

The farrowing environment sets the conditions for sow and piglet productivity and their welfare

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Introduction

- Yolande:

- Associate Prof & NSERC IRC in swine welfare
- PhD Health management of grow-finish pigs
- 16 years in pig science: behaviour & welfare: between EU & North America



- Vivi:

- Chief Scientist SEGES Innovation
- PhD Management of outdoor sow herds
- 20+ years in SEGES Innovation – On farm trials



Expectations of hyperprolific sows

- We 'want' sows:
 - i. Capable of nursing many, strong, viable piglets
 - ii. To remain in the herd for >6 farrowings with high productive performance
 - iii. To be resilient & require low inputs for labour & medication
- We expect sows to:
 - i. Have uncomplicated farrowings
 - Despite with large litters it is a marathon of 4-8hrs
 - ii. To produce large amounts of milk continuously
 - 16 L/day on average
 - iii. To release many fertile eggs & conceive promptly after weaning

I just gave birth to 25 liveborn piglets – took 8 hours



I'm producing 16 liter of milk every day



I'm carrying 18-32 fetuses



Expectations and conditions

- High expectations regarding the sows' performance
 - Must provide conditions for them to be able to meet our expectations



Housing

+



Nutrition

+



Management and producer
/ barnstaff needs

+



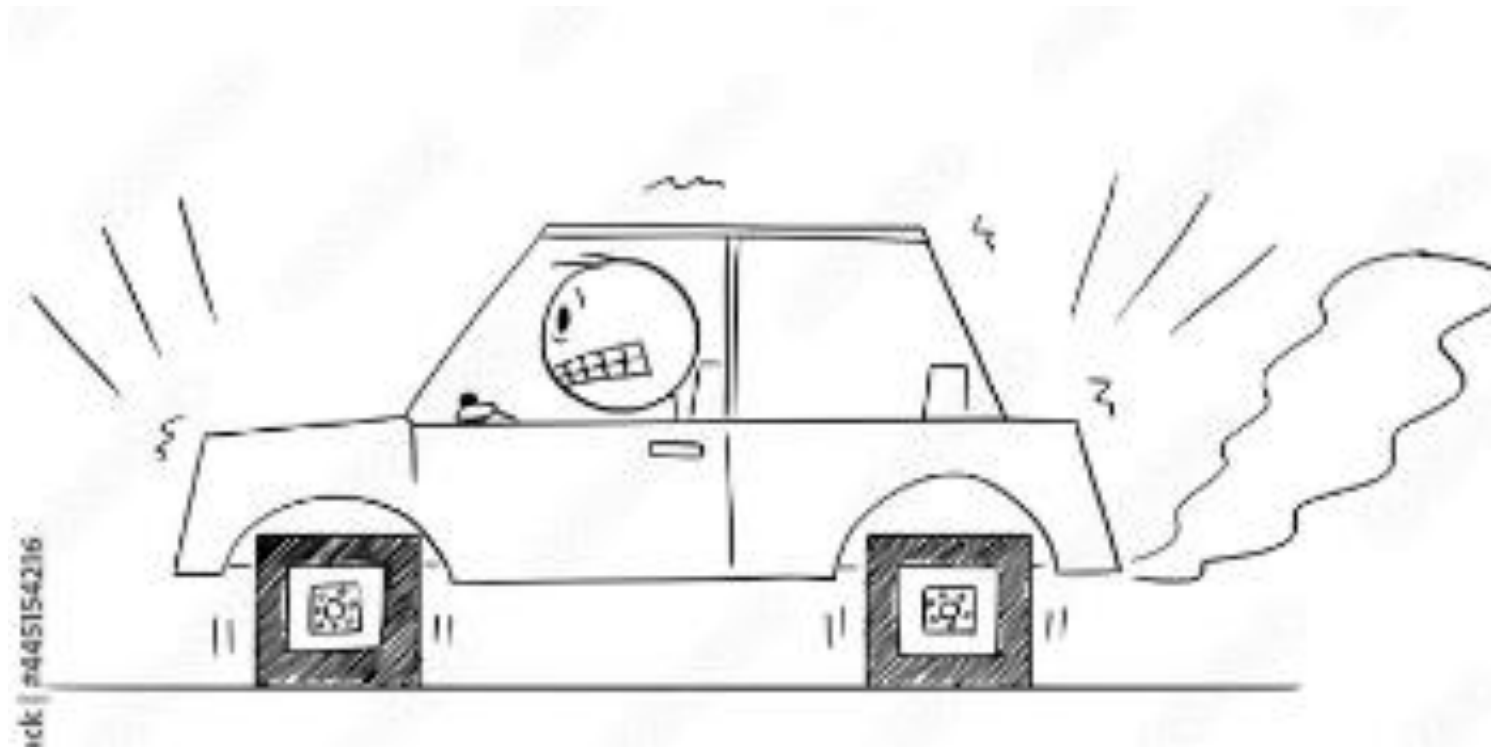
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Species specific needs: Meet basic requirements for welfare

The importance of optimizing the farrowing environment

- It may sound obvious but...Get the basics right!



Decisions before building and running afterwards

- Key decisions
- Once you've build – conditions are given - live with it....and optimize within conditions
- Start with successful implementation
 - Include in design and thoughts:
 - What do pigs do
 - When do they do it
 - Why do they do it
 - How do they do it
 - ...



Rest



Socialize



Urinate and defaecate



Nurse

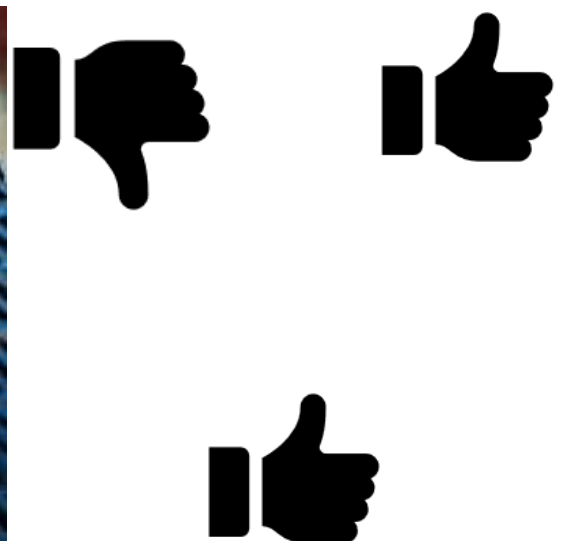


Eat and drink



Explore

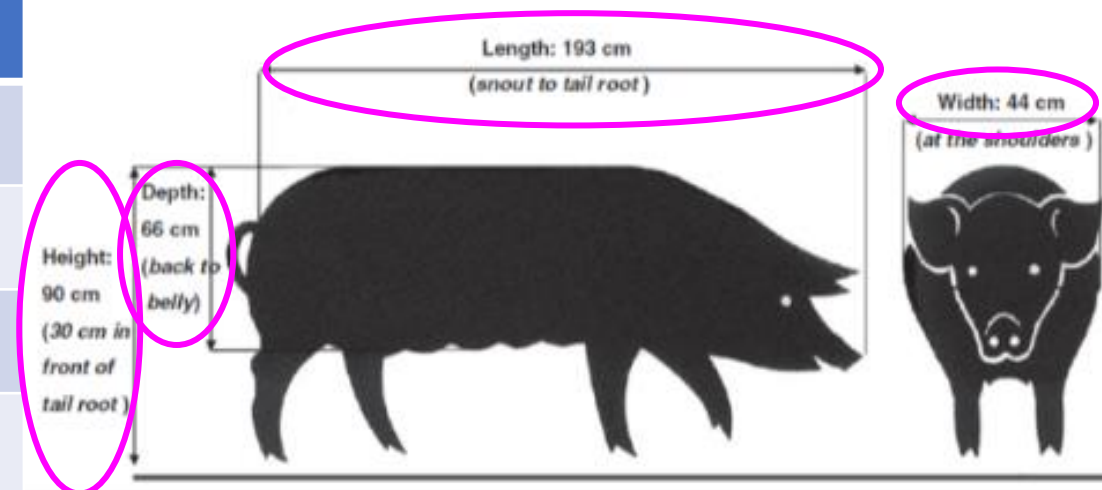
Spatial dimensions



Sow dimensions

Danish crossbred sows in commercial herds in 2017

Year	2017	
Sows:	N = 103, \geq parity 5	
Dimension	Ave. \pm s.e.	95% percentile
Length, cm	192 (± 0.6)	203
Height, cm	90 (± 0.4)	96
Width, cm	43 (± 0.5)	48
Depth, cm	65 (± 0.6)	72



*Mousten et al., (2011)
Livestock Science 141, 272-275*

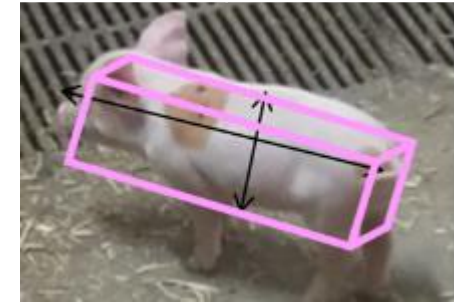
Mousten & Nielsen, Meddelelse 1113, www.svineproduktion.dk

Nielsen et al. (2018), Livestock Science 209, 73–76.

Piglet dimensions

	Age	
	< 1 week (n = 42)	3 weeks (n = 65)
Dimensions (cm)		
Length	31.3	44
Height	17.8	24.5
Width	7.3	11.5
Depth	8	12.5
Piglet weight (kg)	1.4	5
Space/piglet (m ²)	0.02	0.06

Data: SEGES pig production



Total area (m²) required: space at maximum piglet age & number housed within the pen

EU Directive: minimum requirements for piglets

Total area (m²) required: space at maximum piglet age & number housed within the pen

Pre-weaning: 'Part of the total floor, sufficient for animals to rest at the same time must be solid....' (EU directive, 2008/120/EC).

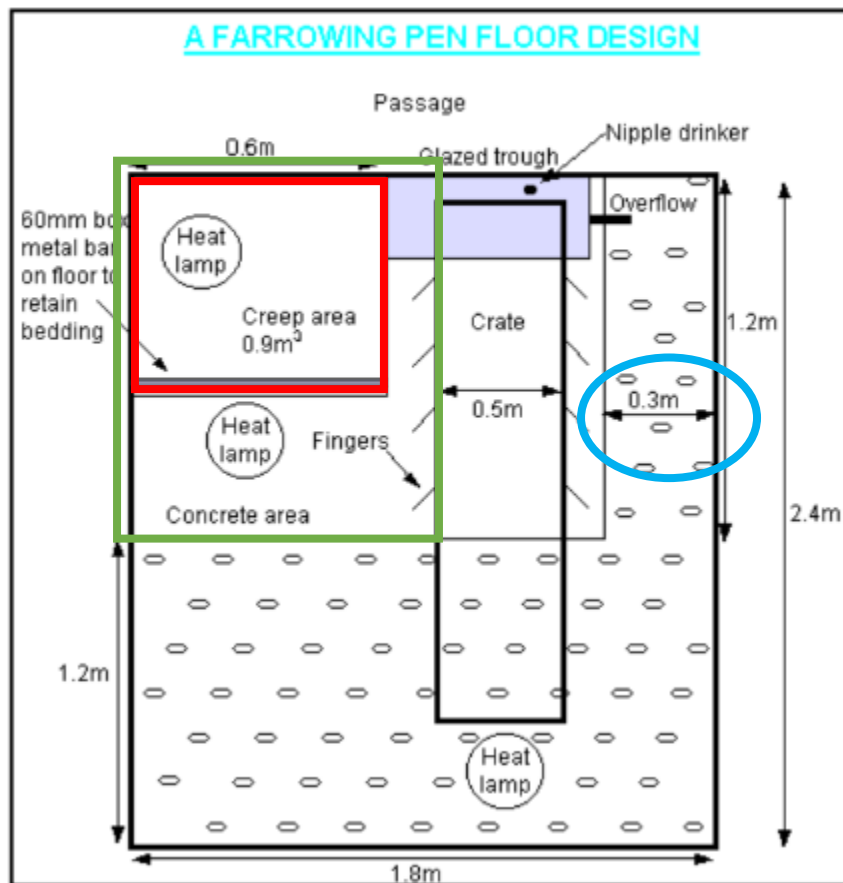


K value: <small>(Kxbodyweight^{0.67})</small>	Space/ piglet (m ²)	Piglet age weeks	Piglet weight (kg)	Number of piglets in pen					
				10	12	14	16	18	20
0.019: standing & sternal lying	0.02	<1	1.4	0.24	0.29	0.33	0.38	0.43	0.48
	0.08	4	8	0.77	0.92	1.07	1.22	1.38	1.53
0.027: Semi-lateral recumbency	0.03	<1	1.4	0.34	0.41	0.47	0.54	0.61	0.68
	0.11	4	8	1.09	1.31	1.52	1.74	1.96	2.18



Equipment & guidelines: Review before you invest!

An example of a satisfactory farrowing pen layout is shown in Fig.8-23.



Creep area: $0.6 \times 0.8 = 0.48\text{m}^2$ ✓

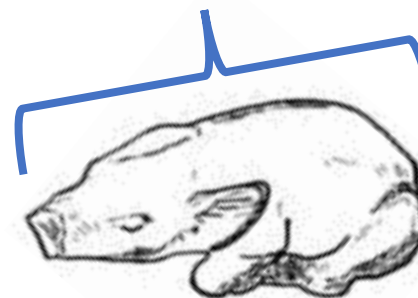


Unobstructed, solid lying area for piglets: $0.6 \times 1.2 = 0.72\text{m}^2$ ✗



Suckling space adjacent to wall = 0.3m ✗

Nose to tail: 44cm at 3 weeks of age



(Fig.8-23)

Thepigsite.com, 2018: <https://www.thepigsite.com/genetics-and-reproduction/farrowing/farrowing-house-design>

Beyond static sow dimensions: space for movement

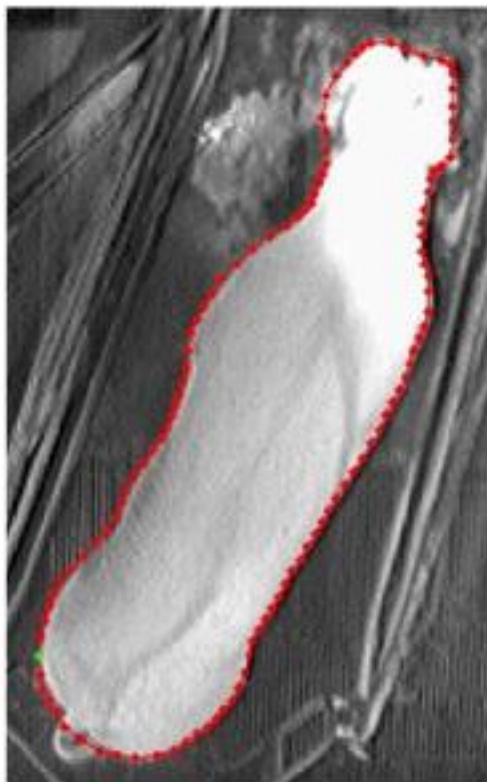


Figure 1.
Line around a standing sow,
before movement

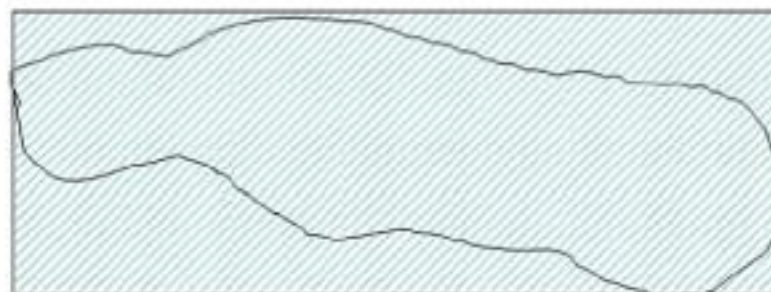


Figure 2.
Frame around the sow before movement was
initiated

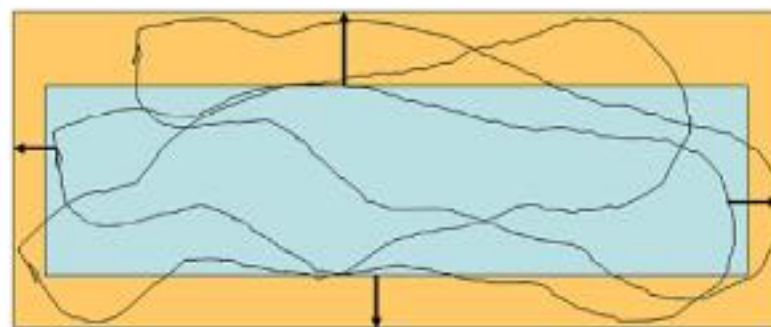


Figure 3.
Frame after movement – showing area used
during manouvers to rise and lie down

Behaviour	Space (cm) beyond bodysize required during sow posture changes
Raising	Length: + 18 Width: +16*
Lying down	Length: +10 Width: +17*

* Loose sows: width raising: + 32cm | Lying: +25cm

Equipment: Review before you buy!

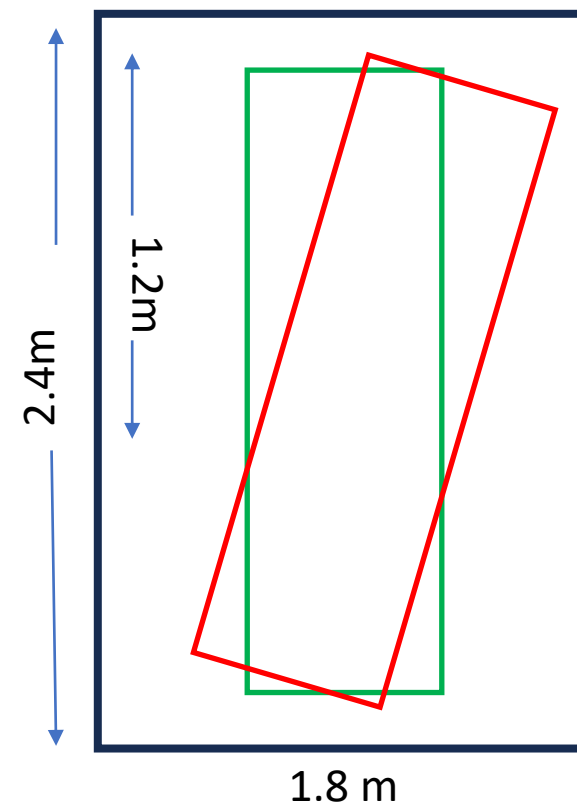
Is the 'standard' equipment meeting your current *and* future production targets?

Beyond static sow dimensions: space for movement

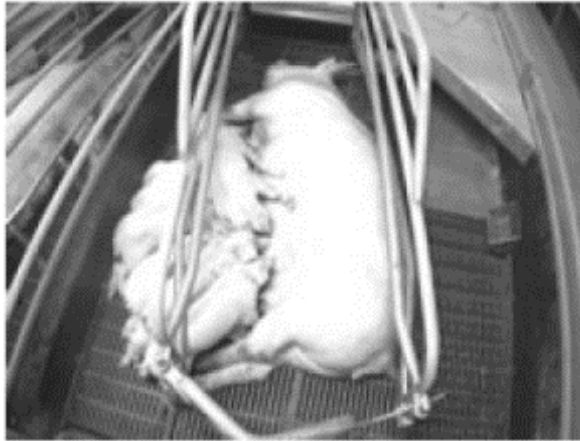
Minimum sow total space required in crates:

- Unobstructed length: body length + additional length for posture change
- Width: body width + additional width for posture change, **plus**
 - Width of crate should accommodate depth of sow body when lactating

Location	Length (m), including trough	Sow space after trough (length m)	Width (m)	Pen length (m)	Pen width (m)
North America	2.13 - 2.40	1.73 - 2.0	0.43 - 0.64	2.1 x 1.5	1.5
EU	2.40	1.95 - 2.0		2.4 - 2.6	1.4-1.8
Sow >5 th parity: space for static & posture change		Length: 192 cm + 18cm = 210 cm	Width: 43 cm + 17cm = 65 cm Depth: 65 cm		



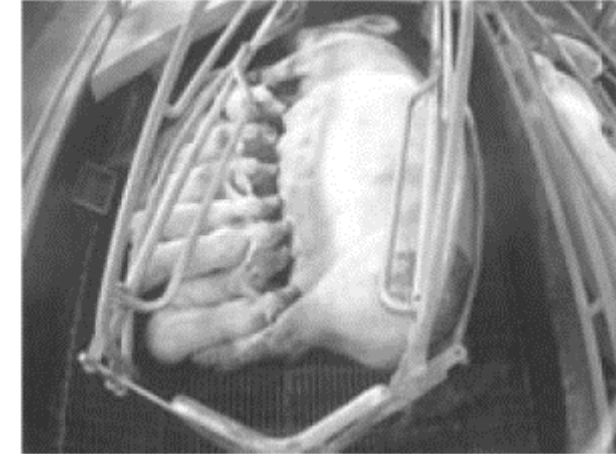
Beyond static sow dimensions: space for movement



Crates: 23 cm wider at front



Crates: 30 cm wider at rear



- Increase in space: increased access to the udder for piglets
 - ✓ Improved weight gain pre-weaning \approx increased by 19%
 - ✓ Fewer teat fights \approx reduced by 75%
 - ✓ Fewer piglets missing out on milk-let down \approx reduced by 57%
 - ✓ Fewer terminations of suckling by the sow \approx reduced by 28%

Floating floors



Creates challenges for the sow

Narrow width incorporated into design to stop piglets falling off 'shelf' when the floor raises

Narrow pens with insufficient space → increase risk of piglet mortality



Source: Pig333.com: https://www.pig333.com/articles/the-ideal-farrowing-facilities-nr-of-crates-room-size-type-of-crate_12464/

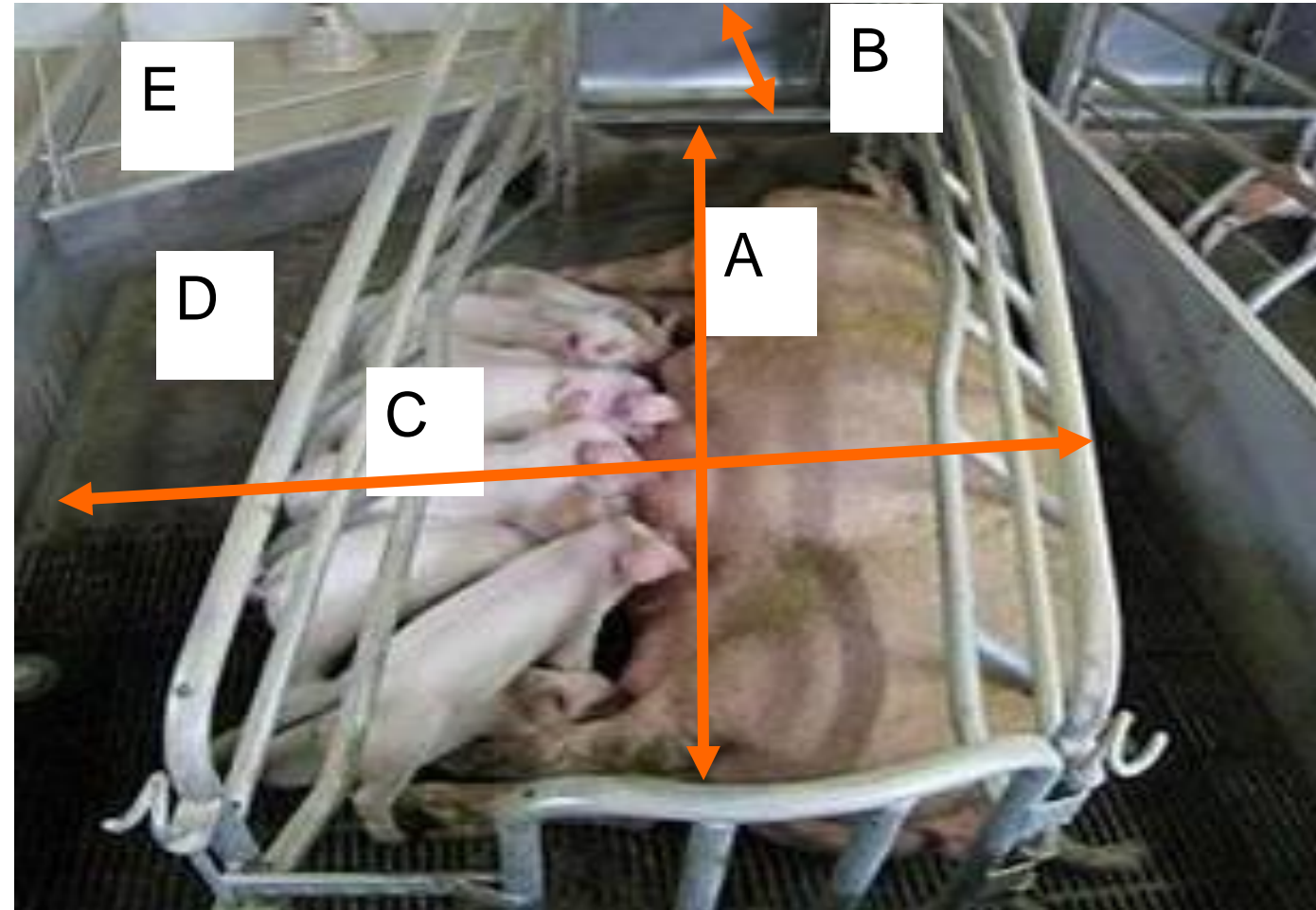
Dimensions – pen equipment

Sow:

- A. Crate length \geq 210 cm:
- trough front to rear of crate

Piglets:

- C. Suckling space \geq 125 cm length
- Sow depth + maximum piglet length
- D. Height of bars: 20cm
- E. \geq 1 m² solid floor lying area
- F. Covered creep: minimum 0.8 m²
- Pen length: \geq 270 cm
 - \geq 15 cm from crate gate to pen gate



From crate to loose

- The sow is/will be loose most or all of the time

Farrowing crate
– confined sows

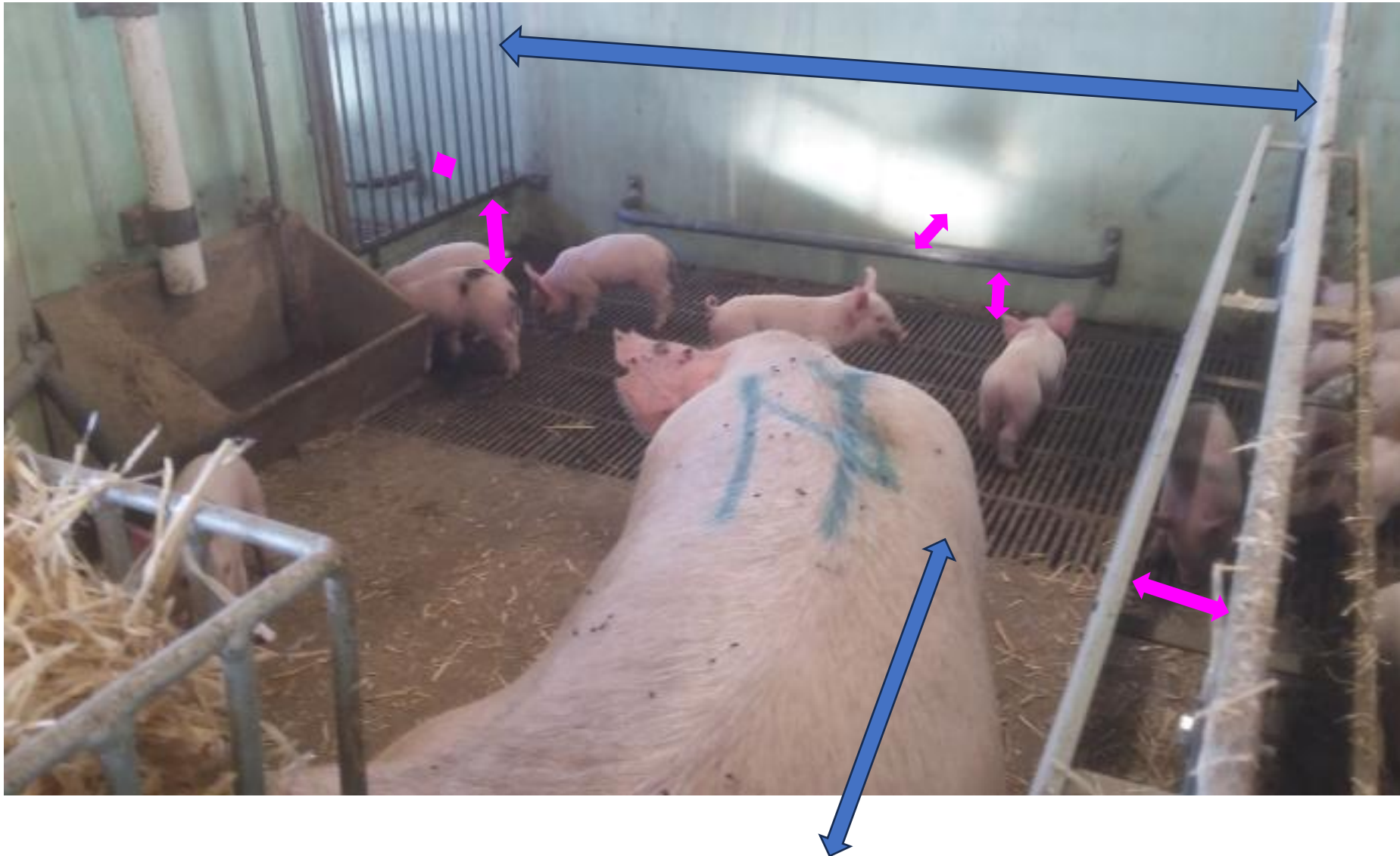


Farrowing pen
– loose sows



Use temporary confinement –
BUT in a pen designed for a
loose sow

Dimensions – pen equipment



Sows:

Dunging

Lying

Thermoregulate

...

Piglets:

Shoulder width

Safety zones

.....

'Ideal' pen size – space for the sow

- Sows' dimensions

- Minimum



- Planar width – turning space

- Minimum
- Ease of movement



Planar width of 153 cm

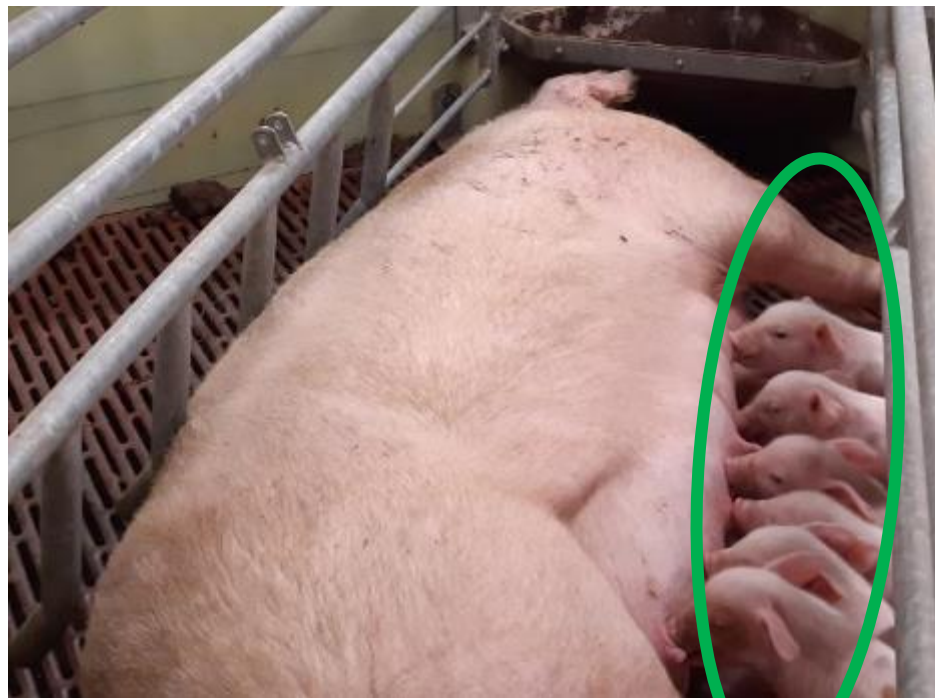
Planar area of 3.17 m²

considered necessary to allow unobstructed turning for sows with the 95-percentile weight.

Needs further research

'Ideal' pen size - space for piglets

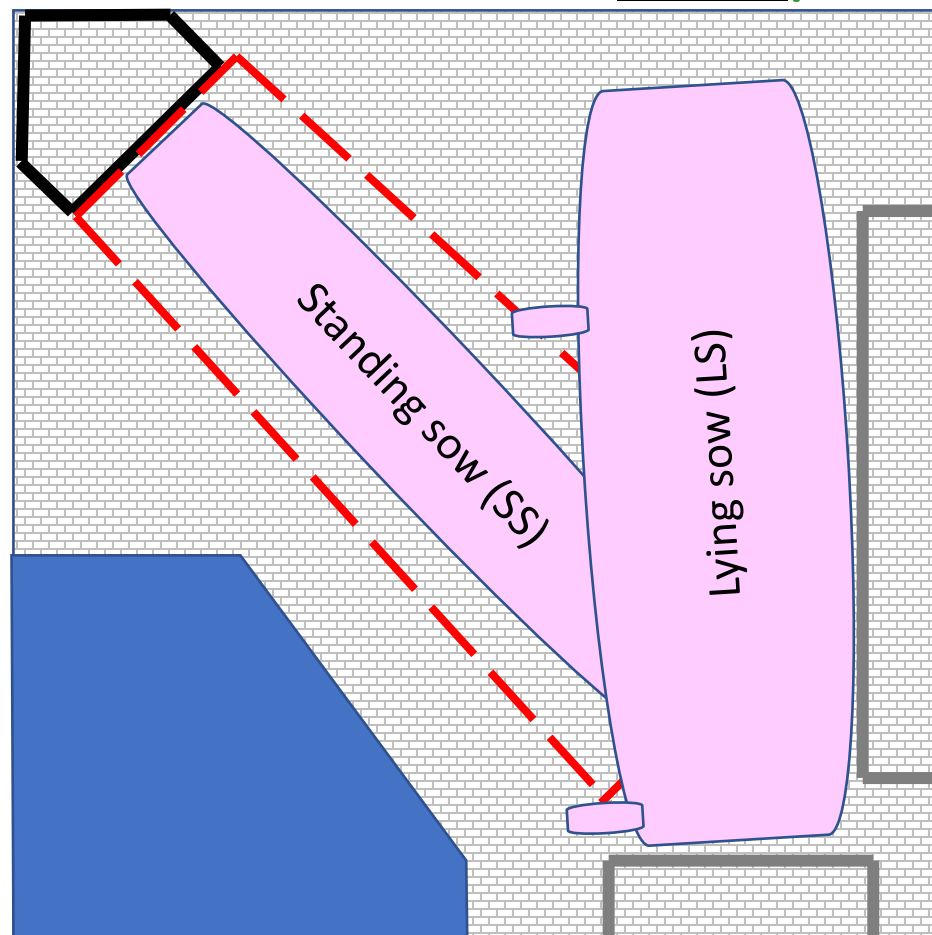
- Dimensions*number
- Piglet dimensions
 - Birth,
 - One week
 - Four-five weeks
- Litter size in pen
- Functional areas
- Piglet safety zones



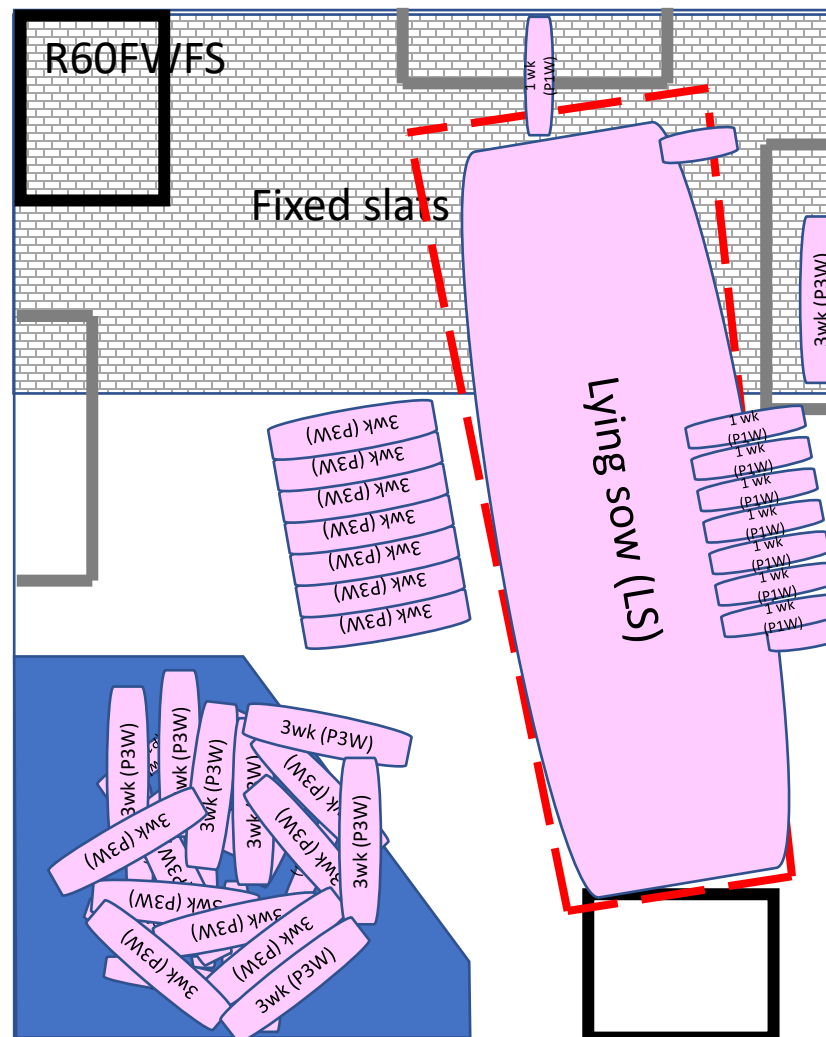
Space – temporary confinement and loose



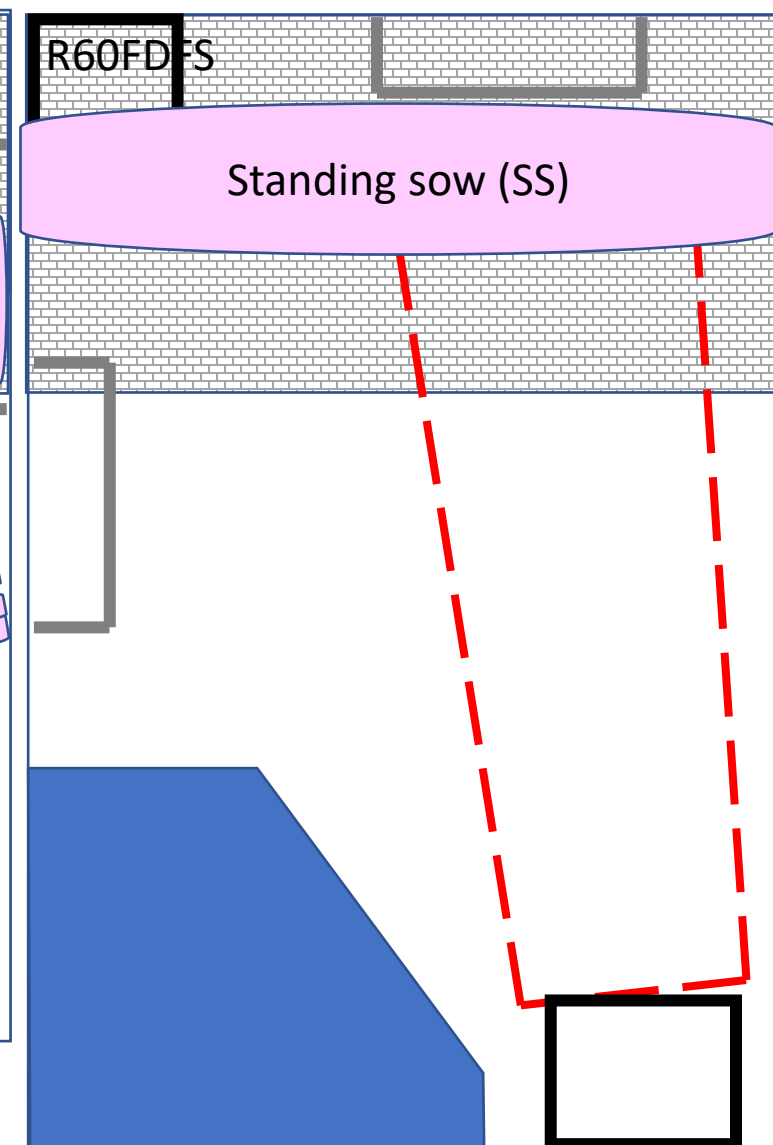
How different can 6 m²-pens be?



Square
S60 / 245*245

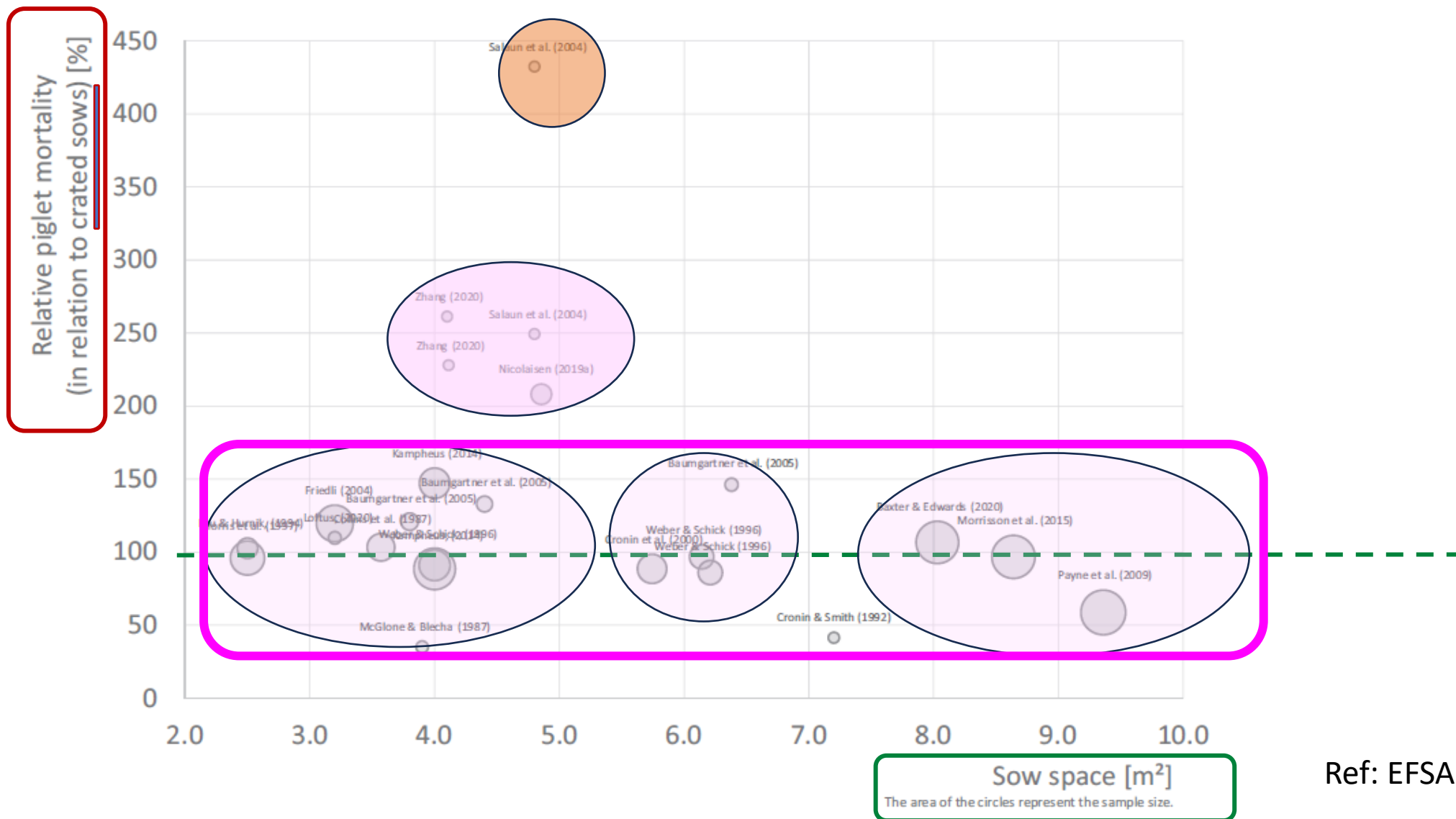


Rectangular – width (220 cm)
273*220



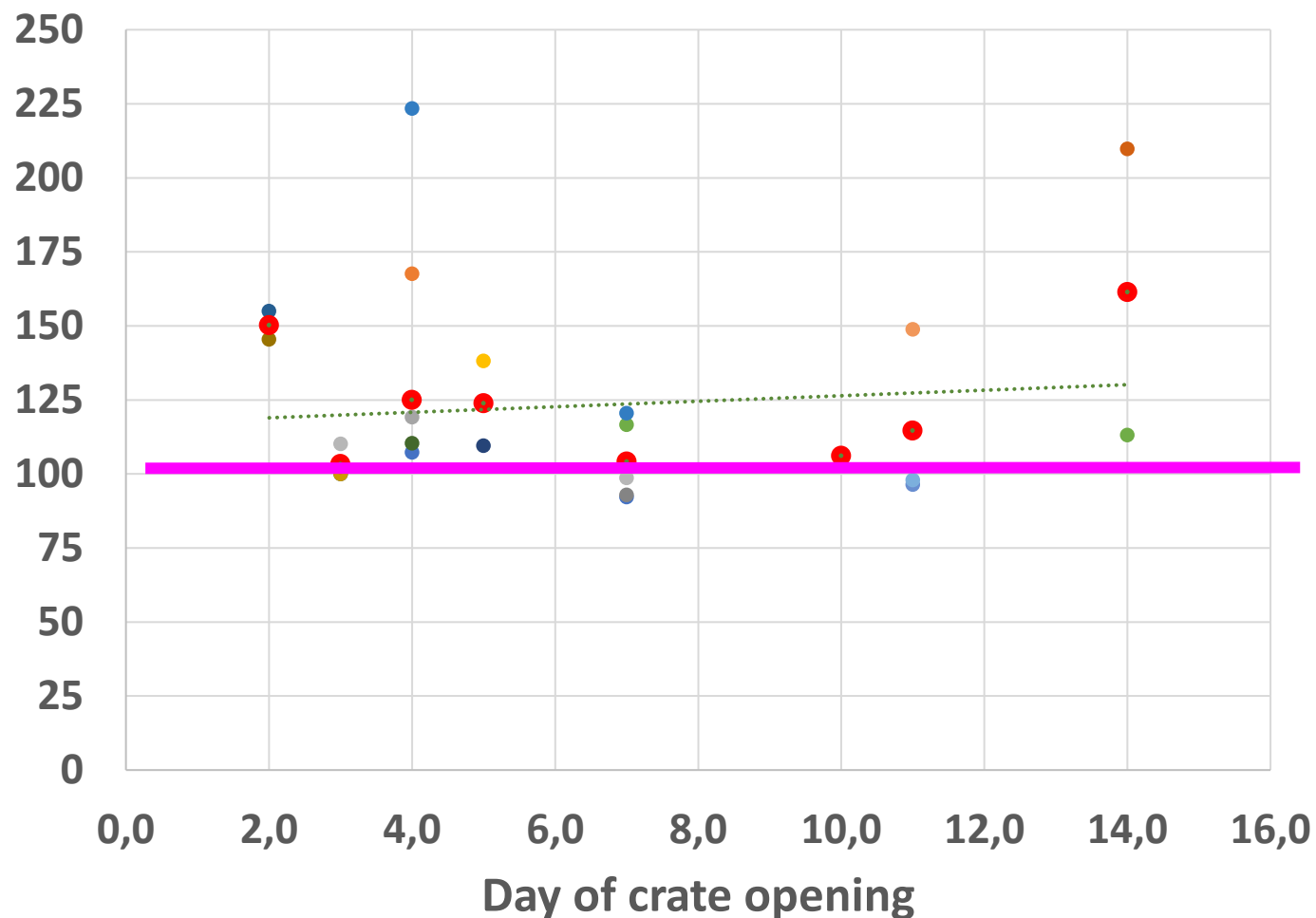
Rectangular – depth (300 cm)
300*200

Space & piglet survivability



Temporary or permanent confinement

Liveborn mortality from birth to weaning
(permanent crate = 100)

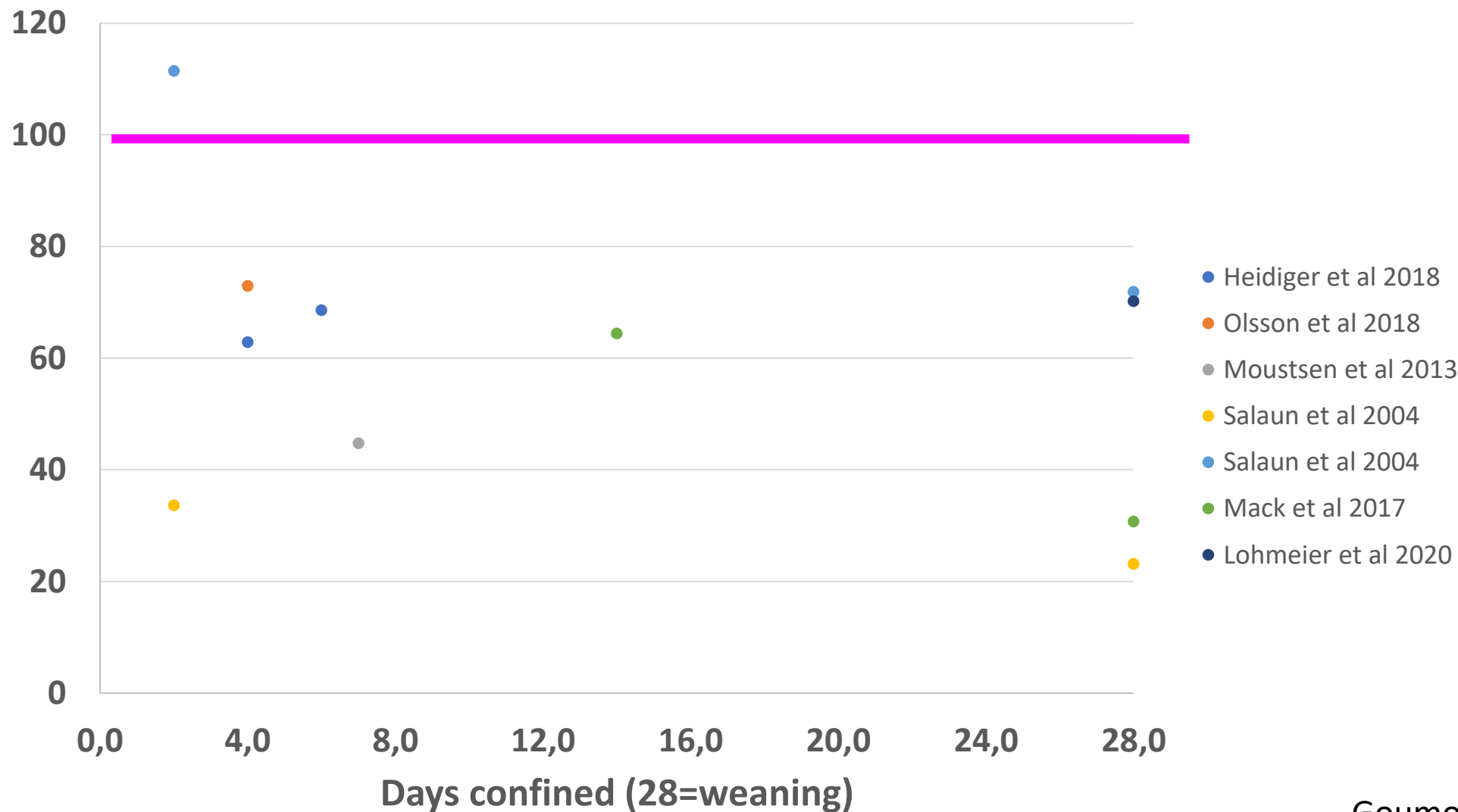


- Ceballos et al 2021
- Chidgey et al 2015
- Chidgey et al 2016a
- Choi et al 2020
- Höbel et al 2018
- Lambertz et al 2015
- Loftus et al 2020
- Lohmeier et al 2020
- Lohmeier et al 2020
- Salaun et al 2004
- Salaun et al 2004
- Kinaine et al 2021
- Caille et al 2010
- Caille et al 2010
- Condous et al 2016
- King et al 2019a
- Caille et al 2010
- Caille et al 2010
- Gouman et al 2018
- Mack et al 2017
- Spindler et al 2018
- Singh et al 2017
- Moustsen et al 2013
- mean
- Lineær (mean)

Temporary confinement or zero confinement

Liveborn mortality from birth to weaning

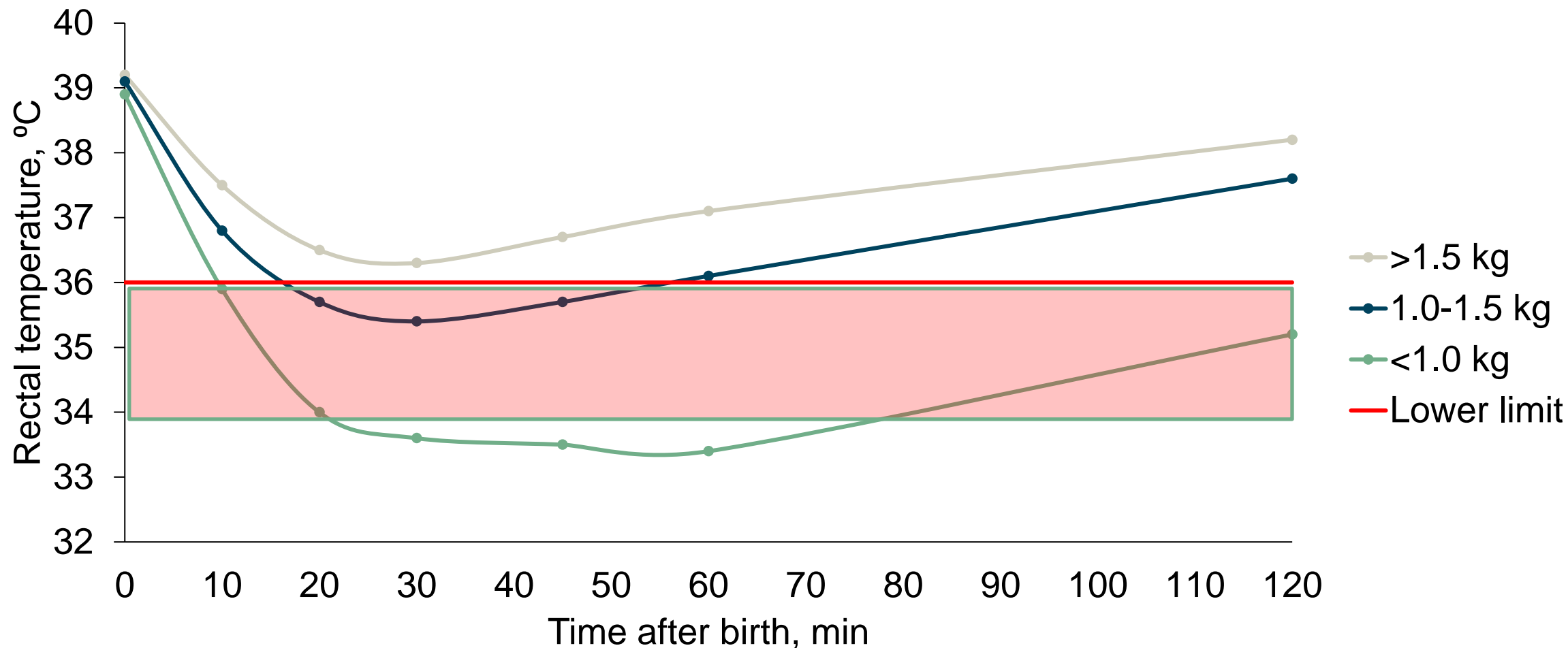
(zero confinement = 100)



Smaller piglet = larger temperature drop

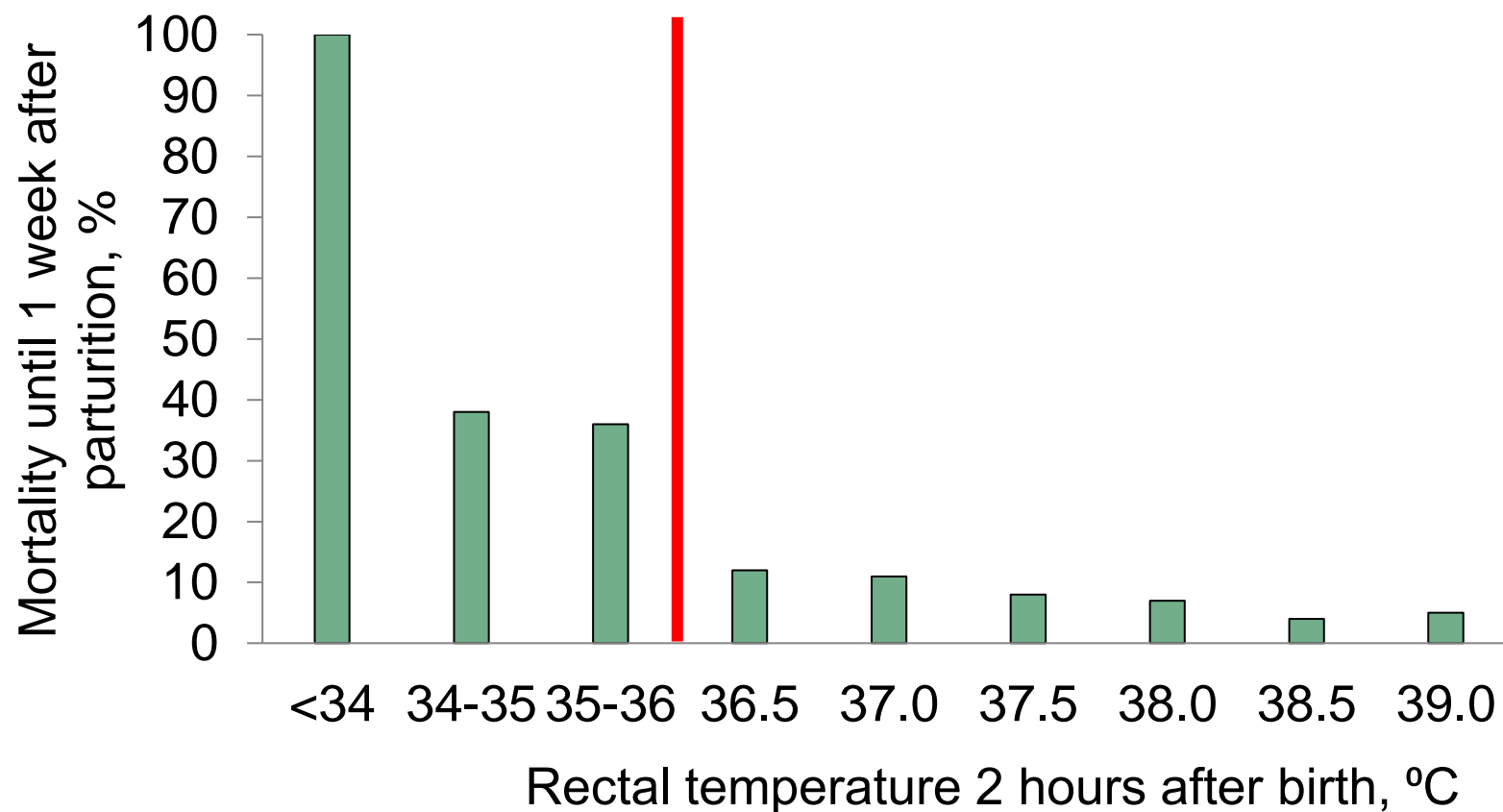
Reestablishment takes a long time

Room temperature
22.5 °C



HEAT:

Rectal temperatures (piglets) above 36 °C increase survival

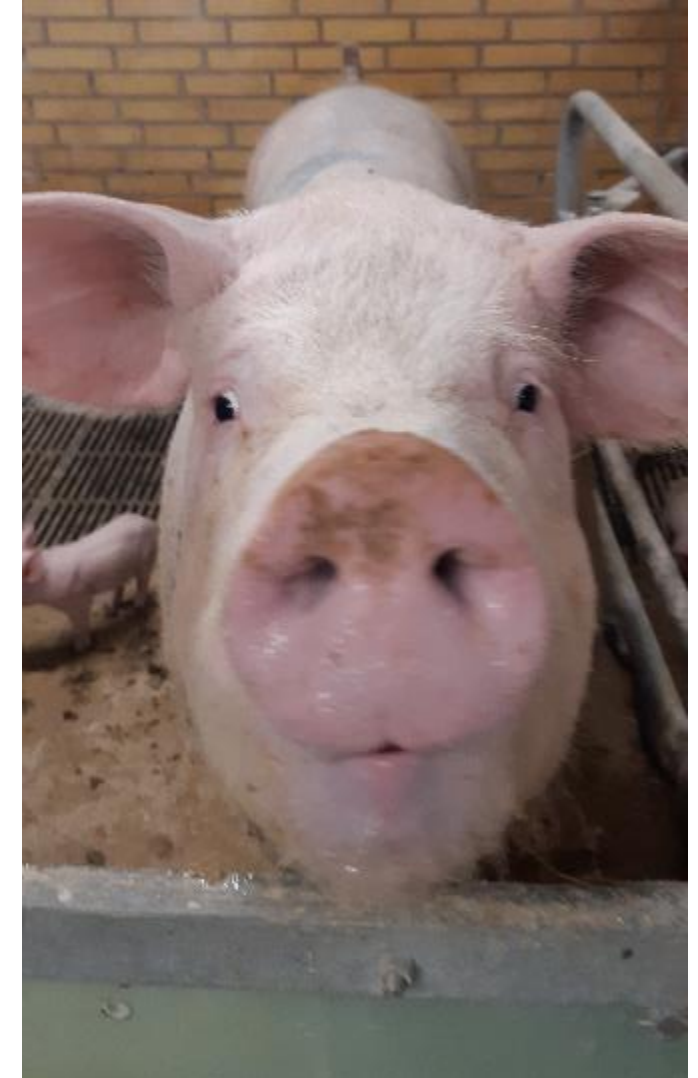


Trial report no. 1087

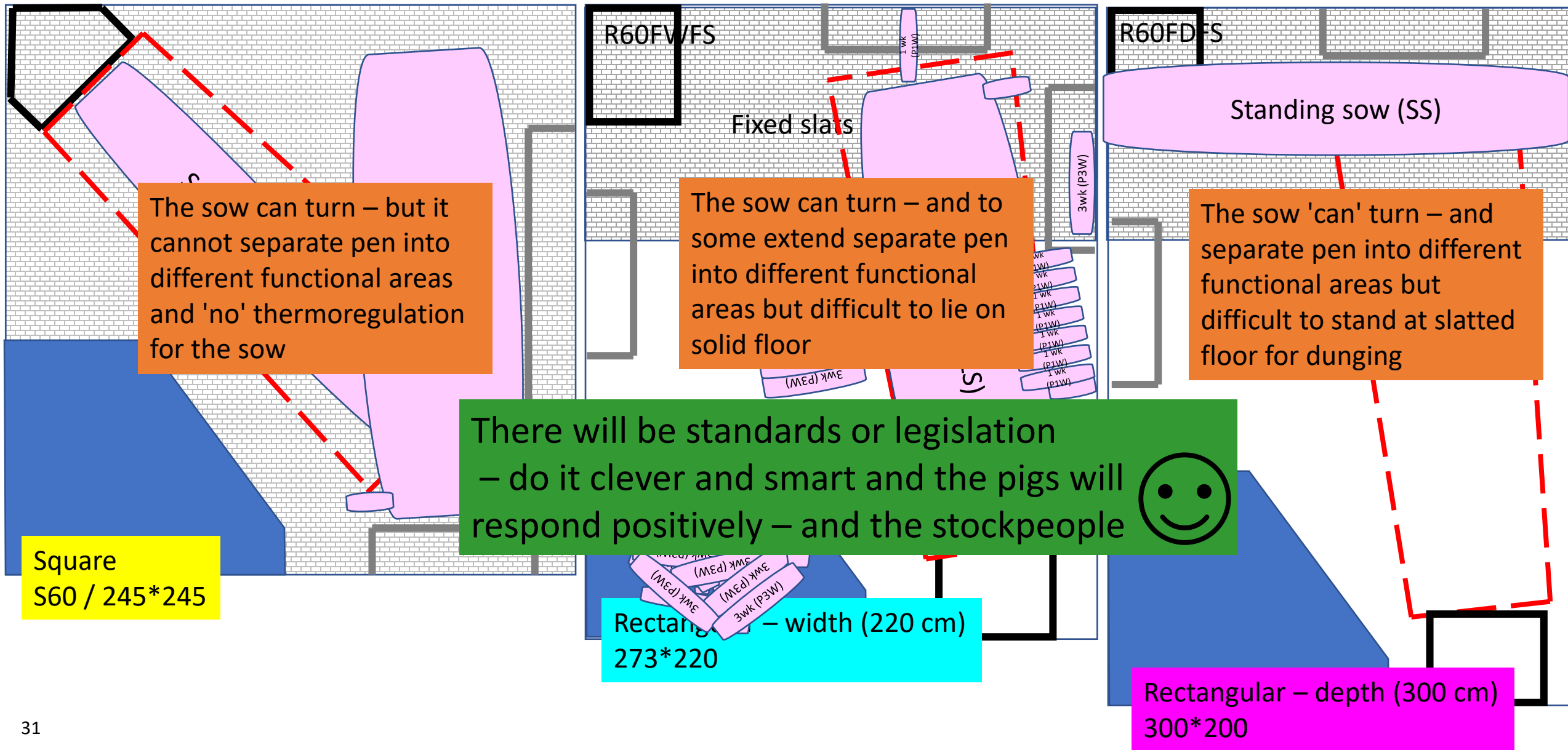
Legal framework as it relates to space

Welfare legislation

- For legislation to be 'meaningful'
 - Controllable
 - Sanctionable
 - → Space
- Challenge
 - Does it make a difference – outcome based?



How different can 6 m²-pens be?



The sow can turn – but it cannot separate pen into different functional areas and 'no' thermoregulation for the sow

The sow can turn – and to some extent separate pen into different functional areas but difficult to lie on solid floor

The sow 'can' turn – and separate pen into different functional areas but difficult to stand at slatted floor for dunging

Square
S60 / 245*245

Rectangular – width (220 cm)
273*220

Rectangular – depth (300 cm)
300*200

Pen layout – work conditions

- First decision regarding design
 - Creep area along passageway
 - Safety
 - Efficiency
 - Reduce risk of transferring diseases
 - Easy access
 - Worker wellbeing
 - Human – animal relationship
 - Quality of and in care



European Union: Enrichment for farrowing SOWS

- Farrowing sows: access to nesting material
- Compliance and value to the pigs:
 - Not just does the pig have enrichment
 - Is the pig *using and benefitting from the enrichment*



Understanding Environmental enrichment

- Environmental enrichment can be a vague concept
- Misunderstood or undervalued
- Often used to refer to an object to modify the environment
 - Whether it is enriching or not!



Environmental Enrichment: An essential component of animal care

“An improvement in the biological functioning of captive animals resulting from modifications to their environment,” (Newberry, 1995)

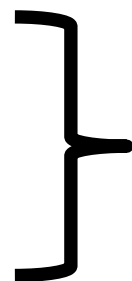
- Support expression of sow maternal behaviour
- Support piglet behavioural development
 - Oral manipulation of pen mates
 - Novelty
 - Ingestive behaviours



Maternal Care Behaviours

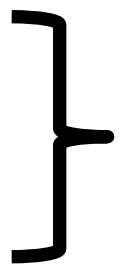
High scores for:

- Nest building
- Communication
- Carefulness



Greater number of piglets weaned

- Communication
- Carefulness



Lower piglet mortality

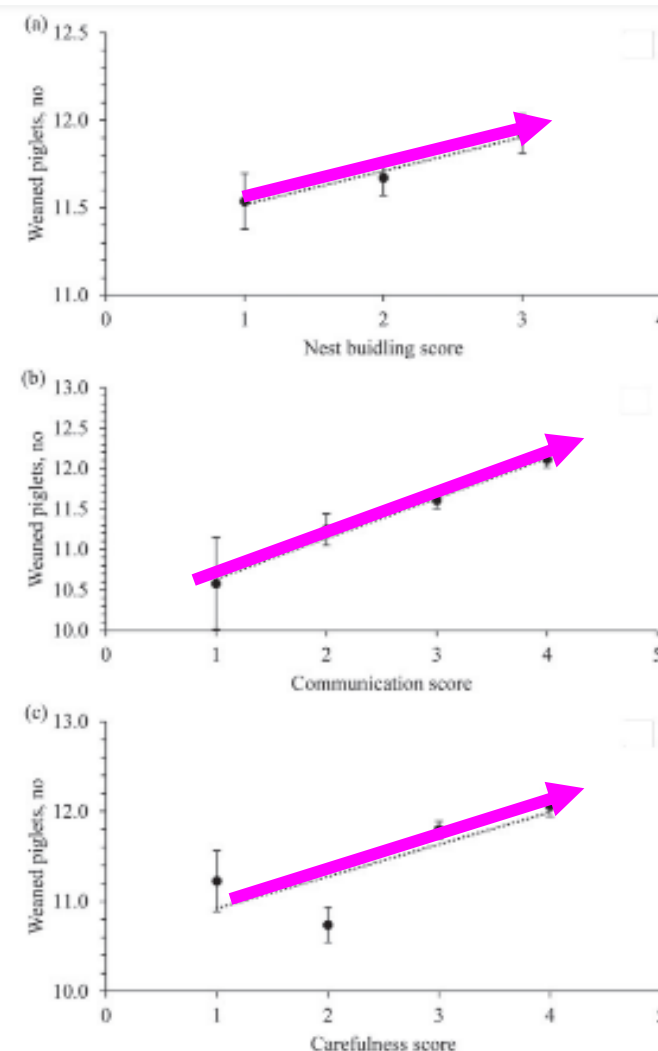


Figure 8. Relation between number of weaned piglets and behavioral scores: (a) nest building ($F_{1, 799} = 6.8, P = 0.009$), (b) sow communication to piglets ($F_{1, 799} = 14.0, P < 0.001$), and (c) sow carefulness toward piglets ($F_{1, 799} = 6.8, P = 0.009$).

Provision of straw influences maternal care behaviours

Loose-housed sows provided with straw as nesting material pre-partum:

- Reduced negative communication to piglets by 66%
 - Bites, barks, rough pushing
- Increased the proportion of sow-initiated nursing's by 46%

Straw treatment: provided from two days prior to farrowing, until farrowing

- 2kg long-stemmed straw each morning
- 1kg long-stemmed straw in afternoon

Control sows: housed with only wood shavings

Enrichment for Farrowing Sows

Burlap provision to sows on litter performance at birth and weaning , 1,500 sow unit.

	Treatment		Significance
	Burlap	Control	P-value
Number of Litters	277	277	-
Born Alive / Litter (# of piglets)	13	12.54	0.113
Total Born	13.95	13.74	0.475
Mean Liveborn Birth Weight (kg)	1.38	1.38	0.824
Stillborns / Total Born (%)	6.5 ^a	8.3 ^b	0.004
Piglets fostered out/Total litter (%)	8.4 ^a	7.1 ^b	0.049
Total Piglet Deaths / Total Litter ² (%)	12	12.1	0.866
Total Weaned / Litter (# of piglets)	11.6	11.5	0.461



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Burlap for farrowing sows: Return on investment

- Per four litters: 1 x extra piglet
- Ability to reduce pre-weaning mortality
 - 1 x extra piglet has \$50 value at weaning
- A 200% return on investment
 - For every \$1 spent on burlap, \$3 can be returned in pig value.

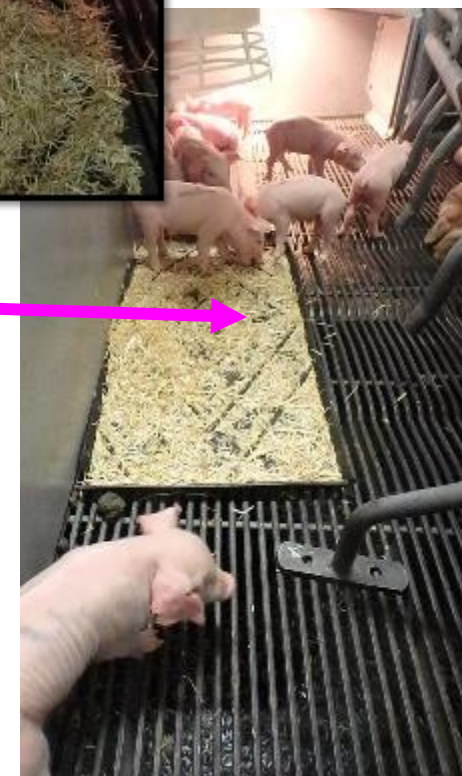
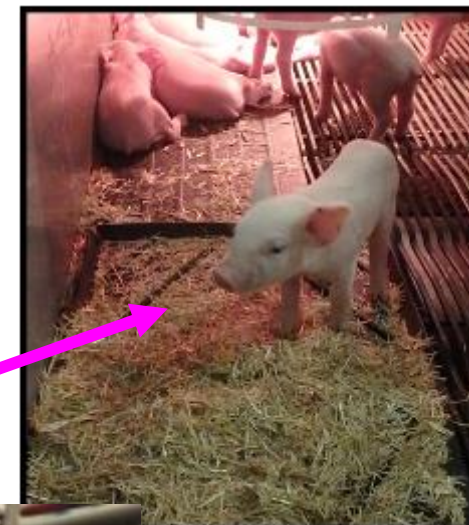


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Fynn et al. (2021) J. Anim. Sci. 101: 781–787, [dx.doi.org/10.1139/cjas-2021-0027](https://doi.org/10.1139/cjas-2021-0027).

Piglet appropriate enrichment

- Properties attractive to pigs
 - Chewable
 - Manipulable
 - Ingestible (small quantities)
 - Destructible
 - Rootable



Enrichment in farrowing: piglets

Enrichment type	Provision	Effect
Rope & paper	Continuous access in farrowing environment only	Reduction in % of pigs with mild and severe tail damage in nursery*
Burlap/Jute	Continuous access	50% reduction in biting of pen-mates : long-lasting effect
Rope	Around creep feeder	Increased interest in creep pre-weaning; 14% increase in ADG days 1-15 post-weaning. ³

* Pigs reared with undocked tails

¹Telkänranta et al. (2014) *Appl. Ani. Behav. Sci.* 161, 51-59;

²Ursinus et al. (2014) *J. Ani. Sci.* 92: 5193-5202; ³Middelkoop et al. (2019) *Sci. Reports*, 9, 16140.



Space for piglets: healthy behavioural development

- Space availability pre-weaning affects later social skills – level of aggressiveness
- Litters reared in pens of 3.5m^2 (0.44m/piglet) vs 6.7m^2 (0.84m/piglet – 8 piglets)
 - Lower space – more aggressive pigs:
 - low display of threat behaviour, higher frequency of physical aggression
- Available space in farrowing crate /piglet at 28-day weaning (14 piglets) – 0.22m/pig



Complexity of the rearing environment: Easily achieved in loose lactation pens!



Extra substrate opportunities

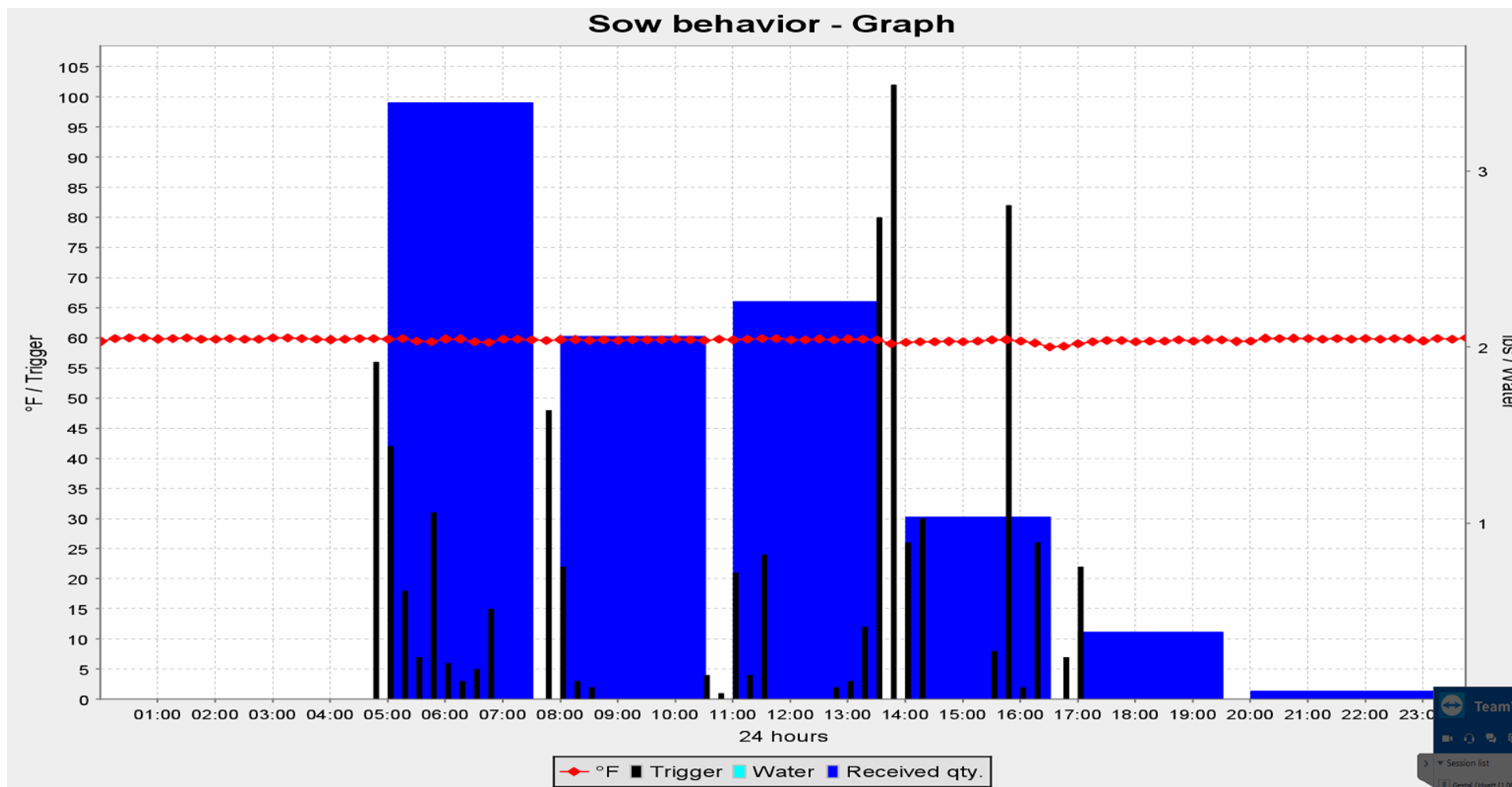
Space for social development



Sow offspring interaction: maternal –offspring transfer of information

Feed: Handling control back to the sow to stimulate intake

- Automated farrowing feeders: Animals press trigger to request more feed

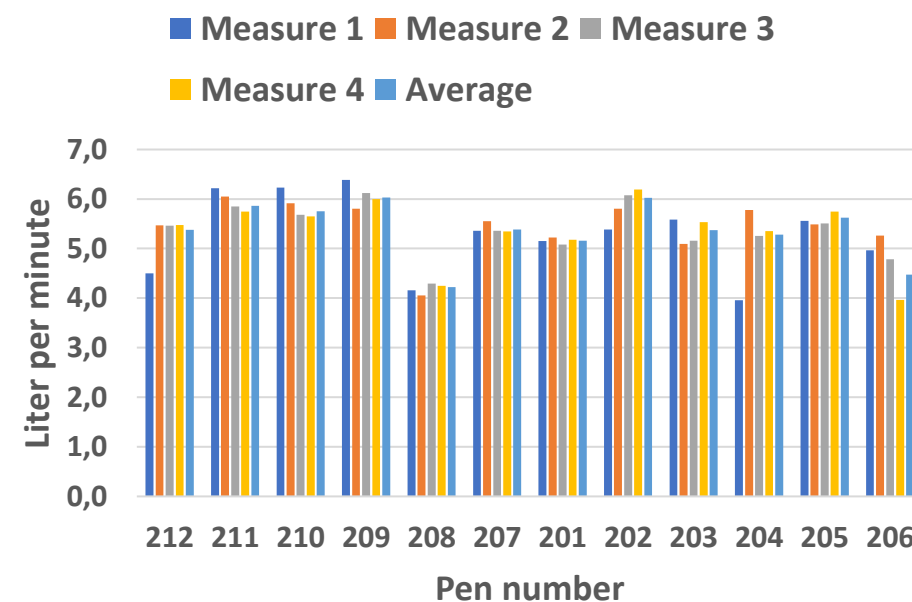


Water

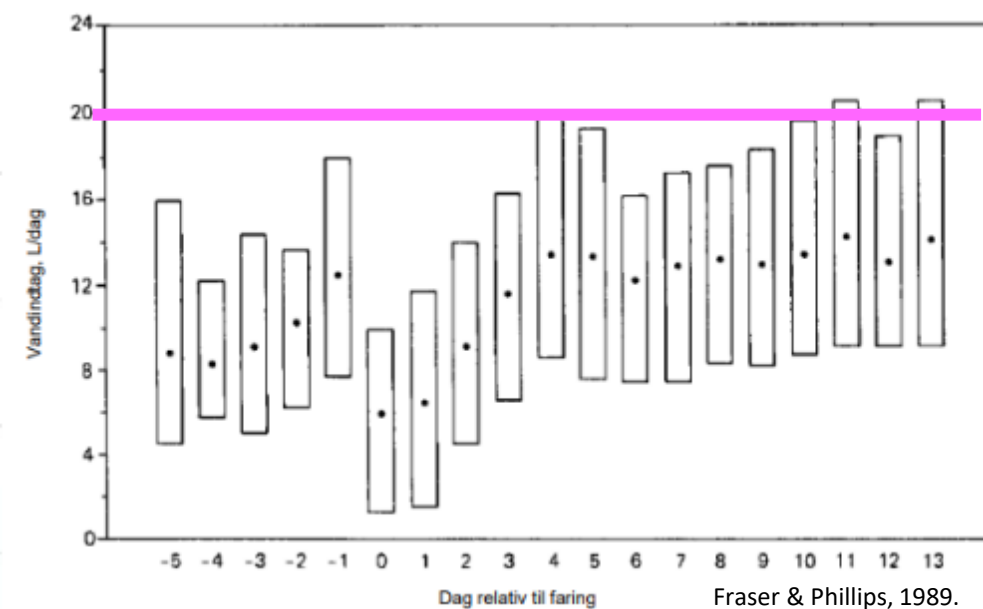
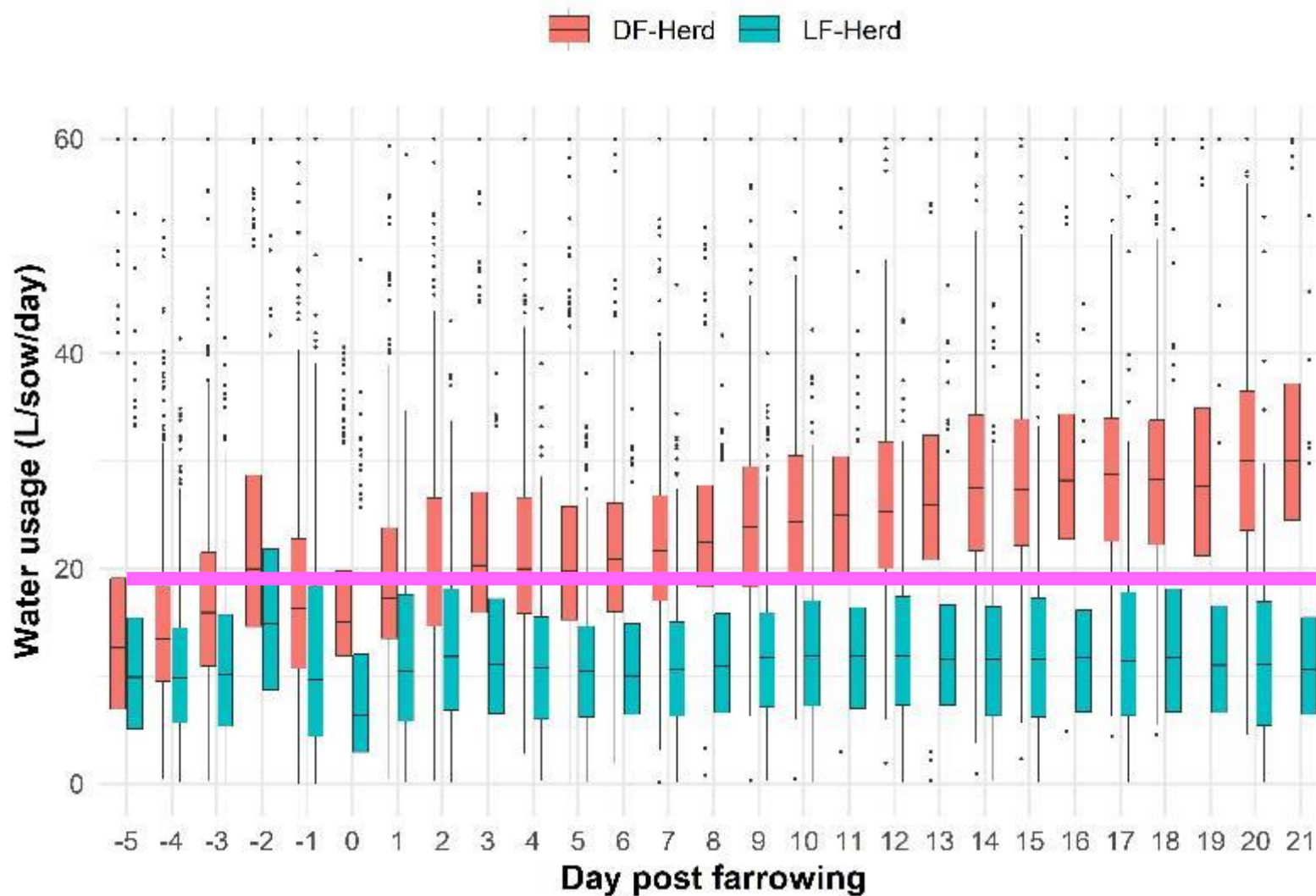
- 50% of a sow's body is water
- 80% of sow milk is water
- WATER is essential
 - One farrowing/lactating sow
 - One farrowing section
 - All farrowing sections
 - Mating, gestation, weaning
 - Mix of feed (if liquid)
 - Soaking, washing
 - Seasonal increase in water consumption – starts at outdoor temperatures of **10°C**



Is there capacity for procedures to run at the same time – or?



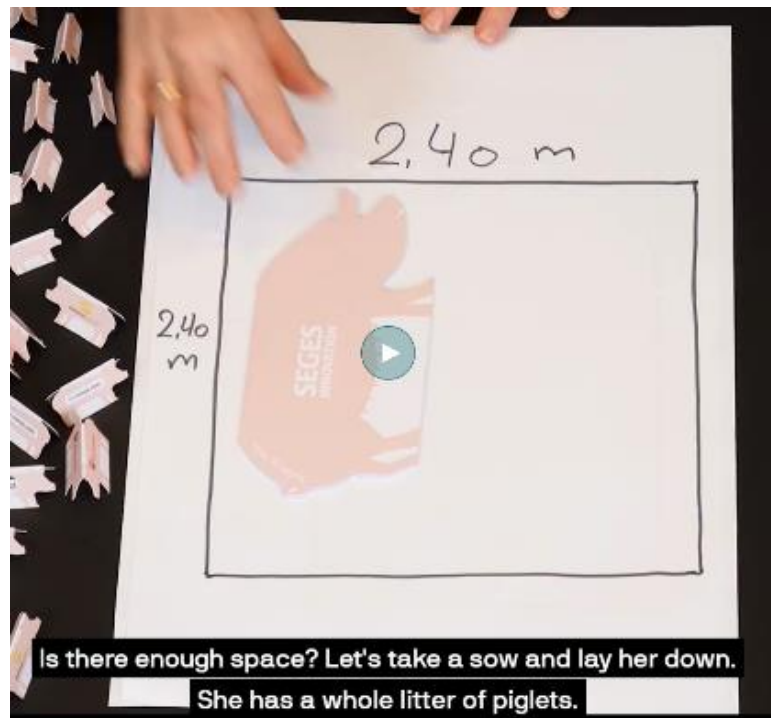
Waterconsumption day -5 to day 21 (dry- and liquid)



- Similar pattern
 - At a higher level
- Has the capacity followed the increase in consumption??

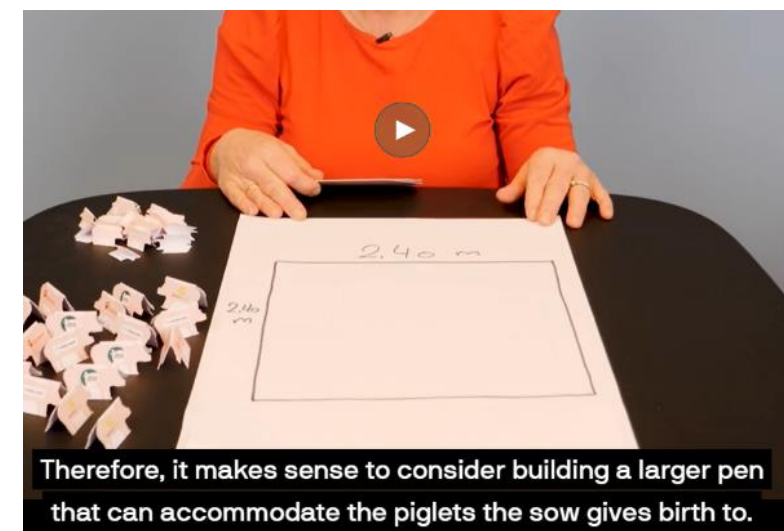
Decision support tool

- Is the design criteria meeting the needs of the sow, piglets and caretakers?



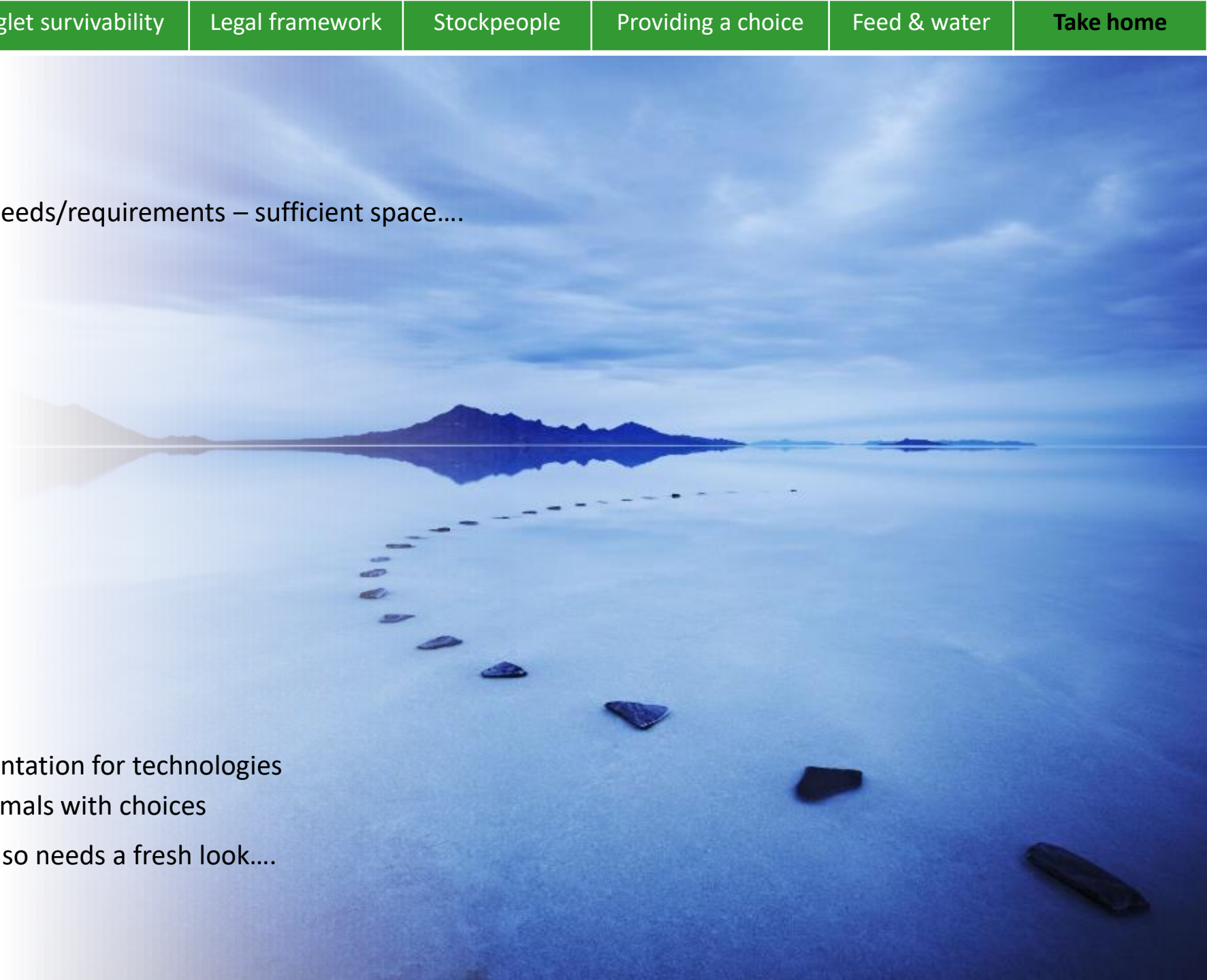
- [Papgrise og checkliste hjælper dig til bedre staldindretning - SEGES TV](#)

Video – with English subtitles



Conclusions

- Step 1 - Animals
 - Understanding the animals needs/requirements – sufficient space....
 - Dimensions
 - Activity
- Step 2 - Animals
 - Future production
 - Loose
 - Larger litters
 - Sustainability
- Step 3 -
 - Farm staff
 - Legal framework
- Step 4 – Supporting the animals
 - Understanding the animals
 - in design and implementation for technologies
 - when providing the animals with choices
- Step 5 – and the most obvious – also needs a fresh look....
 - Feed, water, air...





Take Home Message

- The farrowing environment sets the conditions for sow and piglet productivity and their welfare
- Set the conditions in the farrowing environment which leads to high welfare and productivity