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Impact assessment on the modification of the keeping of sows in service areas

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The OVG of Saxony-Anhalt made a judgement on Sec. 24 para 4 TierSchNutztV on 24.11.2015. Accordingly, sow crates must be designed in such a way that each pig can freely stand up, lie down, stretch its head and, when lying on its side, stretch its limbs. Four different types of building for producing piglets are selected in order to assess the economic costs. Different scenarios are then examined on this basis and the increases in costs or decreases in proceeds determined, taking the stock reductions necessary for modification measures into account.

The increases in costs, on the one hand, and reductions in stock that are necessary if no extensions are carried out, on the other hand, vary, depending on the weekly cycle and the way in which pregnant sows are kept in groups. Stock reductions, which are absolutely necessary if wider sow crates are installed, entail very high costs or decreases in proceeds and should be avoided from an economic point of view. Extensions to compensate for reductions in places are generally less expensive. Farms practising 3-week cycles must reckon with much higher costs in comparison to farms with 1-week cycles. Given a 3-week cycle, the length of time in which the service area is not used increases if the time the sows are kept in the sow crates is reduced. Farms on which sows are kept in large groups in the waiting area can calculate with lower increases in costs than farms on which pregnant sows are kept in small groups. The most cost-effective option for the conversion of the service area is to keep the animals in groups, confined in hinged crates. However, in this scenario too, fertility can be adversely affected and the demands on the management are comparatively high.

Keywords

Magdeburg judgement, service area, sow crate, animal welfare, reduction of the length of time spent

According to the judgement by the Higher Administrative Court (OVG) of Saxony-Anhalt of 24.11.2015 and the ruling of the Federal Administrative Court (BverwG) of 08.11.2016, sows in service areas may no longer be kept in sow crates with a width of 70 or 65 cm because they cannot lie stretched out in them. Thus, among others, sow crates with a width that at least corresponds to the height of the pigs housed in them (i.e. the withers height, measured as the distance between the floor and the highest point of the standing pig) fulfil the requirements of the provision. It is also permissible to either leave the neighbouring sow crates unoccupied or to set them up with sufficient space between them so that the animal can stretch its limbs without any hindrance. Enabling the animals to stretch their limbs into occupied neighbouring sow crates is not sufficient.

An appeal was lodged against the judgement of the OVG of Saxony-Anhalt regarding the denial of leave to appeal. With its ruling of 08.11.2016, the BverwG rejected the appeal (BverwG 2016). With that, the judgement by the OVG of Saxony-Anhalt is legally binding and, due to its factual binding ef-

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fect, applies nationwide. Thus, sows in service areas may no longer be kept in sow crates with a width of 70 or 65 cm (AG Tierschutz LAV 2017) because they cannot lie down full-length in them.

Problem

According to the ruling of the BverwG, action is warranted on the part of sow farmers and veterinary offices with regard to the keeping of sows in service areas. A uniform solution is being sought throughout the country. A discussion is ongoing regarding the amendment of the TierSchNutztV (2006) with the option of reducing the length of time that sows are kept in sow crates as well as increasing the width of these crates. Two aspects are each considered individually for an impact assessment on the modification of the keeping of sows in service areas.

1. Requirements concerning the size/width of the sow crates in accordance with Sec. 24 TierSchNutztV against the backdrop of the judgement by the OVG of Saxony-Anhalt allow the following options for the sow farmers concerned:

- Stock reduction: leaving every second sow crate unoccupied
- Alteration: trapezoid-shaped sow crates (wider at the base, narrow at the top) or spaces between sow crates

2. Taking into account a theoretical amendment to Sec. 30 (reduction of the length of time sows are kept in sow crates) and Sec. 24 TierSchNutztV (reduction of the width of the sow crate), the following scenarios are possible:

- Reduction of the length of time that sows are kept in sow crates in the service area from currently admissible 28 days to max. 4 days (during the heat) with
  - sow crates with a width of 90 cm (Sec. 24 TierSchNutztV)
  - sow crates with a width of 70 cm (amendment of Sec. 24 TierSchNutztV)
- Reduction of the length of time that sows are kept in sow crates in the service area from currently admissible 28 days to max. 10 days after weaning (Dutch model) with
  - sow crates with a width of 90 cm (Sec. 24 TierSchNutztV)
  - sow crates with a width of 70 cm (amendment of Sec. 24 TierSchNutztV)
- Introduction of keeping in groups in the service area: close confinement of sows in service areas only for feeding and/or insemination permissible (Danish model).

The mentioned scenarios are considered below for modification in existing buildings. The legal requirements and recommendations that have formed the basis so far are assumed for the dimensions of the service area and the keeping facilities. The number of animal places applies to a specific production method and a specific production cycle (lactation period, weekly cycle and group size). As a rule, modifications involve a need for investment for keeping technology and installation; in the case of existing buildings, they may mean a stock reduction and resulting economic losses or, in the case of structural extensions, a building permit may be required. A comprehensive impact assessment is necessary in order to reveal the effects of the individual options under discussion in connection with an amendment of the TierSchNutztV with regard to specifications for keeping in service areas.

Bases for Calculation

For the impact assessment, four different types of buildings for the production of piglets were selected from the KTBL online application “Baukost” (KTBL 2017) in order to calculate the various scenarios as models: All four building types are closed, thermally insulated buildings with forced ventilation

and partially perforated floors. In the farrowing area, there are individual farrowing pens with farrowing crates. The service area comprises several compartments fitted with conventional sow crates (70 cm x 240 cm). In addition, boar buildings, which also remain in place in the case of alterations, are placed in the direct vicinity of the service compartments. Table 1 shows some important details for the four types of building:

Table 1: Characteristics of the four different types of building

	Building 1 ZS 14003[1)]	**Building 2 ZS 14004**	**Building 3 ZS 15001**	**Building 4 ZS 15002**
Stock size (productive sows)	1176	1176	252	252
Production cycle	1-week	1-week	3-week	3-week
Number of groups in the service area	5	5	2	2
Number of groups in the waiting area (incl. reserve places)	12	12	4	4
Number of groups in the farrowing area	5	5	2	2
Number of sows/group	56	56	36	36
Number of animal places in the service area	280	280	72	72
Number of animal places in the waiting area	696	708	160	195
Keeping method in the waiting area	Small group with self-locking feeding crates	Large group with on-demand feeding	Small group with self-locking feeding crates	Large group with on-demand feeding
Annual costs for buildings in €/(productive sow p.a.)	204	180	254	239

[1)] Number of building type in Baukost (KTBL 2017).

The following assumptions are made: The piglets are produced conventionally. The average weaning weight is 7.8 kg with a lactation period of 28 days. On average, 13 piglets are born alive per farrowing. Given a piglet loss of 13.9%, 11.2 piglets per farrowing are weaned. This results in 26.4 weaned piglets per sow and year, with 2.35 farrowings per sow.

The following assumptions were taken into consideration for the cost assessment (Table 2):

Table 2: Assumptions for cost assessment

Building components	Costs in € per building component (including installation)	Source
Conventional sow crate (70 cm clear dimension)	158.00	Himel Maschinen GmbH[2)]
Trapezoid-shaped sow crate	224.42	Himel Maschinen GmbH
Hinged sow crate	343.50	Dorsch (2005)
Installation of additional partition	45.80	Own calculation
Self-locking feeding and lying crate	379.19	BFL (2012)
Transponder stations per sow (for 50 sows)	296.19	BFL (2012)
Expansion/alterations per sow crate	26.25	Own calculation (1.5 man-hours/sow crate, 17,50 €/ man-hour)
Material value per sow crate	1.38	Own calculation (Scrap: 60 €/t; weight per sow crate: 23 kg (Firm: Himel))
Extension service area per sow place	2,500	KTBL (2016)
Extension waiting stall per sow place	2,000	KTBL (2016)

[1)] All amounts without VAT.
[2)] Detlef Schubert, Himel Maschinen GmbH, personal communication.

The cost assessment for the respective modification measures must take the pure investment costs (e. g. new building equipment) and/or a possibly necessary stock reduction into consideration. A reduction of stock means economic losses for the farm amounting to the loss of proceeds minus direct costs. These losses are calculated from proceeds minus all direct costs. The proceeds minus direct costs including piglet rearing amount to 467.02 € per sow and year.

One possible way of avoiding the loss of proceeds minus direct costs is to compensate the reduced sow places by building new ones. This scenario involves investment costs for the alteration within the existing building shell and for the extension to replace the reduced places. Depending on the scenario, new places must be built in the service area or the in waiting unit.

The underlying annual costs for a alterations (depreciation, costs of interest, and costs of repairs) are calculated at 12 % of the investment requirement; the percentage for an extension is calculated at 9 % of the investment requirement due to the longer useful life.

Results

For the individual scenarios, the additional costs for alterations are listed in the calculation tables, on the one hand, per remaining productive sow and year and per produced weaner as well as the number of sows included in the scope of stock reduction in dependence on the farm's weekly cycle and the type of keeping in the waiting unit. On the other hand, the additional costs are stated for the scenario without a reduction of the existing stock: Here investment costs arise for the alterations within the building and for the extension to replace the reduced places. These additional costs are also stated per productive sow and year and per produced weaner.

A possible way of avoiding the loss of proceeds minus direct costs due to a reduction of sow stock is to compensate the reduced sow spaces in the service area by building new ones. This requires an alteration permit as it is a change in use of the existing facility in the legal sense. In the case of farms not providing a forage area which were approved prior to the amendment of the German Federal Building Code (25.04.2013) this could mean that a new permit is not granted (Feller 2017).

1. Modifications in the service area

Increase of the floor space at the sides by leaving every second sow crate unoccupied

Description and constructional implementation:
The provision according to Sec. 24 para 4 TierSchNutztV is also fulfilled if the sow is able to stretch its limbs into the two unoccupied neighbouring sow crates without hindrance. This means that the simplest measure excluding alteration is to leave every second sow crate unoccupied.

Economic consequences:
This reduces the number of sows – both per group and as a result in the entire stock – by a half. As a result, only one half of the proceeds minus direct costs can be achieved. Applied to the remaining productive sows, additional costs amount to 467.02 € per productive sow and roughly 18 € per reared piglet (Table 3).

Table 3: Additional costs for the scenarios without extension (with stock reduction) and with extension (without stock reduction), if every second sow crate in the existing building remains unoccupied

Parameter	Scenario		Scope of stock reduction	Additional costs Piglet production and rearing	
			in %	in €/(sow p.a.)	in €/weaner
1-week cycle, small group of pregnant sows	Without extension	Investment costs		-	-
		Stock reduction	50	467.02	17.67
		Total additional costs		467.02	17.67
	Extension	Investment costs		26.97	1.01
1-week cycle, large group of pregnant sows	Without extension	Investment costs		-	-
		Stock reduction	50	467.02	17.67
		Total additional costs		467.02	17.67
	Extension	Investment costs		26.97	1.01
3-week cycle, small group of pregnant sows	Without extension	Investment costs		-	-
		Stock reduction	50	467.02	17.67
		Total additional costs		467.02	17.67
		Investment costs		32.14	1.22
3-week cycle, large group of pregnant sows	Without extension	Investment costs		-	-
		Stock reduction	50	467.02	17.67
		Total additional costs		467.02	17.67
	Extension	Investment costs		32.14	1.22

If investment costs amounting to 2,500 € (KTBL 2016) are estimated for a service place, additional annual building costs for an extension of 50% of the animal places in a service area amount to almost 27 € per productive sow for farms with a 1-week cycle and roughly 32 € per animal place for farms with a 3-week cycle (Table 3). These additional costs do not refer to the service places, but are allocated to the entire sow stock. They must be added to the annual building costs per productive sow and year (Table 1). The monetary difference between the two production cycles is explainable through the fact that the share of service places in the entire animal places (farrowing building, waiting unit, service area) is smaller on farms with a 1-week cycle than that on farms with a 3-week cycle. The investment costs per productive sow are correspondingly lower for an extension on a farm with a 1-week cycle. The costs for an extension are lower than the economic costs of a stock reduction which amount to 467 € per sow for piglet production and rearing. The proceeds minus direct costs would not differ in comparison to the initial situation because the stock size would remain unchanged. The costs for carrying out the work should only change slightly because here the existing number is decisive.

Enlargement of the floor space at the sides from 70 cm to 90 cm by providing trapezoid-shaped sow crates or spaces between the sow crates

Description and constructional implementation:

The requirements according to Sec. 24 para 4 TierSchNutztV are also fulfilled if a sow is kept in a sow crate with a width at least equivalent to the withers height of the pig kept in it. Here there is a risk that the sows can turn around more easily. In the first few days after weaning and during the heat, sows are particularly restless, so that the risk of injury, e. g. through turning around is particularly high during this period (Ziron 2016). Especially gilts could turn in a „forward roll“. Possible consequences would be injuries to the animals and excrements falling into the trough (Meyer 2017). From an animal welfare perspective, the considerable risk of injuries caused through turning must be prevented by all means. Hence, a sow crate design which meets the requirements of Sec. 24 para 4 regarding animal welfare and conformity with legal provisions in the first few days after weaning of the piglets and during the heat is only possible in sow crates that „limit” the side spice around the sow’s torso when it stands so that it cannot turn around (LAVES 2017). Trapezoid-shaped sow crates and the installation of a second partition between two customary sow crates fulfil these provisions (Figure 1). So far, no studies on this are known.

Figure 1: Trapezoid-shaped sow crate and sow crate with a second partition (© S. Meyer-Hamme)

Where sow crates are installed for which the floor space is increased from 70 to 90 cm, only 75% of the places that customary construction would allow can be accommodated. In the example of building 1 and 2 (Figure 2), the number of places in the service area is reduced from 280 to 210.

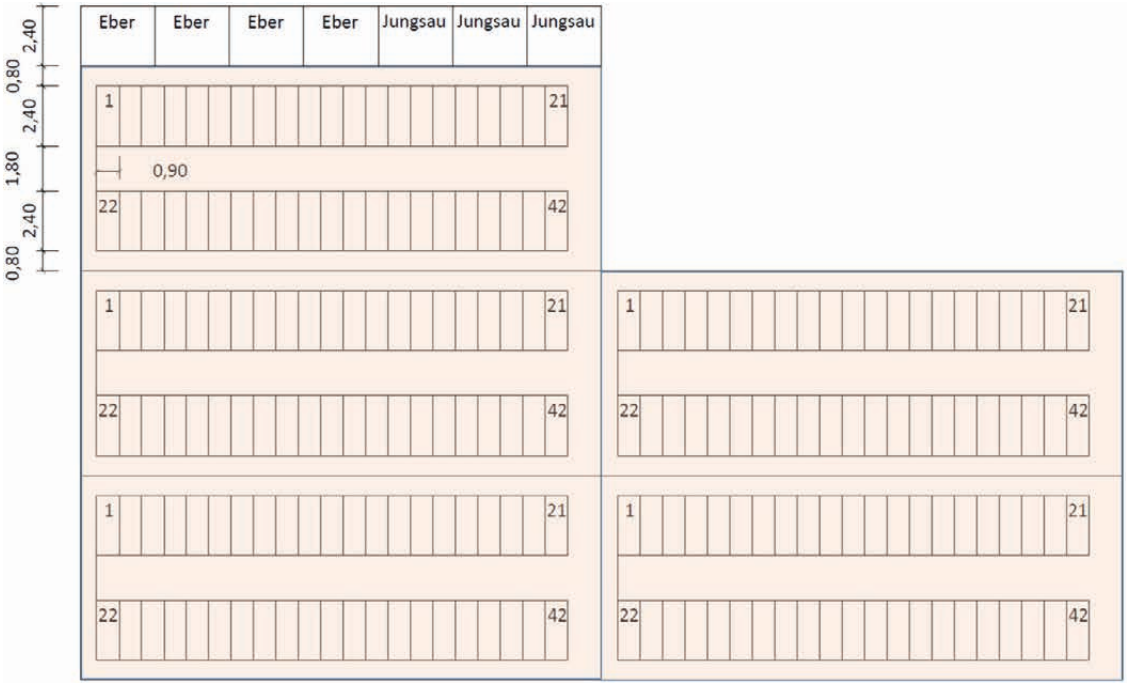

Figure 2: Floor plan of the service area (building 1 and building 2) with sow crates 90 cm apart and 210 instead of the original 280 animal places in 5 compartments with 42 places each (25% stock reduction)

Economic consequences:
Here the farm loses proceeds minus direct costs and costs are incurred through new investments. The old sow crates with a width of 70 cm have to be removed and replaced with new trapezoid-shaped sow crates or sow crates with a second partition. It is assumed that the old sow crates can be sold at material value and thus cover a part of the costs of the expansion. Sow crates that, on the one hand, provide more leg space for the sow and, on the other hand, are equipped to prevent it from turning around (Himel Maschinen GmbH) are roughly 42% more expensive than customary sow crates. The additional costs for alterations amount to roughly 160 € per productive sow and 6 € per reared piglet, depending on the type of building, weekly cycle and sow crates.

If the farm receives a permit for an extension, it must take into consideration both the investment costs for the modification within the existing building shell (expansion of the old sow crates, installation of the new sow crates) and the investment costs for an extension to replace the reduced places (25% of the service places, i. e. 2,500 € per service place). The additional annual costs for a modification and extension amount to about 20 € per productive sow and 0.80 € per reared piglet (Table 4), depending on the type of sow crate installed, building and weekly cycle. With that, the additional costs for a modification and stock reduction are considerably higher than the additional costs for a modification and an extension that replaces the places reduced (without stock reduction).

Table 4: Additional costs for the scenarios without extension (with stock reduction) and with extension (without stock reduction) if the floor space at the sides of the sow crate is increased to 90 cm (2nd partition, trapezoid shape)

Parameter		Scenario	Scope of stock reduction	Additional costs			
				Piglet production and rearing			
				Second partition		Trapezoid shape	
			in %	in €/(sow p.a.)	in €/weaner	in €/(sow p.a.)	in €/weaner
1-week cycle, small group of pregnant sows	Without extension	Investment costs		2.31	0.28	7.36	0.28
		Stock reduction	25	155.67	5.90	155.67	5.90
		Total additional costs		157.98	5.98	163.03	6.18
	Extension	Investment costs		15.12	0.57	18.91	0.72
1-week cycle, large group of pregnant sows	Without extension	Investment costs		2.31	0.28	7.36	0.28
		Stock reduction	25	155.67	5.90	155.67	5.90
		Total additional costs		157.98	5.98	163.03	6.18
	Extension	Investment costs		15.12	0.57	18.91	0.72
3-week cycle, small group of pregnant sows	Without extension	Investment costs		2.77	0.10	8.83	0.33
		Stock reduction	25	155.67	5.90	155.67	5.90
		Total additional costs		158.44	6.00	164.50	6.23
	Extension	Investment costs		18.15	0.69	22.69	0.86
3-week cycle, large group of pregnant sows	Without extension	Investment costs		2.77	0.10	8.83	0.33
		Stock reduction	25	155.67	5.90	155.67	5.90
		Total additional costs		158.44	6.00	164.50	6.23
	Extension	Investment costs		18.15	0.69	22.69	0.86

2. Change in the length of time the sows are kept in the service area

Reduction of the length of time that sows are kept in sow crates in service areas from currently 28 days to max. 4 days

a) Reduction of the length of time sows are kept in sow crates and maintenance of 70 cm width for sow crates

Description and constructional implementation:

In this scenario, the sows are closely confined in a sow crate for a maximum of 4 days during the heat up to service. The sow crates still have a width of 70 cm, which has been customary in practice up to now and is largely orientated to the implementation instructions (Annex 2 to "Handbuch Tierschutzüberwachung in Nutztierhaltungen", AG Tierschutz LAV 2017). Alteration to achieve a space of 90 cm between the sow crates is not intended. This scenario can only be implemented if Sec. 24 TierSchNutztV is amended.

As the length of time in the service area is reduced from originally 28 days to 4 days, only the group to be serviced needs to be kept in the service area, both in a 1-week and a 3-week cycle (Figure 3, orange area A).

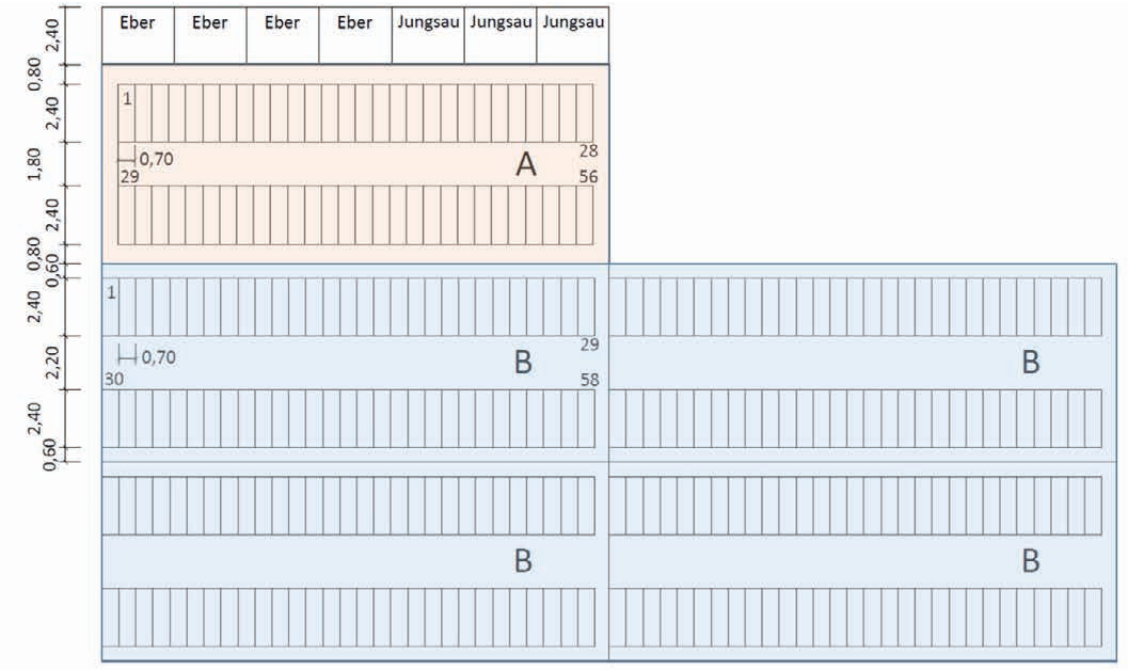

Figure 3: Floor plan of the service area (building 1 and building 2) with sow crates with a width of 70 cm and a stay of 4 days for small group keeping; 56 animal places in the service area (orange); 232 place (4 x 58) in the waiting building with group keeping (blue); scope of stock reduction 3.57 %

Thus, space must be reserved in the waiting area for a total of 17 sow groups(1-week cycle) or 6 sow groups (3-week cycle) including a reserve group as the sow group to be serviced from the service area is also kept in the waiting area for the remaining days. This required space for the sows can be created, for example, by converting parts of the existing service area to a waiting area with group keeping (Figure 3, blue area B). To achieve this, the existing old sow crates with permanent close confinement must

be removed and replaced with self-locking feeding and lying crates that can be independently entered and left by the animals at any time. On farms on which large groups are kept in the waiting area, parts of the service area are equipped with on-demand feeding stations.

Economic consequences:
In the underlying building types, with the exception of farms with a 3-week cycle and keeping in large groups, the required space cannot be fully provided, which means that the group size must be reduced. A reduction of the existing stock is the consequence. In contrast to farms with a 1-week cycle, the service area on farms with a 3-week cycle is unoccupied most of the time (2.5 weeks) and cannot be utilised as it is only completely occupied for a short period (4 days). Only the part of the service area that is not needed for accommodating the sow group to be serviced can be converted into group keeping space with self-locking feeding and lying crates for the waiting sows. Correspondingly, stock reduction on a farm working with a 3-week cycle and small groups is 11 % and thus larger than the 3.6 % on a farm with a 1-week cycle. Farms with a 3-week cycle that use keeping in large groups and on-demand feeding in the new waiting area (originally the service area) can accommodate more sows on the same area than farms with keeping in small groups and self-locking feeding and lying crates. These farms do not have to reduce sow stock if the length of time spent in the sow crate (width 70 cm) is reduced to 4 days.

Depending on the type of building, weekly cycle and keeping of the sows in the new waiting area, additional costs incurred through lost proceeds minus direct costs and investment costs for sow keeping with piglet rearing lie between almost 7 and 67 € per productive sow and year and between 0.26 and 2.51 € per reared piglet (Table 5).

Provided that the farm obtains a building permit for the extension, it must, on the one hand, take into consideration the investment costs for the alterations in the existing building shell (modification of the service area for one group of sows, modification of the remaining service area to allow group keeping) and, on the other hand, include the investment costs for an extension to replace the missing places for group keeping of 2,000 € per waiting place (KTBL 2016). The additional annual costs for a modification and extension amount to between 10 and 22 € per productive sow and between 0.39 and 0.80 € per reared piglet (Table 5), depending on the type of building and the weekly cycle.

Table 5: Additional costs for the scenarios without extension (with stock reduction) and with extension (without stock reduction) if the amount of time spent in the service area is reduced to 4 days (sow crates with a width of 70 cm)

Parameter	Scenario		Scope of stock reduction	Additional costs Piglet production and rearing	
			in %	in €/(sow p.a.)	in €/weaner
1-week cycle, small group of pregnant sows	Without extension	Investment costs		9.90	0.37
		Stock reduction	3.57	17.30	0.66
		Total additional costs		27.20	1.03
	Extension	Investment costs		12.09	0.46
1-wee cycle, large group of pregnant sows	Without extension	Investment costs		7.61	0.29
		Stock reduction	3.57	17.30	0.66
		Total additional costs		24.91	0.94
	Extension	Investment costs		10.40	0.39
3-week cycle, small group of pregnant sows	Without extension	Investment costs		7.79	0.30
		Stock reduction	11.11	58.38	2.21
		Total additional costs		66.17	2.51
	Extension	Investment costs		21.21	0.80
3-week cycle, large group of pregnant sows	Without extension	Investment costs		6.93	0.26
		Stock reduction	0	0	0
		Total additional costs		6.93	0.26
	Extension	Investment costs		-	-

Construction requirements:
The prerequisite for a modification to group keeping is that a passageway width of at least 2 m between the rows is available and that the space requirement of 2.25 m² per sow is observed (Sec. 30 (2) TierSchNutztV). This conversion is therefore only possible if the rows of sow crates are moved in such a way that at least 2 m space is created and at the same time the space requirement of 2.25 m² per sow is observed. For the assumed building types, this means that the distance of 80 cm to the wall must be reduced to 60 cm. As the sow crates in the described buildings have a length of 2.4 m, the total space requirement is observed (Figure 3). Where sow crates are shorter, the moving area between the rows must be correspondingly wider. It is difficult to assess whether such modification measures can be realised on the farms. Presumably, individual solutions will have to be found for various farms, and the necessary structural prerequisites do not always exist.

Risks to animal health and animal performance:
A shorter length of time spent in the service area can pose risks with regard to animal health and animal performance. The background is that the literature often states that the length of time the sows spend in the sow crate affects their fertility performance. According to analyses by Scholz et. al. (2016), a shorter length of time spent in the sow crate does not, however, have an effect on return-to-oestrus rate. Besides the length of time spent in the sow crate, the start of group keeping after service is also under discussion as a factor influencing fertility performance. Various studies show the following correlation: sows that were put into group keeping between the 7th and 14th day of gestation achieved

the smallest number of born piglets per 100 inseminated sows (Cassar et al. 2008). Other studies reach comparable results. Sows grouped between day 3 and 7 or day 13 and 17 after insemination had a lower farrowing rate than those grouped on day 35 (Knox et al. 2014). Hence, from the aspect of embryonic mortality and therefore also fertility performance, the most critical period for group formation is the period between the 3rd and 17th days of gestation. The time directly after the piglets have been weaned and hence before service is recommended for group formation (Hoy 2010, FLI 2015).

The calculation does not take into consideration the extent to which possible higher return-to-oestrus rates can affect the economic result or additional costs. The fact that in these scenarios oestrus control can no longer take place in the service area but must be carried out in group keeping in the waiting area, increasing the workload, must also be taken into account.

If possible, the formation of groups of sows should take place in a spacious and structured, neutral area, e.g. in an arena (Neumaier and Wiedmann 2007, Laves 2016), on slip-resistant floors and without dead ends. An area of 4 to 6 m² per sow in the arena has proved to be favourable (Neumaier and Wiedmann 2007, Görtz et al. 2017). However, up to now, the arena concept has only been implemented on a few sow farms. Probably, arenas would still need to be built in most cases. Legal requirements for permits and economic consequences are not taken into consideration in this calculation but can be substantial.

b) Reduction of the length of time spent in the sow crates and increase in floor space at the sides of the sow crates to 90 cm

Description and constructional implementation:
According to Sec. 24 para 4 TierSchNutztV, sows must only be kept – also when closely confined for a maximum of 4 days – in sow crates that allow the animal to stretch its limbs without hindrance and ensure that it can stand up and lie down unhindered.

For the calculation, a sow crate with a second partition is assumed. The space requirement for a sow crate is increased from 70 to 90 cm. In addition, the length of time spent in the service area is shortened from originally 28 days to 4 days. For both 1-week and 3-week cycles, only the group to be serviced needs to be kept in the service area. Thus, space must be reserved in the waiting building for a total of 17 sow groups (1-week cycle) or 6 sow groups (3-week cycle) including reserve places for one group. This considerable space requirement for the sows can be created, for example, by converting parts of the existing service area to a waiting area with group keeping (Figure 4, blue area).

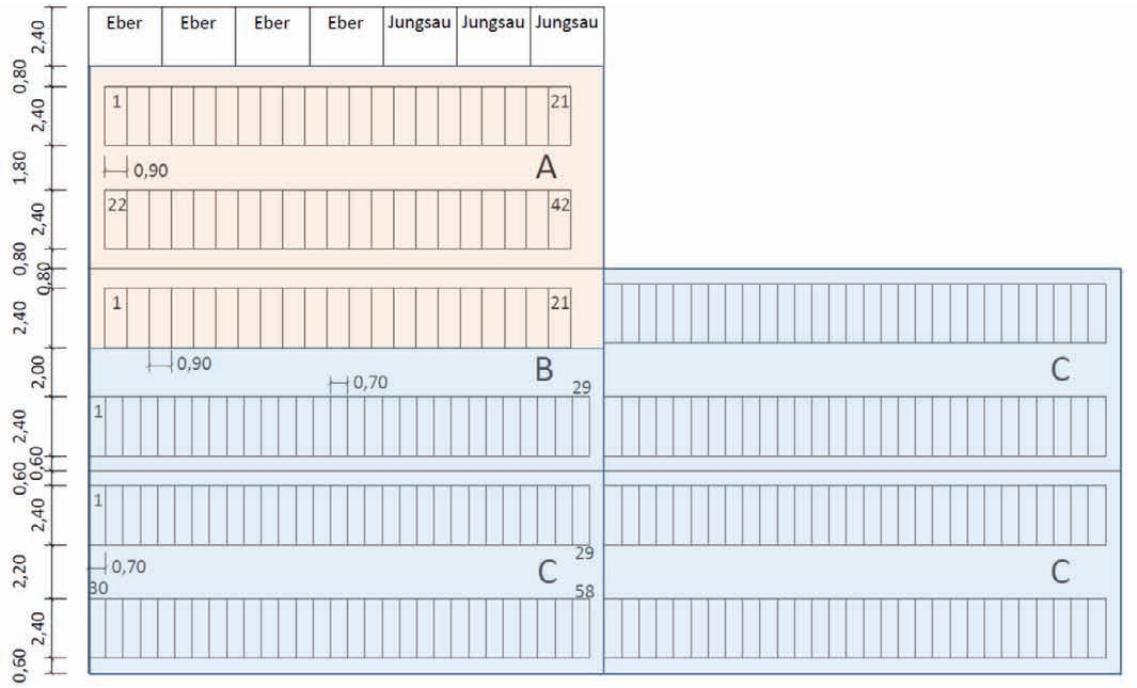

Figure 4: Floor plan of the service area (building 1 and building 2) with sow crates with a width of 90 cm and a length of time of 4 days for small group keeping; 63 animal places in the service area (orange); 203 places in the waiting building with group keeping (blue); scope of stock reduction 7 %

Economic consequences:

In this scenario too, the required space cannot be fully provided, which means that the group size must be reduced. As a result, the existing stock must also be reduced. Due to the fact that the service area is unoccupied for a long time (2.5 weeks) on farms with a 3-week cycle, the stock reduction here is 19% and thus larger than the 7% on farms with a 1-week cycle (Figure 4). For farms with a 3-week cycle which make use of keeping in large groups with on-demand feeding in the new waiting area (originally the service area) the stock reduction is only 2.78%.

Depending on the type of building, weekly cycle and keeping of the sows in the new waiting area, additional costs incurred through lost proceeds minus direct costs and investment costs for sow keeping lie between 44 and 120 € per productive sow and year and between 0.69 and 4.52 € per reared piglet. In this scenario, the additional annual costs for a modification and extension without stock reduction amount to between 7 and 31 € per productive sow and between 0.23 and 1,18 € per piglet, depending on the type of building and weekly cycle. Generally, an extension is more favourable than a modification (Table 6).

Table 6: Additional costs for the scenarios without extension (with stock reduction) and with extension (without stock reduction) if the length of time spent in the service area is reduced to 4 days (sow crates with 90 cm space between the crates)

Parameter	Szenario		Scope of stock teduction	Additional costs Piglet production and rearing	
			%	in €/(sow p.a.)	in €/weaner
1-week cycle, small group of pregnant sows	Without extension	Investment costs		9.55	0.36
		Stock reduction	7.14	35.92	1.36
		Total additional costs		45.48	1.72
	Extension	Investment costs		16.98	0.64
1-week cycle, large group of pregnant sows	Without extension	Investment costs		7.77	0.29
		Stock reduction	7.14	35.92	1.36
		Total additional costs		43.70	1.66
	Extension	Investment costs		14.41	0.55
3-week cycle, small group of pregnant sows	Without extension	Investment costs		6.64	0.25
		Stock reduction	19.44	112.73	4.27
		Total additional costs		119.37	4.52
	Extension	Investment costs		31.06	1.18
3-week cycle, large group of pregnant sows	Without extension	Investment costs		5.50	0.21
		Stock reduction	2.78	13.34	0.51
		Total additional costs		18.32	0.69
		Investment costs		6.06	0.23

Risks to animal health and animal performance:
The likely risks in connection with a shorter length of time spent in the sow crate are described in detail in the previous chapter. A broader sow crate with a shape that prevents the sow from turning around does not pose an additional risk.

Construction requirements:
The prerequisite for a conversion to group keeping is that a passageway width of at least 2 m between the rows is available and that the space requirement of 2.25 m² per sow is observed (Sec. 30 (2) TierSchNutztV).

Reduction of the length of time that sows are kept in sow crates in the service area from currently 28 days to max. 10 days

a) Reduction of the length of time spent in sow crates to 10 days and maintenance of 70 cm width for sow crates

Description and constructional implementation:
The Dutch model is also under discussion in addition to a reduction of the length of time that sows are kept in sow crates to 4 days during the heat. Here the sows are closely confined in a sow crate for a maximum of 10 days after weaning. In this scenario, the width of the sow crate is 70 cm clear dimension and is also orientated to the implementation instructions (amendment of Sec. 24 TierSchNutztV provided).

On a farm practising a 1-week cycle, two groups of sows must be simultaneously kept in the service area as a new group of sows is put in the service area every week, but a group is only removed from the service area every 10 days. Thus 16 groups of sows (including a reserve group) must be accommodated in the waiting area. This can be accomplished by converting a part of the old service area for the group keeping of waiting sows.

The reduction of the length of time spent in the service area to a maximum of 10 days on a farm with a 3-week cycle must be implemented in exactly the same way as a reduction of the length of time to 4 days. Here too, it must be possible to keep a complete group of sows in the service area for a certain length of time (10 days). The sow crates in the service area are unoccupied for the remaining 11 days. Only the part of the service area that is not needed for keeping the sow group to be serviced can be converted into group keeping space for the waiting sows (Figure 5).

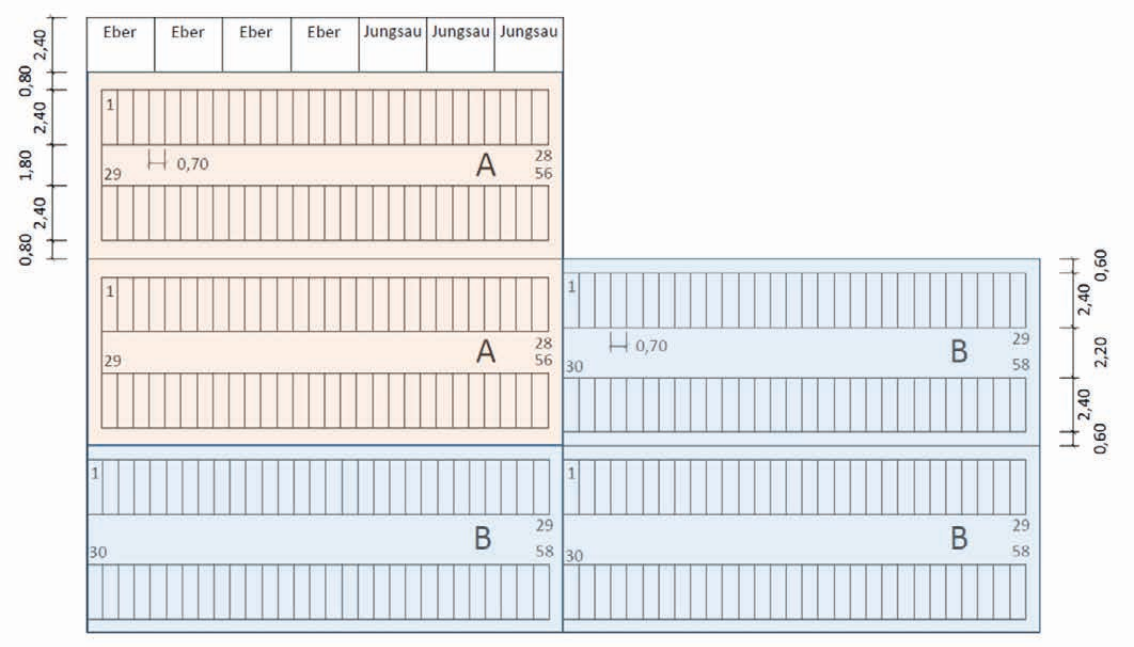

Figure 5: Floor plan of the service area (building 1 and building 2) with sow crates with a width of 70 cm and a length of time of 10 days for small group keeping; 112 animal places in the service area (orange); 174 places in the waiting building with group keeping (blue); scope of stock reduction 3.57 %

Economic consequences:

On a farm practising a 3-week cycle, the additional costs are just as high as they would be for a reduction of the length of time to 4 days (Table 5). Hence, for a length of time of 10 days, a reduction of the group size and a corresponding reduction of existing stock must be expected just as for a reduction of the length of time to 4 days because not sufficient space is available for the necessary conversion in the existing building.

The additional costs for a farm with a 1-week cycle that practices keeping in small groups are slightly higher for a length of time of 10 days than 4 days as space must be reserved in the service area for not only one but two groups of sows. Depending on the type of building, weekly cycle and keeping of the sows in the new waiting area, additional costs can increase to almost 67 € per sow and

to almost 2.50 € per reared piglet (Table 7). The additional annual costs for a modification and extension amount to between 7 and 21 € per productive sow and between 0.39 and 0.80 € per piglet (Table 7), depending on the type of building and the weekly cycle.

Table 7: Additional costs for the scenarios without extension (with stock reduction) and with extension (without stock reduction) if the length of time spent in the service area is reduced to 10 days (sow stalls with a width of 70 cm)

Parameter	Scenario		Scope of stock reduction	Additional costs Piglet production and rearing	
			in %	in €/(sow p.a.)	in €/weaner
1-week cycle, small group of pregnant sows	Without extension	Investment costs		7.47	0.28
		Stock reduction	3.57	17.30	0.66
		Total additional costs		24.77	0.94
	Extension	Investment costs		10.23	0.39
1-week cycle, large group of pregnant sows	Without extension	Investment costs		5.76	0.22
		Stock reduction	3.57	17.30	0.66
		Total additional costs		23.05	0.87
	Extension	Investment costs		8.61	0.33
3-week cycle, small group of pregnant sows	Without extension	Investment costs		7.79	0.30
		Stock reduction	11.11	58.38	2.21
		Total additional costs		66.17	2.51
	Extension	Investment costs		21.21	0.80
3-week cycle, large group of pregnant sows	Without extension	Investment costs		6.93	0.26
		Stock reduction	0	-	-
		Total additional costs		6.93	0.26
	Extension	Investment costs		-	-

Risks to animal health and animal performance:
The likely risks in connection with a shorter length of time spent in the sow crate have already been described in detail.

Construction requirements:
The observance of Sec. 30 TierSchNutztV is the prerequisite for a conversion to group keeping.

b) Reduction of the length of time spent in the sow crates to 10 days and increase in floor space at the sides of the sow crates to 90 cm

Description and constructional implementation:
Just as in the case of a reduction of the length of time the sows are kept in the sow crate to 4 days, according to Sec. 24 para 4 TierSchNutztV it must be ensured that each sow is kept in a sow crate which enables it to stretch its limbs without hindrance and stand up and lie down unhindered, even if closely confined for a maximum period of 10 days. For the calculation, a sow crate with a second partition is assumed. The space requirement per sow crate is increased from 70 to 90 cm (Figure 6).

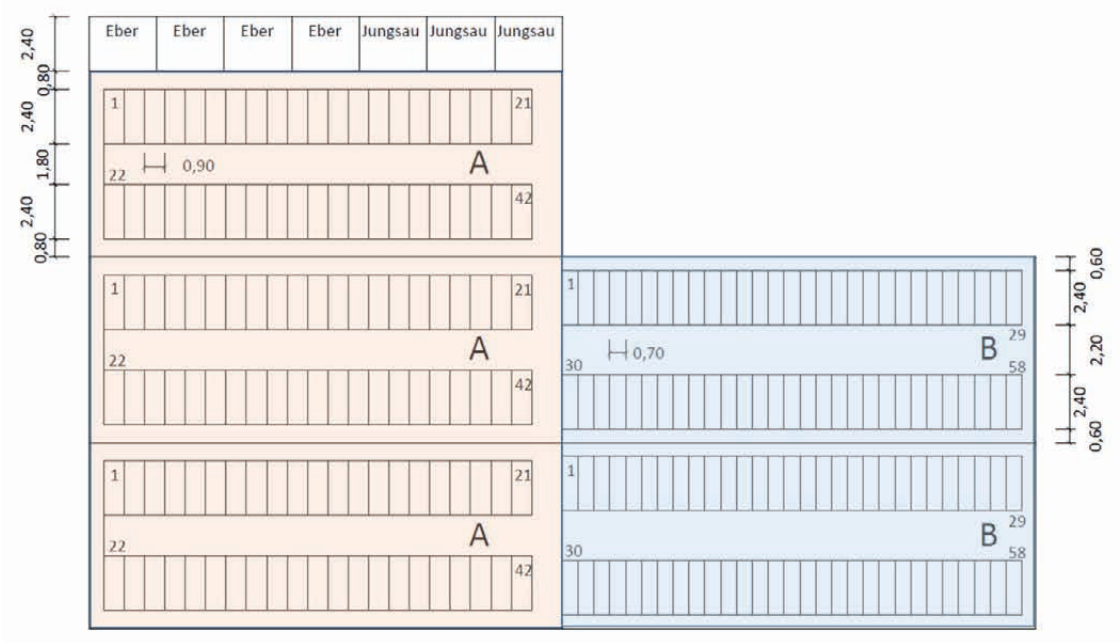

Figure 6: Floor plan of the service area (building 1 and building 2) with sow crates with a width of 90 cm and a length of time of 10 days for small group keeping; 126 animal places in the service area (orange); 116 places in the waiting building with group keeping (blue); scope of stock reduction 10.71 %

In principle, the implementation is comparable to the scenario if a width of the sow crate is maintained at 70 cm clear dimension. However, due to the broad sow crates for keeping the sows in the service area, the space requirement and, as a result, the stock reduction are higher.

Economic consequences:
For a farm practising a 3-week cycle, the additional costs are just as high as they would be for a reduction of the length of time to 4 days (Table 6). For a farm practising a 1-week cycle and small group keeping, the additional costs for a length of time of 10 day are slightly higher than for 4 days.

Depending on the type of building, weekly cycle and keeping of the sows in the new waiting area, the additional costs (lost proceeds minus direct costs plus investment costs) can increase up to almost 119 € per sow and up to almost 5 € per reared piglet (Table 8). The additional annual costs for a modification and extension amount to between 6 and 31 € per productive sow and between 0.23 and 1.18 € per piglet (Table 8), depending on the type of building and the weekly cycle.

Table 8: Additional costs for the scenarios without extension (with stock reduction) and with extension (without stock reduction) if the length of time spent in the service area is reduced to 10 days (sow crates with a width of 90 cm)

Parameter	Scenario		Scope of stock reduction	Additional costs Piglet production and rearing	
			in %	in €/(sow· p.a.)	in €/weaner
1-week cycle, small group of pregnant sows	Without extension	Investment costs		6.54	0.25
		Stock reduction	10.71	56.04	2.12
		Total additional costs		62.59	2.37
	Extension	Investment costs		18.70	0.71
1-week cycle, large group of pregnant sows	Without extension	Investment costs		5.31	0.20
		Stock reduction	10.71	56.04	2.12
		Total additional costs		61.35	2.32
	Extension	Investment costs		16.37	0.62
3-week cycle, small group of pregnant sows	Without extension	Investment costs		6.64	0.25
		Stock reduction	19.44	112.73	4.27
		Total additional costs		119.37	4.52
	Extension	Investitionskosten		31.06	1.18
3-week cycle, large group of pregnant sows	Without extension	Investment costs		5.50	0.21
		Stock reduction	2.78	13.34	0.51
		Total additional costs		18.32	0.69
		Investment costs		6.06	0.23

Risks to animal health and animal performance:
The likely risks in connection with a shorter length of time spent in the sow crate have already been described in detail.

Construction requirements:
The observance of Sec. 30 TierSchNutztV is the prerequisite for a conversion to group keeping.

Introduction of group keeping in the service area: close confinement of sows in the service area only permissible for a few hours for feeding and/or insemination

Description and constructional implementation:
The introduction of pure group keeping in the service area as well (Danish model) is a further scenario. Here too, the mandatory minimum area of 2.25 m² per sow (Sec. 30 (2) TierSchNutztV) and a passageway width of at least 2 m between two rows of sow crates must be observed.

In group keeping, the sows can move freely and are only closely confined for insemination and possibly twice a day for short periods for feeding. In existing buildings, the introduction of group keeping is only possible if hinged crates are installed in the existing service areas. The hinged crates are only lowered for insemination and feeding. During the rest of the time they are raised so that the entire compartment area is available for moving around outside feeding times. During feeding, the animals are protected just as in a self-locking feeding crate and cannot push one other away. As long as the sows are closely confined, they are easy to inseminate, control and handle.

However, the suitability of hinged crates for use in old buildings is limited despite their small space requirement. The system requires a certain layout, at least in parts. If a hydraulic cylinder is to be utilised to full capacity to raise the partition, at least eight crates should be installed next to one another (Dorsch 2005). Given a crate width of 70 cm, the compartment must have a length of almost 5 m. The width should be at least 3.0 m so that there is still space for a narrow inspection corridor. A hinged crate costs approximately 350 € including assembly.

For the types of buildings selected for the impact assessment, the space in the service area is sufficient for keeping the sows in groups and installing hinged crates. Beforehand, the old sow crates must all be removed and replaced with hinged crates. The sow stock can be maintained and no additional costs are incurred through lost proceeds minus direct costs.

Economic consequences:
The investments amount to roughly 11 € per sow and year or roughly 0.45 € per piglet, depending on the type of building and weekly cycle. As the sow stock does not need to be reduced, no investment costs are calculated for a scenario with an extension (Table 9).

Table 9: Additional costs for the scenario of group keeping in the service area with hinged sow crates

Parameter	Scenario		Scope of stock reduction	Additional costs	
				Piglet production and rearing	
			in %	in €/(sow p.a.)	in €/weaner
1-week cycle, small group of pregnant sows	Without extension	Investment costs		10.52	0.40
1-week cycle, large group of pregnant sows	Without extension	Investment costs		10.52	0.40
3-week cycle, small group of pregnant sows	Without extension	Investment costs		12.63	0.48
3-week cycle, large group of pregnant sows	Without extension	Investment costs		12.63	0.48

Risks to animal health, animal performance and management:
The fact that the sows are in different stages of their heat must be taken into consideration with a view to animal health and welfare as well as occupational safety. Sows in the early and late stages of heat are in the same group. This noticeably increases restlessness and stress among the animals as the sows on heat may mount others (Hoy 2010, Weber et al. 2006). Furthermore, it increases the risk of the animal keeper being injured by sows that mount (Görtz el al. 2017). The biological performance can be adversely affected in this arrangement. The return-to-oestrus rate can increase and the number of piglets born alive can decrease (Spoolder et al. 2009). Scholz et al. (2016) have been examining alternatives to the present length of time sows are kept in the sow crate, i. e. 28 days, since April 2015. According to their findings, the return-to-oestrus rate has increased from 6.5 to 11.9 % with close confinement for a short time for service.

Construction requirements:
With regard to modification, it must be noted that according to Sec. 30 (2) TierSchNutztV a minimum space requirement of 2.25 m² per sow (< 40 sows per group) must be taken into account. According to various expert polls (C. Opitz, Niedersächsisches Landesamt für Verbraucherschutz und Lebensmittelsicherheit, Oldenburg; H. Schrade, Bildungs- und Wissenszentrum Boxberg – Schweinhaltung und Schweinezucht; L. Schrader, Friedrich-Loeffler-Institut, Celle; C. Jais, Bayerische Landesanstalt für Landwirtschaft), the service area must fulfil the following prerequisites for group keeping in order to enable keeping in accordance with animal welfare legislation: at least 3.5 m² stall area should be available per sow, and the passageway width should be at least 3 m, i. e. significantly more than required by Sec. 30 (2) TierSchNutztV. A fully slatted floor is not suitable; a solid floor with straw and/or rubber mats would be better to prevent sows from being injured during mounting or rank order fighting. Lying areas should also be planned for sleeping and resting. A conventional three-area building with sow crates or hinged crates which can be closed or lowered for treatment would be possible.

The described requirements are not included in the calculation as they are recommendations and not required by statutory provisions. The type of building examined only provides an area of 2.5 m² per sow and a passageway width of 2.4 m. The additional costs including the afore-mentioned recommendations would be considerably higher than those in the listed calculation as a stock reduction would also be necessary.

In Denmark, pure group keeping in the service area has been mandatory for new buildings since 2015, although after weaning sows can be kept here for up to three days during heat in sow crates with a conventional width. However, no scientific studies on this are available to date.

Conclusions

The additional costs for a modification and the scope of necessary stock reduction depend on the weekly cycle and the way in which pregnant sows are kept in groups. Stock reductions, which are compelling if, among other things, broader sow crates are installed, are connected with very high costs (high loss of proceeds minus direct costs) and should be avoided from an economic point of view.

Particularly farms that practice 3-week cycles must reckon with much higher costs in comparison to farms with 1-week cycles, if the length of time sows are kept in sow crates is reduced because the service area remains unused for a longer period. Farms on which pregnant sows are kept in large groups can calculate with lower increases in costs than farms on which sows are kept in small groups.

Group keeping with close confinement in hinged crates has proved to be the most cost-effective variant. However, in this scenario too, fertility performance can be adversely affected, and the demands on management are comparatively high.

For farms that also rear piglets, an extension is preferable from an economic viewpoint for all scenarios in order to avoid stock reductions in the piglet rearing. However, as a rule, the farms need an alteration permit for extensions because extensions represent a change in the use of the existing facility.

All options assume that a modification is possible in the existing building and requires excellent arrangements for keeping, feeding, building climate and particularly management. There is uncertainty regarding the consequences the modification scenarios could have in connection with permit law. The influence of the altered keeping conditions on animal health, performance, the work load and management is also not assessable. A detailed evaluation of these effects, also with regard to economic consequences, can currently not be carried out as no experience has been made yet with the described scenarios.

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