
Effect of littered systems on pollutant emissions in gestating sows

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Summary

- ✓ Introduction
- ✓ Objective
- ✓ Materials and methods
- ✓ Results
- ✓ Conclusions
- ✓ Acknowledgments

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Introduction (I)

✓ Change in approach 

- Soil, water and air pollution
- Efficient use of energy and water

✓ Directive IPPC (96/61/EC) '*high level of protection of the environment as a whole*'

 - Key concept: **BAT** (best available techniques)



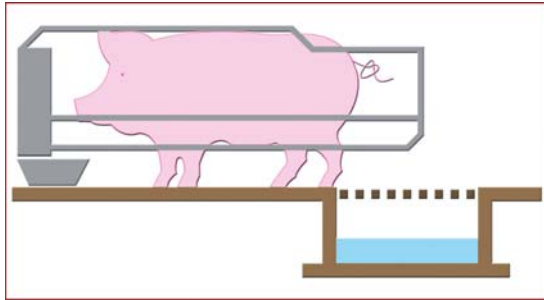
- Spanish **MAPA** selected 

- easy to implement
- cost-effective
- most proper to local conditions

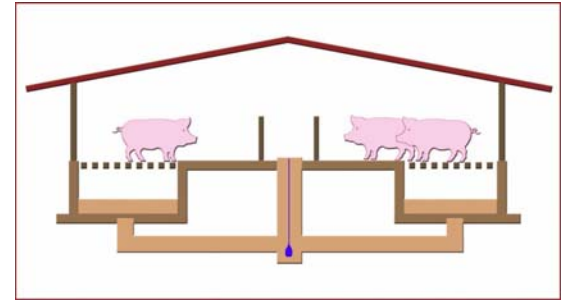
Introduction (II)

BAT proposed in BREF and selected for Spanish MAPA:

Partly-slatted floor and reduced manure pit

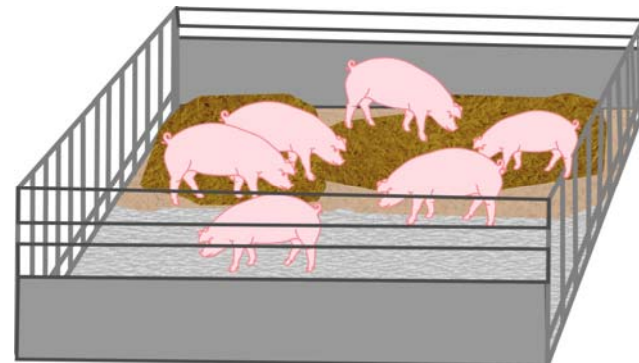


Frequent slurry removal



Littered systems; BAT when using good practices:

- Enough straw
- Changing the straw frequently
- Functional areas



Animal welfare regulations

Summary

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Objective

To assess the influence of **littered systems** (straw based)



using good practices:

- enough straw
- changing the straw frequently
- two functional areas (dunging and lying)

For **gestating sows**



Under Spanish conditions

In ammonia (NH_3), carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) **emissions**

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Materials and methods (I)

✓ Location

Experimental-Commercial-Educational
farm of PigCHAMP Pro Europa, in
Aguilafuente (Segovia, Central Spain).

500 sows multi-site

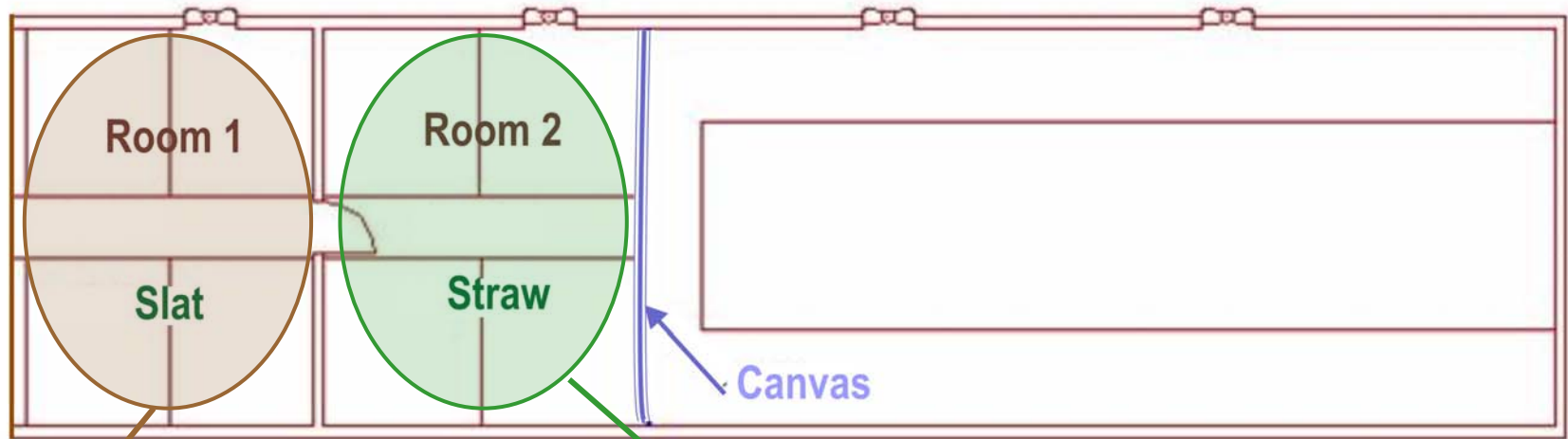


✓ Experimental Animals

60 gestating sows

Materials and methods (II)

✓ Housing: 2 different rooms



1. Reference system

- Partially-slatted floor
- Deep manure channel
- Monthly removal



- ### 2. Concrete floor with straw
- (3 kg per sow and week)



Materials and methods (III)

✓ Sampling and controls

- Concentration of NH_3 , CO_2 , N_2O and CH_4 by means of an *Innova 1312 infrared photo-acoustic system* (SIR, S.A., Madrid, Spain)
- Ventilation rate
- Temperature

Sampling period = 25 days



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Results (I)

Total emissions during the trial

Data in kg/place and year

	Reference system				Littered system			
	NH ₃	CH ₄	N ₂ O	CO ₂	NH ₃	CH ₄	N ₂ O	CO ₂
Mean	1.83	4.41	0.014	703	1.57	1.50	0.039	516
<i>Std Dev</i>	<i>0.384</i>	<i>0.733</i>	<i>0.0096</i>	<i>124.5</i>	<i>0.332</i>	<i>0.428</i>	<i>0.0144</i>	<i>97.6</i>
N	126	115	130	123	123	132	126	124
<i>Quantiles: 5-95%</i>	<i>1.18 - 2.57</i>	<i>3.19 - 5.65</i>	<i>0 - 0.032</i>	<i>500 - 902</i>	<i>1.11 - 2.17</i>	<i>0.90 - 2.35</i>	<i>0.017 - 0.066</i>	<i>378 - 684</i>

Results (II)

Total emissions during the trial

Data in kg/place and year

	NH_3	CH_4	N_2O	CO_2
Reference system kg/place and year	1.83	4.41	0.014	703
Littered systems kg/place and year	1.57	1.50	0.039	516
Effectiveness (%)	14	66	-178	27

Results (III)

Total greenhouse gas emissions, in terms of total
CO₂ equivalents

Data in kg/place and year

	Reference system				Littered system			
	NH ₃	CH ₄	N ₂ O	CO ₂	NH ₃	CH ₄	N ₂ O	CO ₂
Emission	1.83	4.41	0.014	703	1.57	1.50	0.039	516
GWPs ¹	0.01	21	310	1	0.01	21	310	1
CO ₂ equivalents	0.018	92.6	4.34	703	0.016	31.5	12.09	516
Total	800				563			

¹Direct Global Warming Potentials relative to carbon dioxide. IPCC Second Assessment Report. 1996

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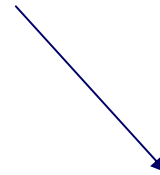
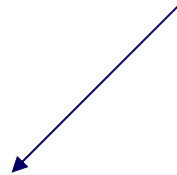
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Results (IV)

✓ Cost calculation

- According to the BREF methodology
- Extra cost for solid concrete floor system with straw, in comparison with reference system



New installations

47.61 - 55.35 €

per place and year

Existing installations

72.71 - 80.45 €

per place and year

Littered system for gestating sows (I)

- ✓ Technical description:
 - Building capacity: 30 places
 - Building surface: 42 m²
 - Floor: 100% concrete slat
- ✓ Assumptions for the calculations:
 - Concrete solid floor life: 10 years
 - Dunghill life: 15 years
 - Repairs (for both): 1% investment costs
 - Interest rate: 5%
 - Straw cost: 0.04 - 0.10 €/kg
 - Straw need: 3.0 kg per sow and week
 - Ratio occupation building: 85%
 - Manpower: 2 hour per week (manual); 0.78 h per week (mechanized)
 - Manpower cost: 15 € per hour (manual); 30 € per hour (mechanized with tractor and fuel)
 - Slurry produced per sow: 2.50 m³ per place per year
 - Slurry application cost: 0.70 €/m³
 - Pit need: 25.2 m³
 - Pit construction cost: 10 €/m³

Littered system for gestating sows (II)

New buildings

	Units	Capital cost (€)	Total cost (€/unit)
Investment cost			
Dunghill construction	€	3412	
Annual cost			
Dunghill amortization	Place		10.96
Dunghill repairs	Place		1.14
Straw	Place		5.16 - 12.90
Manpower (mechanized)	Place		40.50
Pit cost	Place		-8.40
Slurry application	Place		-1.75
Total	Place		47.61 - 55.35

Littered system for gestating sows (III)

Existing buildings

	Units	Capital cost (€)	Total cost (€/unit)
Investment cost			
Floor substitution	€	1120	
Dunghill construction	€	3412	
Annual cost			
Floor amortization	Place		4.83
Dunghill amortization	Place		10.96
Floor repairs	Place		0.37
Dunghill repairs	Place		1.14
Straw	Place		5.16 - 12.90
Manpower (manual)	Place		52
Slurry application	Place		-1.75
Total	Place		72.71 - 80.45



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Conclusions

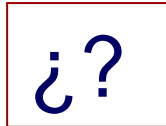
↓ NH_3 decrease

↑↑↑ N_2O strongly increase

Littered (straw) based systems

Overall emissions decrease by a 30% in terms of CO_2 equivalents

Associated costs were extremely high
(what could be limiting its implementation)



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Acknowledgments

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Thank you

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