from other sows. In this case the following systems "twin bay" and "Hörmatik" are ideal. But it is not so good work in this systems during insemination.

Twin bay

This system was developed by the Ulrich¹ Company. In the twin bay system, sows are kept individually next to each other. Two sows share one movement area. This area is located between the sows. When a sow wants to exercise, she can push a flexible gate open around the bay in a

circle. During this time, the movement area is not open to the other sow. Once the first sow is back in her resting area, then the second sow can open the flexible gate and walk in the circle herself.

For this system, an area of about two square meters per sow is necessary. This technology costs about the same as standard technologies with Self-catching Feeding Crates in group housing. For hygiene reasons, the smallest possible area with solid floor is preferred.

Hörmatik

This system was developed by the Hörmann² Company. The sows are kept in individual crates. Behind the crates is a movement room which can be accessed by all of the sows, but only one at a time. For this reason, the crates were modified in such a way that the back doors of all crates close as soon as a sow leaves her crate. As soon as the sow returns to her crate, all of the doors unlock until the next sow leaves her crate.

Since only one sow can move at a time, the space required behind the boxes is relatively small. This system is therefore suited particularly for the reconstruction of traditional single crate technology. About two square meters per sow are required.

Group keeping of sows

Self-catching feeding crates

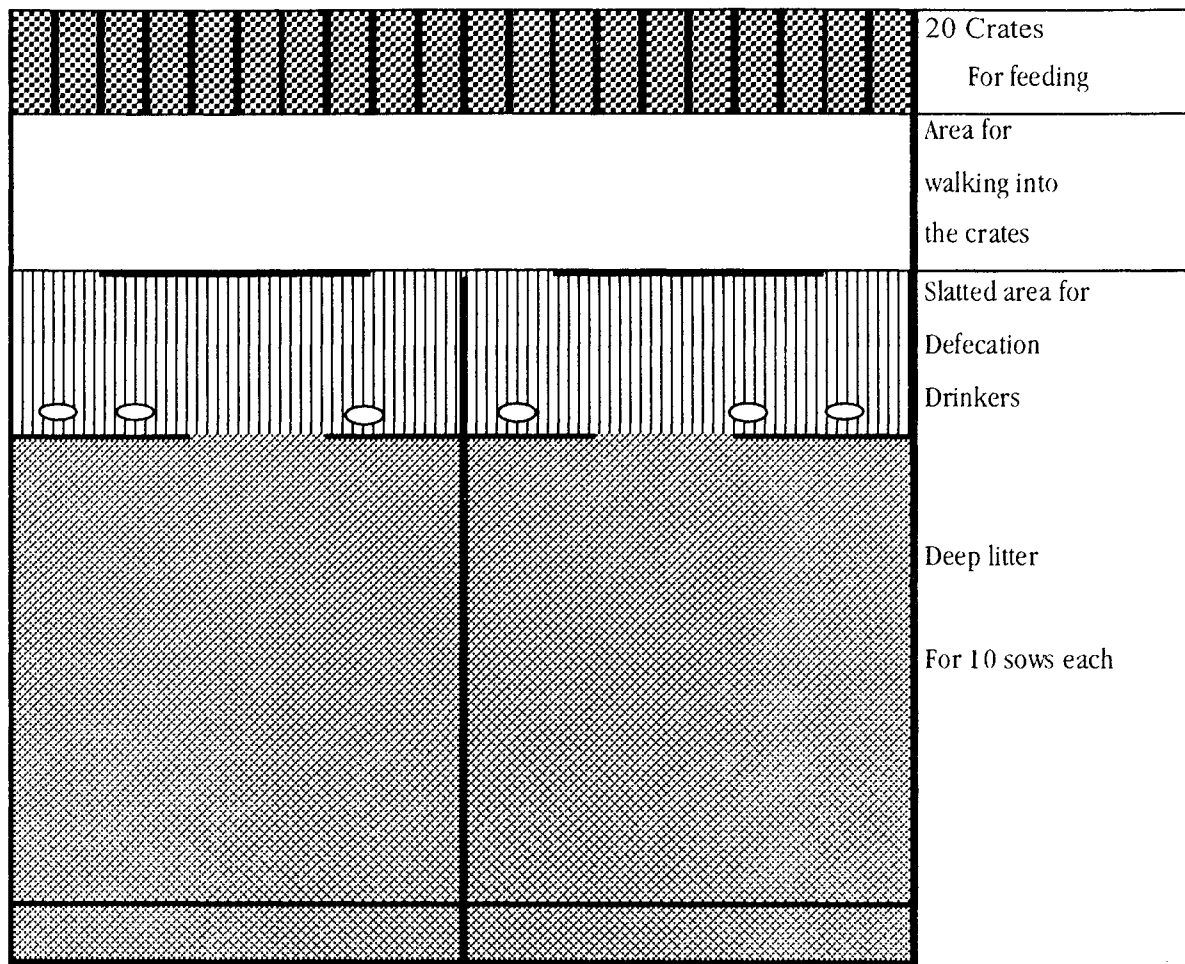
In this system, the sows are protected in individual boxes while feeding on dry or liquid feed, but are able move around freely for the rest of the time. Therefore, there is a mechanism that closes the back door to the feeding area as soon as a sow enters. The boxes can also be closed manually to prevent all or some pigs from leaving their boxes.

To ensure that sows can escape hierarchical conflicts, a minimal area of 2.5 square meters is necessary. In order to ensure good supervision of the group, the groups should not exceed 20 pigs. Individual feeding is difficult, since the sows do not always go into the same crates. In the self-catching feeding system either deep litter or partially slatted floor can be used individually or together. One sow place, in a herd of 320 animals, costs about 4230DM (GARTUNG, et al 1999).

A new variant of this system comes from Denmark, the so-called "cafeteria feeding" (see **Figure 1**). The purpose of its development was to reduce the high investment costs of the above described self-catching feeding system.

For this reason, deep litter is used for the resting areas. In addition, the relatively expensive self-catching feeding crates can be used by two or more groups. This is possible because, in contrast to the normal way, the groups share only one resting and manure area including a drinking station.

Figure 1. The "cafeteria system" from Denmark



Once or twice per day the groups are allowed to enter the feeding area one group after the other. After feeding they are driven back into the appropriate group area. For this, the system needs a special walking area, so that the system as a whole needs nearly three square meters per sow. The reduced costs, however, are offset by increased labor time required to drive the sows back.

Bio fix system

This system, produced by different companies, is also known as dribble feeding. Sows in this system are separated only by shoulder plates. Fighting for feed should be prevented by slowly crumbling the feed into the trough. The sows leave the feeding area only when no feed falls into the trough any longer. They are therefore not technically, but rather "biologically," fixed.

Dry feed is only offered once or twice a day. The amount of feed can only be measured for a group. For this reason, groups of under ten animals are most appropriate for this system. The groups should consist of sows with a uniform reproductive state and body condition. The sows require less than two square meters of space in this sys-

tem. The solid floor area can be either in the feeding area, on the opposite side or in the middle. Due to the overall small pens, they are often difficult to be kept clean enough. In the movement and manure areas there is usually partially slatted flooring. For one sow space in a herd of 320 animals, about 4000DM are needed (GARTUNG, et al; 1999).

Long-trough feeding

If liquid feed is to be used, small groups of up to ten animals and the implementation of a long trough are especially preferable. It also seems possible to implement sensor feeding together with a shorter trough, as known from the fattening pigs.

Feeding takes place at to two times a day. This system allows only for group feeding. The groups should consist of sows with a uniform reproductive state and body condition. The area required per sow is less than two square meters. The solid floor area can be either in the feeding area or on the opposite side or in the middle. This system is hard to keep clean due to the small size of the overall pen.

Computer-controlled individual animal feeding

Individual computer feeding

In call feeding, only one feeding station is required per group of sows. A significantly modified box stand, combined with an electronic recognition system, is required. A call station equipped with an entry recognition can hold up to fifty sows. Without entry recognition the station is blocked by sows moving unnecessarily through the feeding area, which significantly reduces the possible number of animals held in this system. Within the framework of the voluntary DLG testing, three facilities were tested. The test showed that the facilities differ in many points, for example the electronic possibilities. The feed is generally measured out in a dry format; liquid feed is seldom used.

Several points must be observed in the installation of such facilities. Entrances and exits must be located as far apart as possible. The sows in the lying area should all be able to see the entry area to ensure low aggressiveness. For the purposes of labor efficiency, the call station should be built on a slatted floor area. Constant groups are preferable, since there are fewer hierarchical conflicts and the work management is simpler. In the movement and manure area the slatted flooring is used in combination with deep litter in the resting area. For one sow space in a herd size of 320 animals, about DM 4000 is required.

Cereal nipple

The purpose of this development by the Mannebeck³ Company was to create the most hygienic and loss-free presentation of feed, similar to the natural suckling process.

In this system, the feed leaves a storage container via a funnel into a conveyor tube. The tube, similar to a drinking tube, bends slightly into the receptacle below the funnel. A conveyor screw transports the feed to the nipple opening where it is ingested by the pig. Before the dry feed reaches the nipple opening, an adjustable amount of water is sprayed into the feed. Thus, the feed consistency

can be adjusted from semi-liquid to pasty. Coarse meal or granulates are preferable in the system, although pellets can also be used.

The animal puts the mouth to the nipple (as can be seen in **Figure 2**), pushes simultaneously with the tip of the snout the plate which switches the conveyer on and opens the water vent. Feed and water are mixed in the conveyor tube in the specified composition. The feed passes through the nipple directly into the mouth of the pig, therefore, no trough is needed.

Additional equipment in the form of a micro-doser is available. This is a storage container for liquid, a micro-pump with a switch and a thin tube which ends at the bottom of the nipple. This technology helps to supply individual animals with appropriate additives.

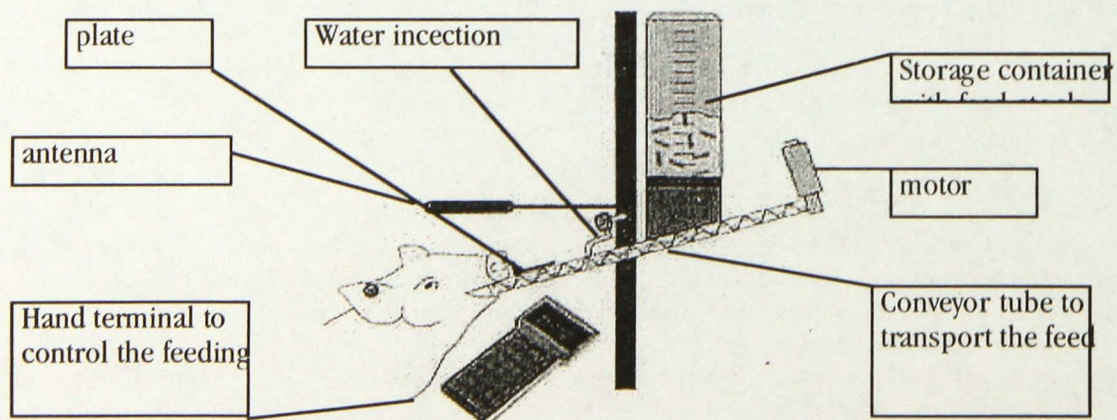
This feeding technology can be used both in small and large groups. An animal-feeding station ratio of 15:1 should not be exceeded. In contrast to call feeding, the high time investment for training the animals to learn the system is not necessary. The financial investment is similar to that of call feeding.

Ad libitum feeding

In the European Union, goals have been set for the proper care of pregnant sows in group husbandry systems. The sows are to be provided with material to chew on and to fill their stomachs by offering them high crude fiber feed. This drove the development of ad libitum feeding. This topic has been addressed especially in Germany for many years.

Particularly important in this process is the ability of the feed to absorb water, because this is giving the sows the feeling of fullness. Therefore, dry feed is preferred for the ad libitum feeding. A ratio of 4 animals per 1 feeding station is the rule in Germany, so that the animals eat during the day and sleep at night. An area of about two square meters per animal is required. In order to save costs in

Figure 2: The "cereal nipple" (originally from the Mannebeck Co.)



such a system it is combined mostly with deep litter flooring. One sow space in a herd of 320 animals costs about 3900 DM (GARTUNG et al, 1999). The investment saving in comparison to call feeding is thus about 100 DM per space.

But the pigs eat about one kilogram of feed every day more than normal, meaning a feed cost increase of between 50–100 DM per year. Also studies showed that due to the lesser feed intake of a sow during the suckling period, and very different states of health, in comparison to other forms of group husbandry, smaller litters are to be expected after the third or fourth litter.

Evaluation of the process from the perspective of the animal and the environment

Individual keeping, as described above, with the opportunity of movement permits a relatively appropriate system of husbandry for sick or problematic sows. From the perspective of the animal, well-managed husbandry systems with a large group are preferred. It is especially good when a group remains constant during the entire reproductive phase. The latter is most economically successful, when the animals have individual feeding possibilities via, for example, a call station or a cereal nipple.

From an environmental perspective, with regard to animal keeping, manure storage and distribution, as well as the effect on groundwater, slurry practices are better than solid manure practices. With regard to minimizing hazardous gas emissions, smaller pen surfaces are preferable. This can be achieved by limiting the areas of movement for the pigs. As long as the solid floor movement areas are clean, a system such as bio fix or trough feeding are appropriate. Practical problems emerge in terms of the cleanliness of solid floor areas, and for this reason they must be kept as small as possible, or have some small inlets to permit the removal of surplus liquids.

The important influence on the success of pig keeping, however, is, apart from technologies processes, the farmer and his or her ability to work with the resources at hand. Theoretically, any technology, even those that were deemed to be appropriate, can be detrimental to the animals when improperly used.

Evaluation of the described systems from the perspective of the farmer and costs

From the human perspective litter processes such as the cafeteria or ad libitum feeding practices can be seen rather negatively from the perspective of labor intensity. In the cafeteria system, an additional disadvantage is the need to drive the sows back from the feeder. Computer-con-

trolled animal-individual feeding such as call stations or the cereal nipple place high demands on the management.

From an economic perspective, cost-saving practices such as the cafeteria system or ad libitum feeding are attractive. If one calculates the costs of straw, of labor time, and the performance of the animal, these practices lose their advantage over other practices. If both labor time and animal performance are to be improved, then practices such as call feeding or the cereal nipple are better.

Summary

Legal regulations have a strong influence on the husbandry of sows. The minimal requirements for Europe have been established in the Regulations for Pig Husbandry, which permits each country to enact stricter laws governing the keeping of pigs. This means that different European countries have different minimal requirements. In terms of sow keeping, there is consensus on making the group keeping of sows mandatory.

In Germany, manufacturers can have their buildings and equipment tested by a federal testing agency. The German Agricultural Society (DLG) has conducted such tests since 1953. The society is financially supported by the German Ministry of Agriculture. The testing of agricultural machinery, including husbandry equipment, allows the dissemination of the test results to consultants, extension resources, and farmers. Almost 80% of the systems tested could be improved by the test results. This is not only beneficial for the animal, but also for the manufacturer and the farmer.

Different combinations of housing and feeding practices for sows are used in Germany. The desired (soon mandatory) exercise possibilities for sows can be best realized in group keeping systems. Slatted floors combined with solid floor or deep litter in the resting areas are preferable. The best feeding techniques are call feeding systems—such as cereal nipples—which permit individual feeding.

From the perspective of the animal, the environment, the farmer, and the economy, each system has advantages and disadvantages. No system is perfect in every sense. The most important observation is that every system is only as good as the farmer operating it. It is therefore more important to find the most appropriate system for each type of farmer than arguing about the “best” system.

Literature

- GARTUNG, J.; UMINSKI, K.; HAGEMANN, J.:
Investitionsausgaben für den Neubau von Zuchtschweineeställen;
Landtechnik Heft 4/99
Anonymus; Varkensbesluit; Staatsblad 1998, Nr. 213 und 214
des Ministrie van Landbouw Natuurbeheer en Visserij

Anonymus; Lov om indendørs hold af draegtige soer og gylte;
Justitsministeri, j. nr. 1997-543-0270

OESTER, H.; TROXLER, J.: Die "Praktische Prüfung auf
Tiergerechtheit im Rahmen des Genehmigungsverfahrens in der
Schweiz; KTBL-Schrift "Beurteilung der Tiergerechtheit von
Haltungssystemen"; Seite 71 bis 80

BERTRAM, H.-H.; HERRMANN, H.: Konzept der freiwilligen
DLG-Prüfung in Deutschland; KTBL-Schrift "Beurteilung der
Tiergerechtheit von Haltungssystemen"; Seite 71 bis 80

HESSE et al: Voluntary testing procedure of farm animal
housing equipment according to the Animal Welfare Act as of
1998; Deutsche Tierärztliche Wochenschrift Heft 4 von 1999,
106. Jahrgang; Seite 138 bis 140

ISERMEYER, F.; HAXSEN, G.; HINRICHS, P.:
Betriebswirtschaftliche Aspekte der Schweinehaltung; Aktuelle
Aspekte bei der Erzeugung von Schweinefleisch Sonderheft
193; ISBN 3-933140-16-1; S. 364-380

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