

CONTROL Y ERRADICACION DE ENFERMEDADES

Valor económico y social

Alberto Morillo Alujas

Control y erradicación de enfermedades: punto de vista económico y social

OBJETIVO:

“Discutir las diferentes estrategias o modelos económicos que permitan al usuario basar la decisión de controlar o erradicar una enfermedad.”

Control y erradicación de enfermedades

Coste de las enfermedades



Factores específicos del sistema de producción

- Producto final que vende la empresa
- Datos productivos
- **Capacidad del sistema**
- Costes de producción
- Estado sanitario e histórico
- Características del patógeno y conocimiento sobre él
- Diseño de las granjas
- Potencial genético actual y futuro
- Auditoría de bioseguridad
- Coste de las instalaciones e intereses de amortización
- Precio de mercado pasado y futuro
- Aspectos legales

Factores que influyen el coste de una mejora en el estado sanitario

- Tratamientos medicamentosos, sin olvidar los aspectos legales
- Pruebas de diagnóstico
- Modificaciones en el inventario
- Rotura de los flujos de animales
- Alquiler de edificios externos, si es necesario
- Personal
- Periodo improductivo, si lo hay

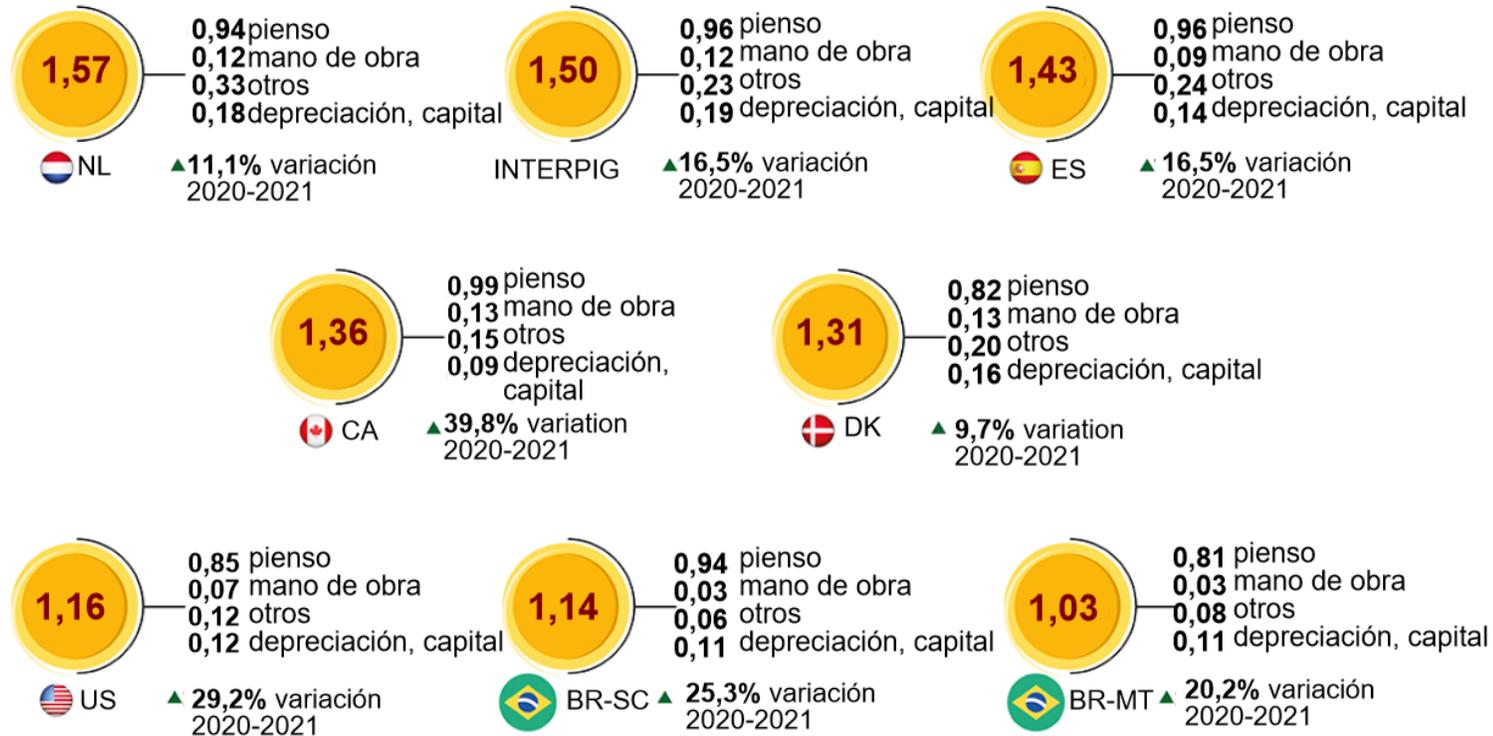
Costes de producción 2021 InterPIG

INTERPIG 2021 | COSTES DE PRODUCCIÓN POR COMPONENTE, EN USD POR KG VIVO



*Datos de la tabla InterPIG 2022 Agriness 2021 para la productividad de las cerdas en Brasil.

*La media de InterPIG también incluye estimaciones para Austria, Bélgica, Finlandia, Francia, Gran Bretaña, Hungría, Irlanda, Italia, la República Checa y Suecia.



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Costes de producción 2021 InterPIG

INTERPIG 2021 | PRINCIPALES ÍNDICES PRODUCTIVOS

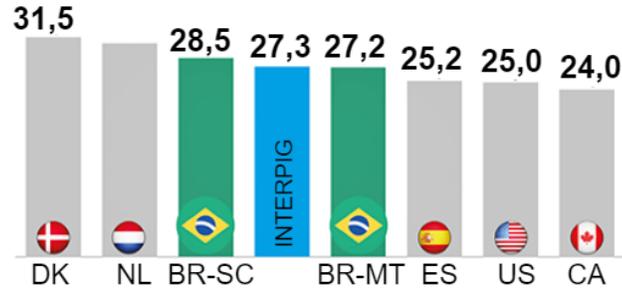


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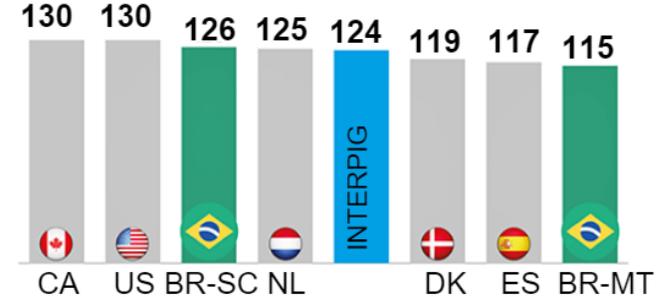
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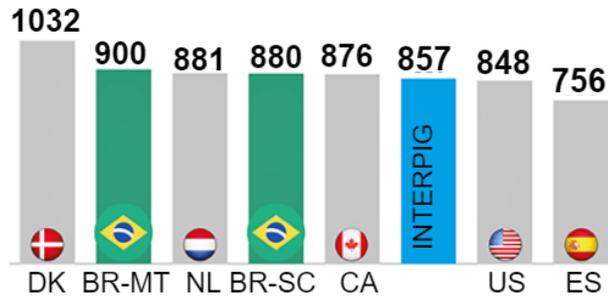
PRODUCCIÓN DE LA CERDA vendidos/año



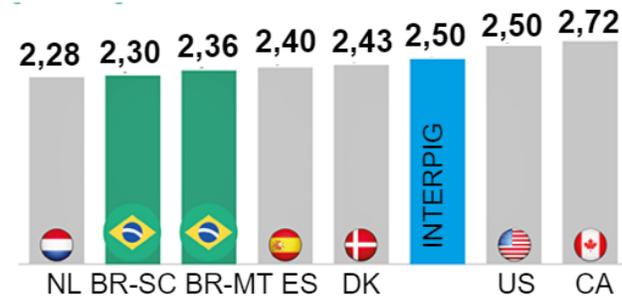
PESO A SACRIFICIO kg peso vivo



GANANCIA DE PESO EN ENGORDE g/day



ÍNDICE DE CONVERSIÓN 8 kg a 120 kg



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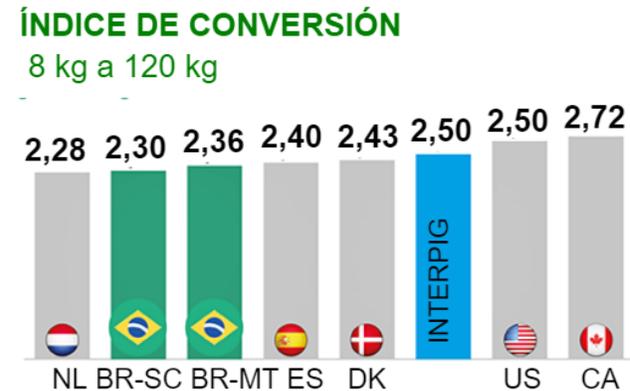
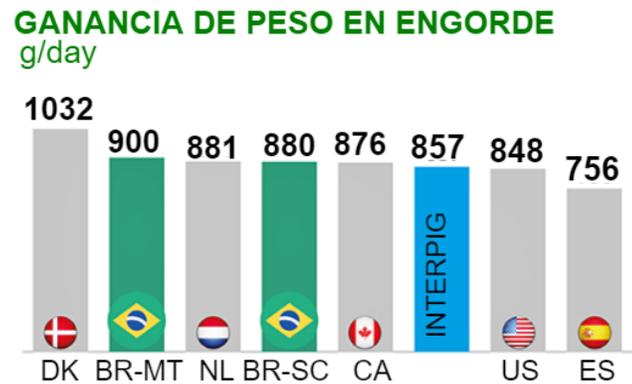
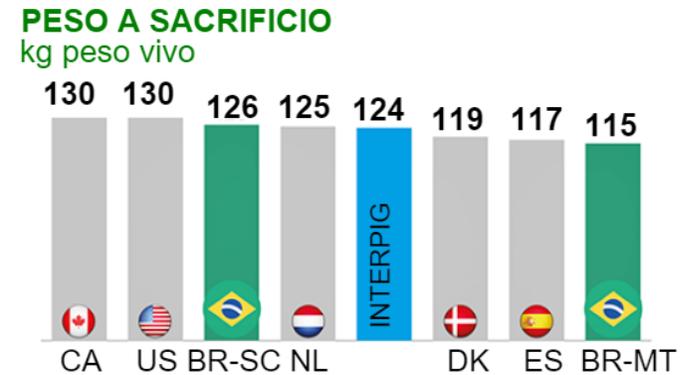
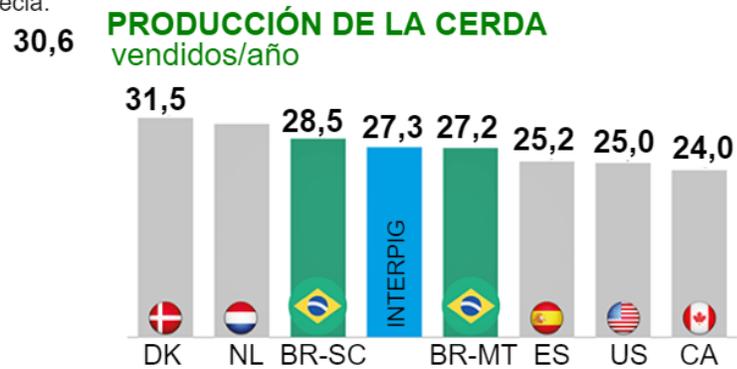
Costes de producción 2021 InterPIG

INTERPIG 2021 | PRINCIPALES ÍNDICES PRODUCTIVOS



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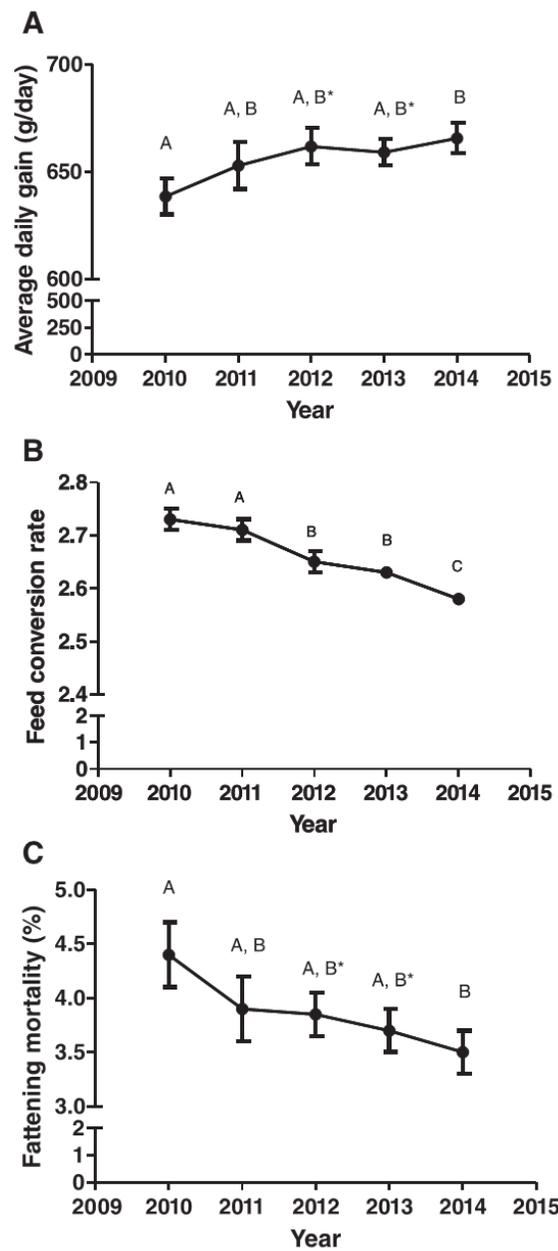
Impacto económico de las enfermedades sobre la producción porcina: **Rocadembosch**

- Establecen un marco de investigación, alcance
- Establecen unos parámetros productivos y económicos sobre los que se hará un seguimiento
- Hacen un análisis

Table 3 Monthly collected and calculated production parameters and pig production cost for each pig production company from 2010 to 2014 in Spain

Production phase	Parameter
Piglet production phase (gestation and lactation)	Number of piglets born alive (NBA)
	Prewaning mortality (%) (PM1)
	Number of piglets weaned by sow (NW)
	Number of piglets produced by sow and year (NPWY)
	Number of cycles by sow and year (NCS)
	Feed price for sows (Euros/tonne) (FP1)
	Kilograms of sow feed per weaned piglet (KFWP)
	Total kilograms of sow feed by year (TSF)
	Cost per Weaned piglet (Euros) (CWP1)

Nursery phase (from weaning to 19 kg of bw)	Nursery average daily gain (g/day) (ADG2)
	Nursery feed conversion rate (FCR2)
	Nursery mortality (%) (NM2)
	Feed price for nursery (Euros/tonne) (FP2)
	Cost per nursery piglet (Euros) (CNP2)
Fattening phase (from 19 to 108 kg of bw)	Drug and vaccine cost per nursery piglet ^a (DVCNP2)
	Fattening average daily gain (g/day) (ADG3)
	Fattening feed conversion rate (FCR3)
	Fattening mortality (%) (FM3)
	Feed price for fattening (Euros/tonne) (FP3)
Whole production phase	Total cost per pig (Euros) (TCP3)
	Drug and vaccine cost during fattening phase (DVCFP3)
	Total feed conversion rate (FCRT)
	Total cost per produced Kg (TCK)
	Total feed cost (Euros) per pig (TFC)
	Total drug and vaccine cost (Euros) per pig (DVCT)
	Total fixed cost (Euros) per pig (TFIXC)
Total reproduction cost (Euros) per pig (TREPC)	



*Statistical tendency with 2010

Fig. 4 Temporal evolution of average daily gain (a), feed conversion rate (b) and fattening mortality (c) during fattening phase from 2010 to 2014 in Spain. Values with different superscripts differ significantly between years at $P < 0.05$

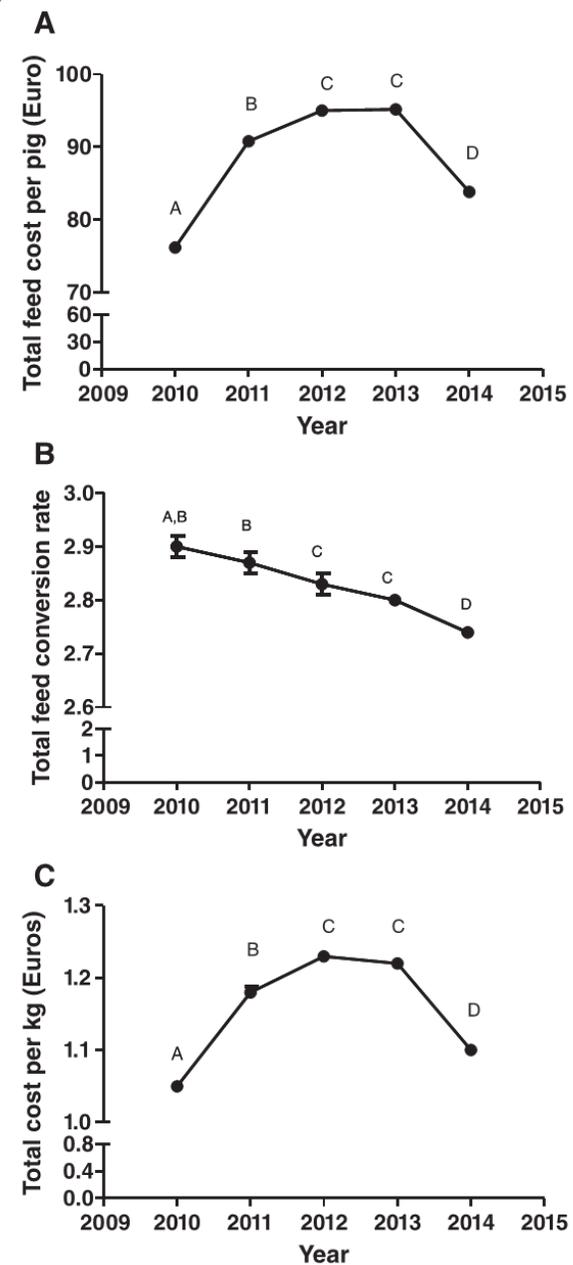


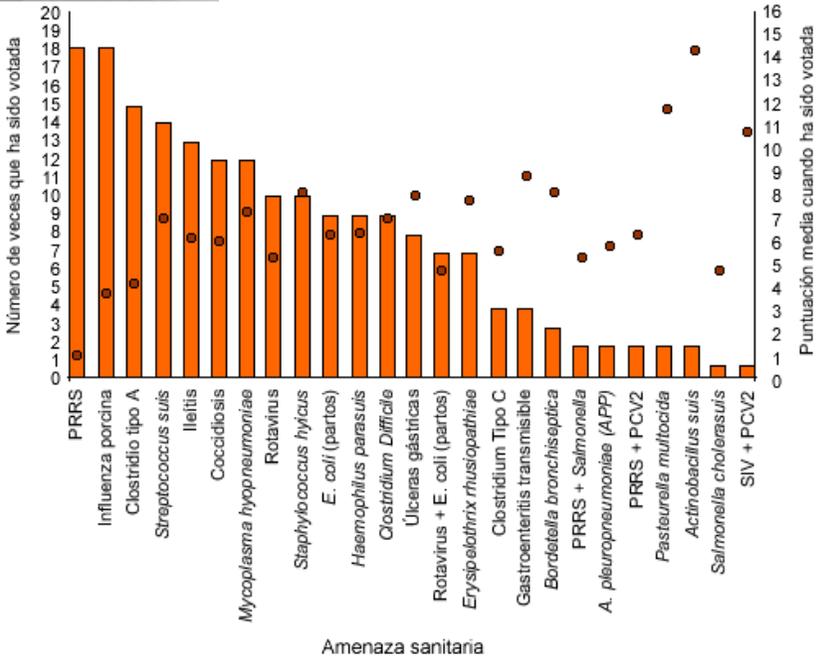
Fig. 5 Temporal evolution of total feed cost per pig (a), feed conversion rate (b) and total cost per kilogram (c) during the whole rearing period from 2010 to 2014 in Spain. Values with different superscripts differ significantly between years at $P < 0.05$

Rocadembosch, J., et al. 2016.
 «Production Parameters and
 Pig Production Cost: Temporal Evolution
 2010–2014».
Porcine Health Management 2 (1): 1-9.

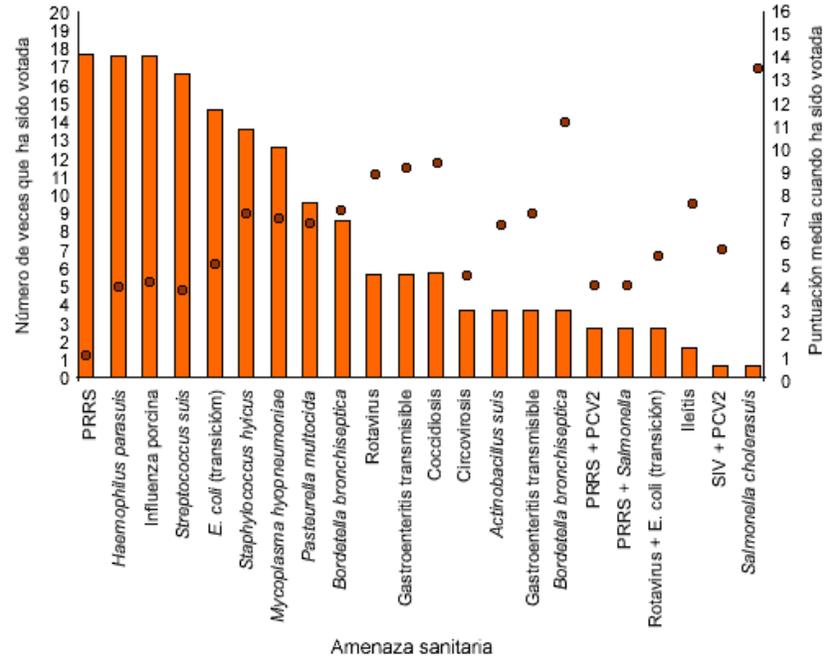
Control y erradicación de enfermedades

- ¿Sobre qué enfermedades enfocarnos?

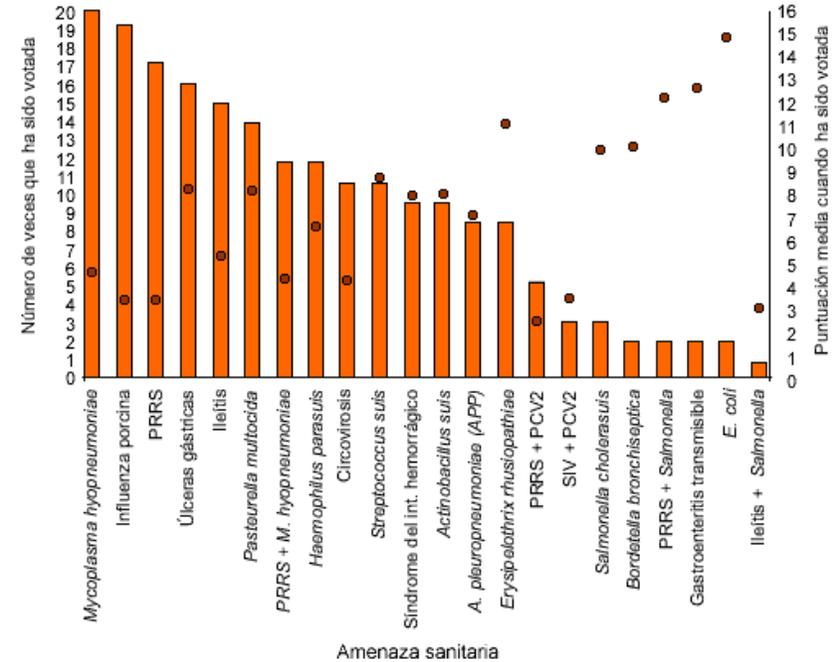
Breeding herd



Nursery



Fattening



«Economic Cost of Major Health Challenges in Large US Swine Production Systems—Part 1». s. f.. <https://www.thepigsite.com/articles/economic-cost-of-major-health-challenges-in-large-us-swine-production-systemspart-1>.

https://www.3tres3.com/articulos/coste-economico-de-las-principales-enfermedades-en-grandes-explotacion_1921/

Holtkamp, D.. Economic cost of major health challenges in large us swine production systems. Swine News 30(3 y4) del North Carolina Cooperative Extension Service.

Variación de ADG y ADFI debido a diferentes desafíos sanitarios



Meta analysis of feed intake and growth responses of growing pigs after a sanitary challenge

Animal (2012), 6:6, pp 952–961 © The Animal Consortium 2011
 doi:10.1017/S175173111100228X



Meta-analysis of feed intake and growth responses of growing pigs after a sanitary challenge

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Pastorelli H, van Milgen J, Lovatto P, Montagne L. Meta-analysis of feed intake and growth responses of growing pigs after a sanitary challenge. *animal*. 2012 Jun;6(06):952–61

Meta analysis of feed intake and growth responses of growing pigs after a sanitary challenge

Table 2 Characteristics of experiments used in the meta-analysis to quantify the effect of a sanitary challenge on feed intake and growth in pigs

	Digestive bacterial infections		Poor housing conditions		LPS challenge		Mycotoxicoeses		Parasitic infections		Respiratory diseases	
	<i>n</i> ^a	Mean ± s.d.	<i>n</i>	Mean ± s.d.	<i>n</i>	Mean ± s.d.	<i>n</i>	Mean ± s.d.	<i>n</i>	Mean ± s.d.	<i>n</i>	Mean ± s.d.
Experimental protocols												
Animal number/treatment	96	13 ± 12	98	50 ± 55	54	18 ± 11	190	10 ± 9	47	13 ± 6	32	30 ± 30
Weaning age (days)	93	29 ± 11	94	26 ± 4	47	21 ± 5	159	29 ± 4	31	30 ± 3	32	19 ± 7
Initial age ^b (days)	93	32 ± 11	94	30 ± 8	47	31 ± 7	159	38 ± 12	31	71 ± 15	29	38 ± 15
Initial BW ^b (kg)	78	9.8 ± 6.3	96	11.0 ± 7.5	54	12.9 ± 13.7	190	13.6 ± 10.0	45	24.8 ± 4.6	32	13.1 ± 8.7
Duration of experiments (days)	96	17 ± 9	102	31 ± 19	54	21 ± 8	190	42 ± 27	47	79 ± 13	32	35 ± 29
Responses^c												
Feed intake reduction (%)	49	8.1 ± 12.1***	54	3.9 ± 10.3**	24	9.8 ± 13.3*	92	23.1 ± 27.7***	32	2.9 ± 8.7*	15	16.3 ± 14.6***
Growth rate reduction (%)		16.5 ± 23.1***		9.6 ± 9.6***		12.2 ± 39.5†		29.7 ± 38.2***		8.4 ± 11.0***		16.2 ± 16.0**
Difference between feed intake and growth reduction		*		**		ns		ns		*		ns

LPS = lipopolysaccharide.

^aNumber of treatments used for calculating the mean.

^bAt the beginning of the experimental challenge.

^cThe response was calculated as the difference between challenged pigs and control pigs and expressed as a percentage of the control.

****P* < 0.001; ***P* < 0.01; **P* < 0.05; †*P* < 0.15; ns = non-significant.

Meta analysis of feed intake and growth responses of growing pigs after a sanitary challenge

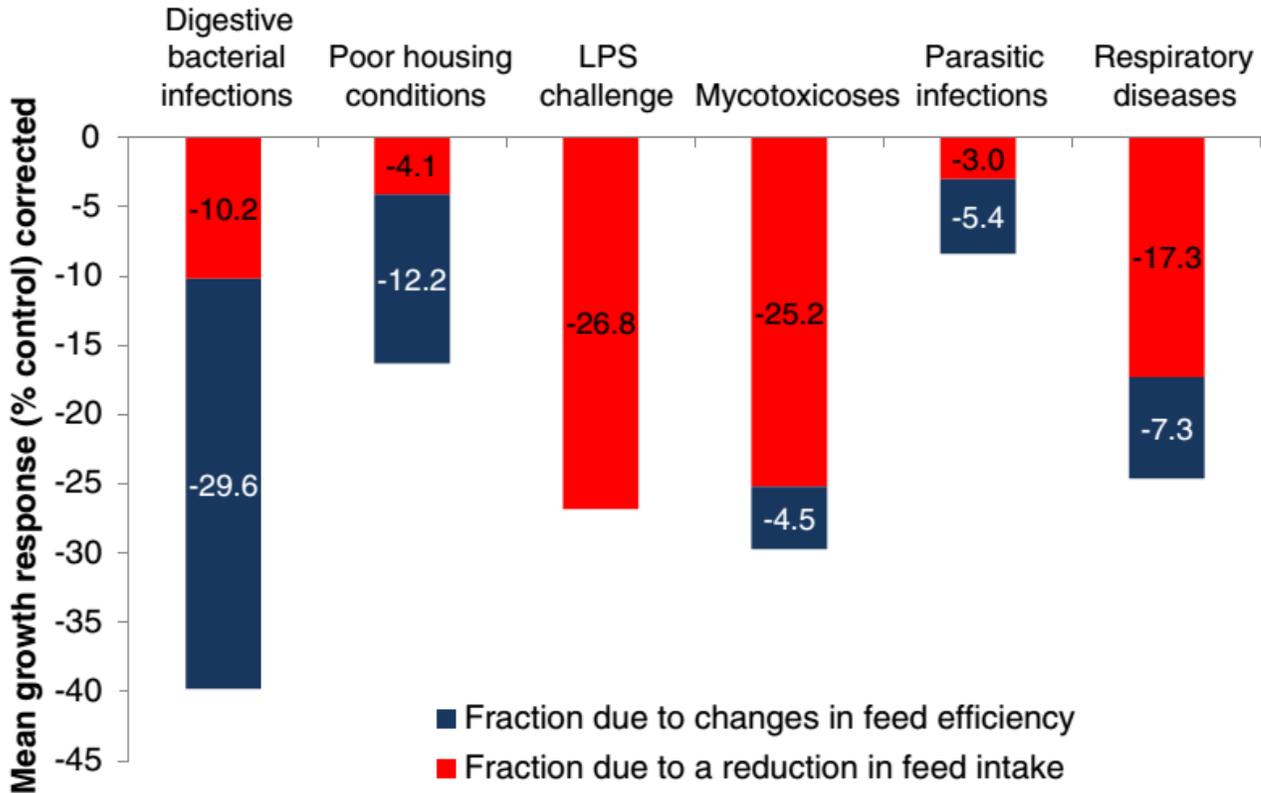


Figure 2 Metabolic consequences of an activated immune system. Partitioning the percentage decrease in average daily gain and feed efficiency as a result of different immune challenges (adapted from Pastorelli et al. [9]).

Pastorelli H, van Milgen J, Lovatto P, Montagne L. Meta-analysis of feed intake and growth responses of growing pigs after a sanitary challenge. *animal*. 2012 Jun;6(06):952–61

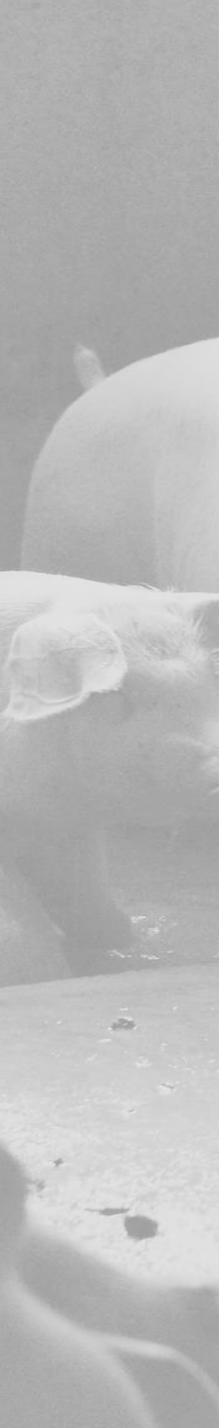
Meta analysis of feed intake and growth responses of growing pigs after a sanitary challenge

- Los desafíos sanitarios:
 - La estimulación del sistema inmunitario
- Respuestas del animal:
 - Reducción en la ingesta de pienso
 - Aumento en el gasto energético, la síntesis de proteínas corporales y catabolismo, y la temperatura corporal
 - Mediada por glucagón, corticosterona y citoquinas que regulan el metabolismo de los nutrientes, la función inmune y el crecimiento

Las consecuencias de los desafíos sanitarios en el crecimiento

- La reducción del crecimiento no sólo es debida a la reducción de ADFI, también es debida a un aumento en los requisitos digestivos y metabólicos
- Daños en las células intestinales: capacidad del hospedador para digerir y absorber nutrientes, reduciendo la disponibilidad de aminoácidos y energía
- La energía y los aminoácidos son necesarios para la síntesis de citoquinas, anticuerpos, proteínas de fase aguda y células inmunitarias específicas

Impacto económico de las enfermedades sobre la producción porcina: **un método**



Impacto económico de las enfermedades sobre la producción porcina: **un método**

- **Parámetros objetivo:**
 - Resultados zootécnicos
 - Calidad de la canal
 - Beneficio neto.
- **Dos metodologías:**
 - Tiempo fijo
 - Peso fijo
- Peso individualizado para conocer la variación
- En cada corral, todo tipo de pesos
- Cada cerdo caracterizado como:
 - Cerdos eliminados por morbilidad
 - Cerdos muertos
 - Cerdos a mercado normal
 - Cerdos ligeros de peso
- Marcados con corral y nave
- Características de la canal
- Fluidos orales a los 7, 63 y 105 días del inicio

Impacto económico de las enfermedades sobre la producción porcina: **un método**

- **Valores fijos de mercado para el cálculo económico**
 - **Gastos:**
 - Pienso
 - Animales
 - Medicinas y veterinario
 - Transporte
 - Integración y otros gastos
 - **Ingresos:**
 - Animales a mercado normal
 - Animales a mercado de bajo peso
- **Caracterización del impacto sanitario:**
 - Datos de laboratorio sobre las enfermedades objetivo (PRRS e Influenza):
 - Alto, medio y bajo impacto

Impacto económico de las enfermedades sobre la producción porcina: **SIP consultors S.L.**

- Identificar factores de producción alterados
- Seguimiento a lo largo del tiempo
- Cuantificar la desviación económica

Impacto económico de las enfermedades sobre la producción porcina: un método

- Estudio del impacto sanitario sobre los parámetros objetivo

Table 3. The effect of three HC and sex on pig fate in grow-finish pigs raised under commercial conditions¹

Item	HC ²			Sex ³			Pooled SEM	P value ⁴	
	LCh	MCh	HCh	Barrows	Mixed	Gilts		HC	Sex
No. pens	36	30	36	44	12	46			
No. pigs	911	756	885	1095	304	1153			
Full-value ⁵ , %	89.2 ^a	80.5 ^b	70.6 ^c	80.1	83.4	80.2	2.6	<0.001	0.496
Light cull ⁵ , %	4.2	6.9	3.2	3.9	4.4	5.6	1.4	0.061	0.168
Mortality ⁵ , %	3.3 ^a	7.7 ^b	19.9 ^c	10.1	6.4	8.3	1.9	<0.001	0.181
Morbidity ⁵ , %	3.1	5.0	6.5	5.0	4.6	4.4	1.4	0.079	0.836

^{a-c} within a row, least square means lacking a common superscript differ, $P < 0.05$.

¹Three 1,000 pig grow-finish facilities, located on the same production site in Iowa, were each populated with 936 crossbred pigs (Cambrough female [PIC 1050] × DNA600 terminal sire); this study did not start until approximately 34 d post weaning (13.1 ± 0.2 kg of BW). Pigs remained on test until achieving marketing BW (130.5 ± 1.4 kg).

²Least square means of HC.

³Least square means of sex.

⁴Probability values for main effects of HC or sex.

⁵Average start body weight used as a covariate.

Cornelison, A S, et al. 2018. «Impact of Health Challenges on Pig Growth Performance, Carcass Characteristics, and Net Returns under Commercial Conditions». *Translational Animal Science* 2 (1): 50-61.

Impacto económico de las enfermedades sobre la producción porcina: un método

- Estudio del impacto sanitario sobre la productividad

Table 4. The effect of three HC and sex on whole body and carcass based growth performance in grow-finish pigs raised under commercial conditions¹

Item	HC ²			Sex ³			Pooled SEM	P value ⁴	
	LCh	MCh	HCh	Barrows	Mixed	Gilts		HC	Sex
Start BW, kg	13.3	13.7	12.4	13.0	13.1	13.2	0.2	<0.001	0.186
Final BW ⁵ , kg	129.1	130.6	130.6	133.6 ^z	130.5 ^y	126.1 ^x	1.4	0.354	<0.001
Start BW CV, %	21.0 ^a	–	26.2 ^b	23.7	23.6	23.6	1.0	<0.001	0.984
End BW CV, %	12.2 ^a	–	15.5 ^b	14.3	14.0	13.3	0.8	<0.001	0.328
ADG ⁵ , kg	0.86 ^a	0.79 ^b	0.74 ^c	0.82 ^z	0.80 ^{zy}	0.77 ^y	0.01	<0.001	<0.001
ADFI ⁵ , kg	2.05 ^a	2.00 ^a	1.83 ^b	2.06 ^z	1.95 ^y	1.85 ^x	0.03	<0.001	<0.001
G:F ⁵	0.42 ^a	0.40 ^b	0.40 ^b	0.40 ^x	0.41 ^y	0.42 ^z	0.004	<0.001	<0.001
Carcass basis									
ADG ⁵ , kg	0.61 ^a	0.55 ^b	0.50 ^c	0.56 ^z	0.56 ^z	0.54 ^y	0.01	<0.001	0.004
G:F ⁵	0.30 ^a	0.28 ^b	0.28 ^b	0.27 ^y	0.29 ^z	0.29 ^z	0.004	<0.001	<0.001

^{a-c} or ^{z-x} within a row, least square means lacking a common superscript differ, $P < 0.05$.

¹Three 1,000 pig grow -finish facilities, located on the same production site in Iowa, were each populated with 936 crossbred pigs (Cambrough female [PIC 1050] × DNA600 terminal sire); this study did not start until approximately 34 d post weaning (13.1 ± 0.2 kg of BW). Pigs remained on test until achieving marketing BW (130.5 ± 1.4 kg).

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Impacto económico de las enfermedades sobre la producción porcina: un método

- Estudio del impacto sanitario sobre los parámetros de la canal

Table 5. The effect of HC and sex on carcass measurements in grow-finish pigs raised under commercial conditions¹

Item	HC ²			Sex ³			Pooled SEM	P value ⁴	
	LCh	MCh	HCh	Barrows	Mixed	Gilts		HC	Sex
Days to market ^{5,6}	133 ^a	143 ^b	148 ^c	141	141	141	0.2	<0.001	0.085
Market weight ⁵ , kg	129.3 ^b	132.6 ^a	132.6 ^a	135.0 ^z	132.0 ^y	127.5 ^x	1.3	0.010	<0.001
HCW ⁵ , kg	93.5 ^b	98.2 ^a	97.6 ^a	99.0 ^z	94.0 ^y	93.7 ^x	1.0	<0.001	<0.001
Yield, %	72.4 ^c	74.1 ^a	73.6 ^b	73.3	73.2	73.5	0.2	<0.001	0.189
Lean, %	55.1	54.8	54.8	53.4 ^x	55.2 ^y	56.4 ^z	0.2	0.428	<0.001
Loin depth, mm	60.2	60.7	60.5	60.1	60.5	60.9	0.6	0.662	0.200
Fat depth, mm	18.1	18.6	18.5	20.7 ^z	18.4 ^y	16.1 ^x	0.3	0.235	<0.001

^{a-c} or ^{z-x} within a row, least square means lacking a common superscript differ, $P < 0.05$.

¹Three 1,000 pig grow-finish facilities, located on the same production site in Iowa, were each populated with 936 crossbred pigs (Cambrough female [PIC 1050] × DNA600 terminal sire); this study did not start until approximately 34 d post weaning (13.1 ± 0.2 kg of BW). Pigs remained on test until achieving marketing BW (130.5 ± 1.4 kg).

²Least square means of HC.

³Least square means of sex.

⁴Probability values for main effects of HC or sex.

⁵Average start body weight used as a covariate.

⁶Days to market = total pig days ÷ sum of market value pig and light-cull pigs.

Cornelison, A S, et al. 2018. «Impact of Health Challenges on Pig Growth Performance, Carcass Characteristics, and Net Returns under Commercial Conditions». *Translational Animal Science* 2 (1): 50-61.

Impacto económico de las enfermedades sobre la producción porcina: un método

- Estudio del impacto sanitario sobre el beneficio a peso fijo.

Table 6. The calculated economic impact of an increasing HC, assuming all pigs sold using a fixed-weight model, 130 kg

Parameter	LCh ¹¹	MCh ¹¹	HCh ¹¹
Production times			
Days on feed ¹	138	152	165
Days to market ²	133	143	148
Production impact			
Total pigs placed, pig	2,400	2,400	2,400
Total pigs marketed full value ³ , pig	2,141	1,932	1,694
Live weight produced ⁴ , kg	278,304.00	251,160.00	220,272.00
Carcass weight produced ⁵ , kg	201,881.72	186,059.33	162,164.25
Pigs sold secondary market ⁶ , pig	101	166	77
Economic impact			
Total revenue ⁷ , \$	306,172.58	287,504.63	245,631.76
Total costs ⁸ , \$	273,712.57	276,498.39	259,371.08
Net profit ⁹ , \$	32,460.01	11,006.24	(13,739.32)
Profit/pig marketed, \$	15.16	5.70	(8.11)
Profit/pig placed, \$	13.53	4.59	(5.72)
Opportunity lost ¹⁰ , \$	–	21,453.77	46,199.33
Loss/pig marketed ¹⁰ , \$	–	9.47	23.27
Loss/pig placed ¹⁰ , \$	–	8.94	19.25

¹Days on feed = total pig days (including mortality and morbidity) ÷ total pigs marketed full value.

²Average days to market required to achieve the target end body weight.

³Total pigs marketed full value = total pigs placed – (mortality + morbidity + pigs sold to secondary market).

⁴Live weight produced = total pigs marketed full value × 130 kg.

⁵Carcass weight produced = live weight produced × % yield.

⁶Pigs that were considered underweight or cull animals.

⁷Total revenue = (carcass weight produced × \$/kg full-value pig) + (pigs sold secondary market × \$/pig secondary market).

⁸Cost of feeder pig, yardage, veterinarian, trucking, and feed.

⁹Net profit = total revenue – total costs.

¹⁰Comparison of the LCh to the MCh and HCh net profit loss for the total barn and per pig marketed and per pig placed.

¹¹All currency in USD.

Cornelison, A S, et al. 2018. «Impact of Health Challenges on Pig Growth Performance, Carcass Characteristics, and Net Returns under Commercial Conditions». *Translational Animal Science* 2 (1): 50-61.

Impacto económico de las enfermedades sobre la producción porcina: un método

- Análisis de sensibilidad de los cerdos vendidos/no vendidos frente a diferentes precios del pienso y del precio del producto

Table 7. Sensitivity of loss/pig marketed to alternative commodity prices (sensitivity analysis) due to an increasing HC, assuming all pigs sold using a fixed-weight model, 130 kg

Change in HC	Feeder pig, primary and secondary market pig prices ¹	Feed costs ¹		
		20% price increase	Baseline ²	20% price decline
LCh to MCh	20% price increase	10.44	9.62	8.79
	Baseline ³	10.29	9.47	8.64
	20% price decline	10.14	9.32	8.49
LCh to HCh	20% price increase	21.96	21.20	20.44
	Baseline ³	24.03	23.27	22.51
	20% price decline	26.10	25.34	24.58
MCh to HCh	20% price increase	11.52	11.59	11.65
	Baseline ³	13.74	13.81	13.87
	20% price decline	15.96	16.02	16.09

¹All currency in USD.

²Baseline price for feed costs \$201.67/t.

³Baseline price for feeder pigs \$41.63/pig, primary market pigs \$1.48/kg carcass weight and secondary market pigs \$73.29/pig.

Impacto económico de las enfermedades sobre la producción porcina: un método

- Estudio del impacto sanitario sobre el beneficio a tiempo fijo.

Table 8. The calculated economic impact of an increasing HC, assuming all pigs sold using a fixed-time model, 133 d

Parameter	LCh ¹¹	MCh ¹¹	HCh ¹¹
Production times			
Days on feed ¹	138	142	149
Days to market ²	133	133	133
Production impact			
Total pigs placed, pig	2,400	2,400	2,400
Total pigs marketed full value ³ , pig	2,141	1,932	1,694
Live weight produced ⁴ , kg	277,476.59	24,0579.94	206,654.51
Carcass weight produced ⁵ , kg	202,557.91	175,623.36	150,857.79
Pigs sold secondary market ⁶ , pig	101	166	77
Economic impact			
Total revenue ⁷ , \$	307,173.34	272,059.39	228,898.21
Total costs ⁸ , \$	273,558.28	266,082.02	245,103.21
Net profit ⁹ , \$	33,615.06	5,977.37	(16,205.00)
Profit/pig marketed, \$	15.70	3.09	(9.56)
Profit/pig placed, \$	14.01	2.49	(6.75)
Opportunity lost ¹⁰ , \$	–	27,637.69	49,820.06
Loss/pig marketed ¹⁰ , \$	–	12.61	25.27
Loss/pig placed ¹⁰ , \$	–	11.52	20.76

¹Days on feed = total pig days (including mortality and morbidity) ÷ total pigs marketed full value.

²Set days allowed for this model.

³Total pigs marketed full value = total pigs placed – (mortality + morbidity + pigs sold to secondary market).

⁴Live weight produced = total pigs marketed full value × (13.1 kg + [ADG × 133 d]).

⁵Carcass weight produced = live weight produced × % yield.

⁶Pigs that were considered underweight or cull animals.

⁷Total revenue = (carcass weight produced × \$/kg full-value pig) + (pigs sold secondary market × \$/pig secondary market).

⁸Cost of feeder pig, yardage, veterinarian, trucking, and feed.

⁹Net profit = total revenue – total costs.

¹⁰Comparison of the LCh to the MCh and HCh net profit loss for the total barn and per pig marketed and per pig placed.

¹¹All currency in USD.

Cornelison, A S, et al. 2018. «Impact of Health Challenges on Pig Growth Performance, Carcass Characteristics, and Net Returns under Commercial Conditions». *Translational Animal Science* 2 (1): 50-61.

Impacto económico de las enfermedades sobre la producción porcina: un método

- Análisis de sensibilidad de los cerdos vendidos/no vendidos frente a diferentes precios del pienso

Table 9. Sensitivity of loss/pig marketed to alternative commodity prices (sensitivity analysis) due to an increasing HC, assuming all pigs sold using a fixed-time model, 133 d

Change in HC	Feeder pig, primary and secondary market pig prices ¹	Feed costs ¹		
		20% price increase	Baseline ²	20% price decline
LCh to MCh	20% price increase	11.12	11.07	11.02
	Baseline ³	12.66	12.61	12.56
	20% price decline	14.20	14.08	14.10
LCh to HCh	20% price increase	20.71	21.13	21.55
	Baseline ³	24.85	25.27	25.69
	20% price decline	28.98	29.33	29.82
MCh to HCh	20% price increase	9.59	10.06	10.53
	Baseline ³	12.19	12.66	13.13
	20% price decline	14.78	15.25	15.72

¹All currency in USD.

²Baseline price for feed costs \$201.67/t.

³Baseline price for feeder pigs \$41.63/pig, primary market pigs \$1.48/kg carcass weight and secondary market pigs \$73.29/pig.

Impacto económico de las enfermedades sobre la producción porcina: **variabilidad**

- En el anterior modelo, no se ha tenido en cuenta la variabilidad de determinados parámetros
- Renken (2021) propone una modelización parecida pero basándose en el trabajo de Nathues (2017):

Table 1 Farm data and economic data describing the breeding part of 21 herds endemically infected with Porcine Reproductive and Respiratory Syndrome Virus (PRRSV) and suffering from corresponding disease in sows, weaners, growers or finishing pigs

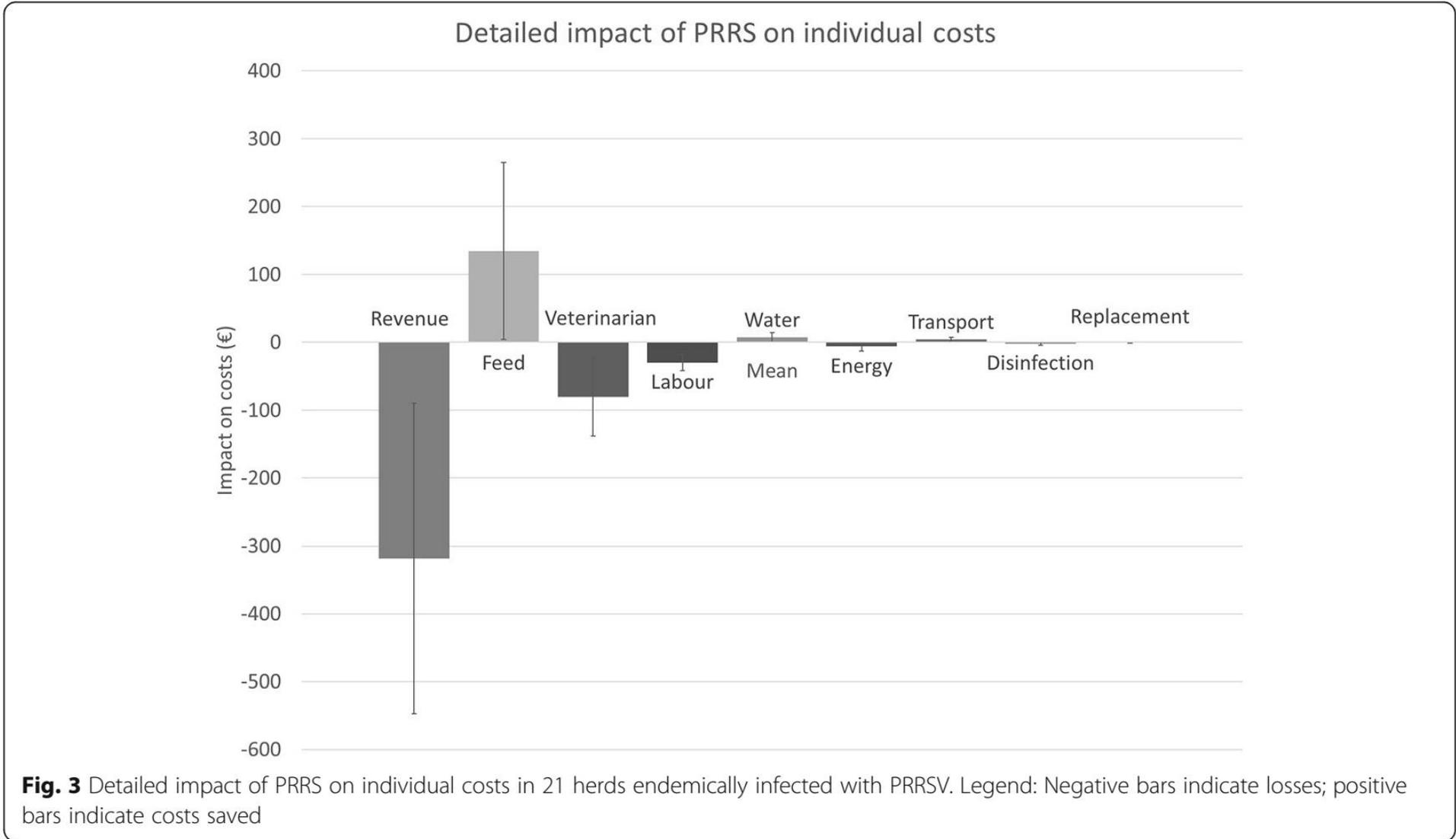
<i>Breeding</i>	<i>Median</i>	<i>Min.</i>	<i>Max.</i>	<i>Mean</i>	<i>SD</i>
Farm data					
Number of working sows in the farm per year (n)	330	150	1200	355	215
Production rhythm (weeks)	3	1	5	2.9	1.07
Length of suckling period (weeks)	4	3	4	3.7	0.5
Replacement rate per year (%)	39.5	26.9	50	39.3	7.2
Feed consumption (gestation) / sow from insemination to farrowing (kg)	300	275	418	316.8	42.5
Feed consumption (lactation) per sow during suckling period (kg)	160	90	260	167	43.8
<i>Return-to-estrus rate (%)^a</i>	8.4	3	20	8.9	4.3
<i>Abortions (%)^a</i>	1.6	0.3	15	2.5	3.1
<i>Piglets born alive per sow per litter (n)^a</i>	15.7	11.7	18.4	15.4	1.5
<i>Prewaning mortality (%)^a</i>	13.6	10	19	13.7	2.5
<i>Weight of suckling pigs at weaning (kg)^a</i>	7.4	5.3	9.5	7.1	1.1
Economic data					
Price per 1000 kg gestation feed (€)	232.25	211.00	380.00	245.29	40.61
Price per 1000 kg lactation feed (€)	278.00	258.00	420.00	287.18	39.40
Veterinary cost per sow per year incl. vaccination costs (€)	193.60	80.00	250.00	177.02	47.81
Price per dose PRRS vaccination (sow) incl. labour (€)	1.56	1.00	2.40	1.60	0.32
Price per dose PRRS vaccination (piglet) incl. labour (€)	1.49	0.33	1.81	1.34	0.44
Costs for a replacement gilt (€)	350.00	250.00	400.00	348.40	39.46
Price per sow slaughtered / replaced (€)	240.00	191.00	500.00	250.69	69.91
Price per semen dose (€)	4.00	2.20	6.00	4.21	1.16
Energy cost per sow and year (€)	62.50	40.00	196.00	73.57	42.73
Labour cost per sow and year (€)	250.00	131.25	438.00	244.48	83.13
Building cost per sow and year (€)	100.00	25.00	200.00	103.90	51.38
Equipment cost per sow and year (€)	10.00	5.00	200.00	44.31	77.20
Inspection, Levy and Insurance cost per sow and year (€)	15.75	1.00	47.00	18.33	13.17
Transport costs for slaughter sows per sow (€)	4.40	0.00	17.00	4.56	4.55
Any other variable cost per sow and year (€)	0.00	0.00	0.00	0.00	0.00
Any other fix cost per sow and year (€)	0.00	0.00	155.80	9.56	34.40

^aParameters in italic are the ones potentially altered if the farm is affected by PRRS

Table 5 Median annual loss attributable to PRRS per sow for each herd, derived from the actual farm budget minus the 'negative' farm budget from Table 4, and annual loss for the herd in total and in the breeding, nursery and fattening part

Farm no.	Loss per year (€)				
	Per sow	Farm total	Breeding part	Nursery part ^a	Fattening part
1	568	85,263	8952	- 8480	84,791
2	461	138,454	24,132	-10,587	124,909
3	305	54,443	8886	25,502	20,055
4	258	84,085	19,958	10,991	53,136
5	375	74,181	16,375	- 7003	64,809
6	209	60,430	17,582	1199	41,649
7	243	53,396	16,370	1912	35,113
8	265	135,225	48,487	10,612	76,126
9	220	72,661	19,289	9889	43,483
10	225	76,447	32,409	1525	42,513
11	298	67,246	12,093	- 702	55,854
12	255	306,395	43,142	18,011	245,243
13	205	55,312	9945	4246	41,121
14	178	60,586	7443	16,757	36,386
15	286	100,211	27,314	- 6462	79,360
16	288	57,528	18,000	8853	30,674
17	306	122,393	29,985	-22,956	115,364
18	176	70,324	22,298	6036	41,991
19	46	16,540	7846	- 680	9375
20	202	90,503	16,679	8368	65,456
21	221	90,371	21,618	- 2253	71,006
Median	255	74,181	18,000	1912	53,136

^aNegative values mean that the herd did not see a loss but saved costs in the nursery part



Impacto económico de las enfermedades sobre la producción porcina: **variabilidad**

- Modelo Nathues (2017):

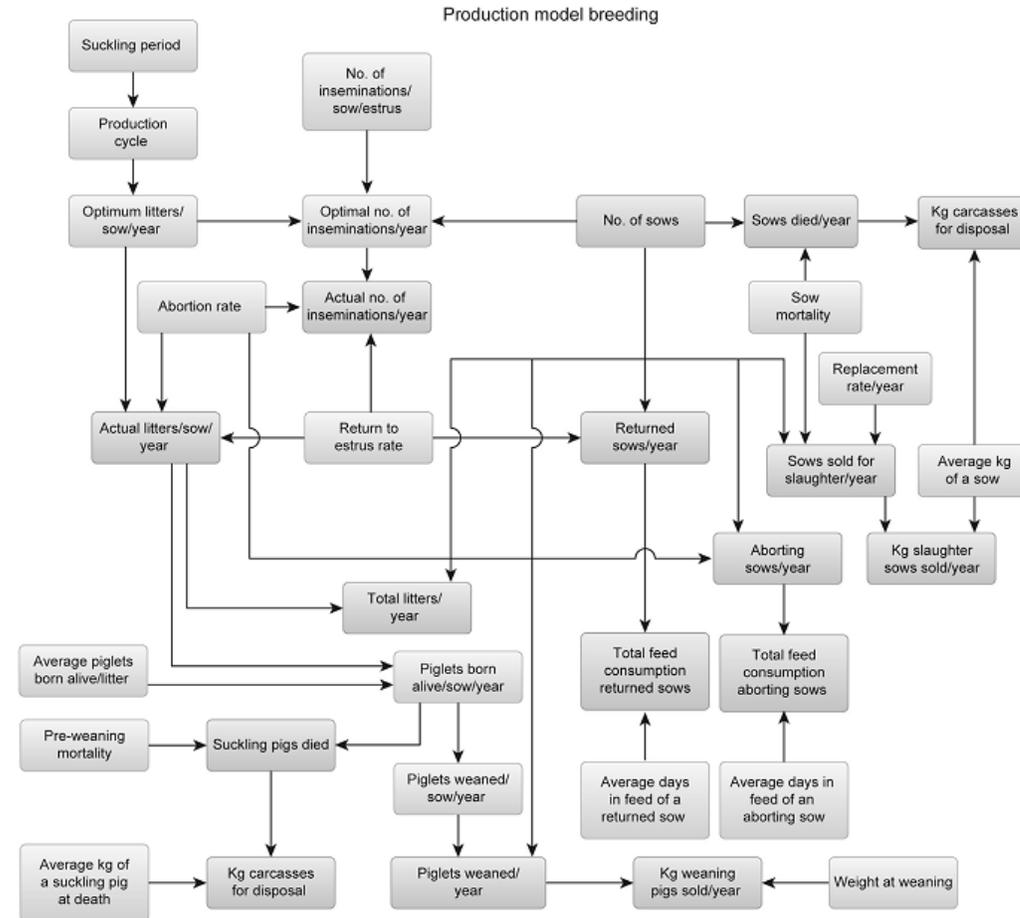


Fig. 1. Schematic production model of the breeding part in a sow herd.

Impacto económico de las enfermedades sobre la producción porcina: **variabilidad**

- **Modelo Nathues (2017):**

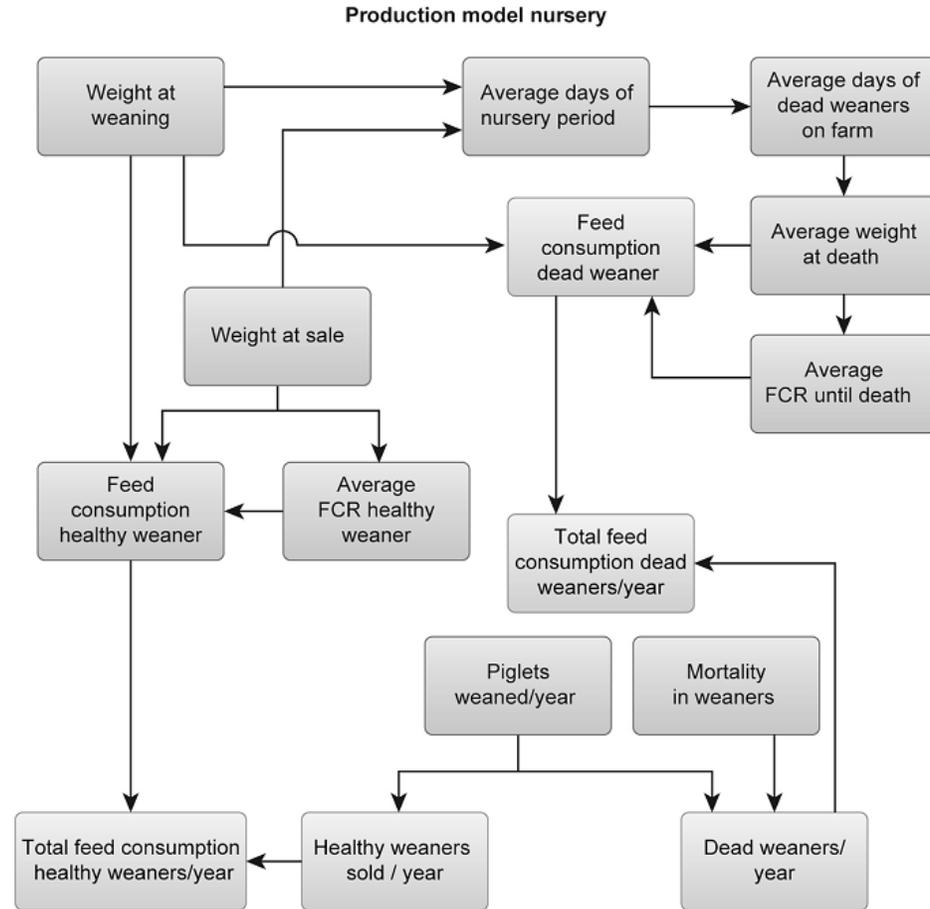


Fig. 2. Schematic production model – nursery part; the fattening part is similar, except (I) that the FCR also depends on the start weight and a correction factor is applied because of a big variation between countries; and (II) that the calculation of days in fattening does not require linear regression with start and end weight, but only takes the total weight gain and standard ADG from literature.

Impacto económico de las enfermedades sobre la producción porcina: **variabilidad**

- **Modelo Nathues (2017):**

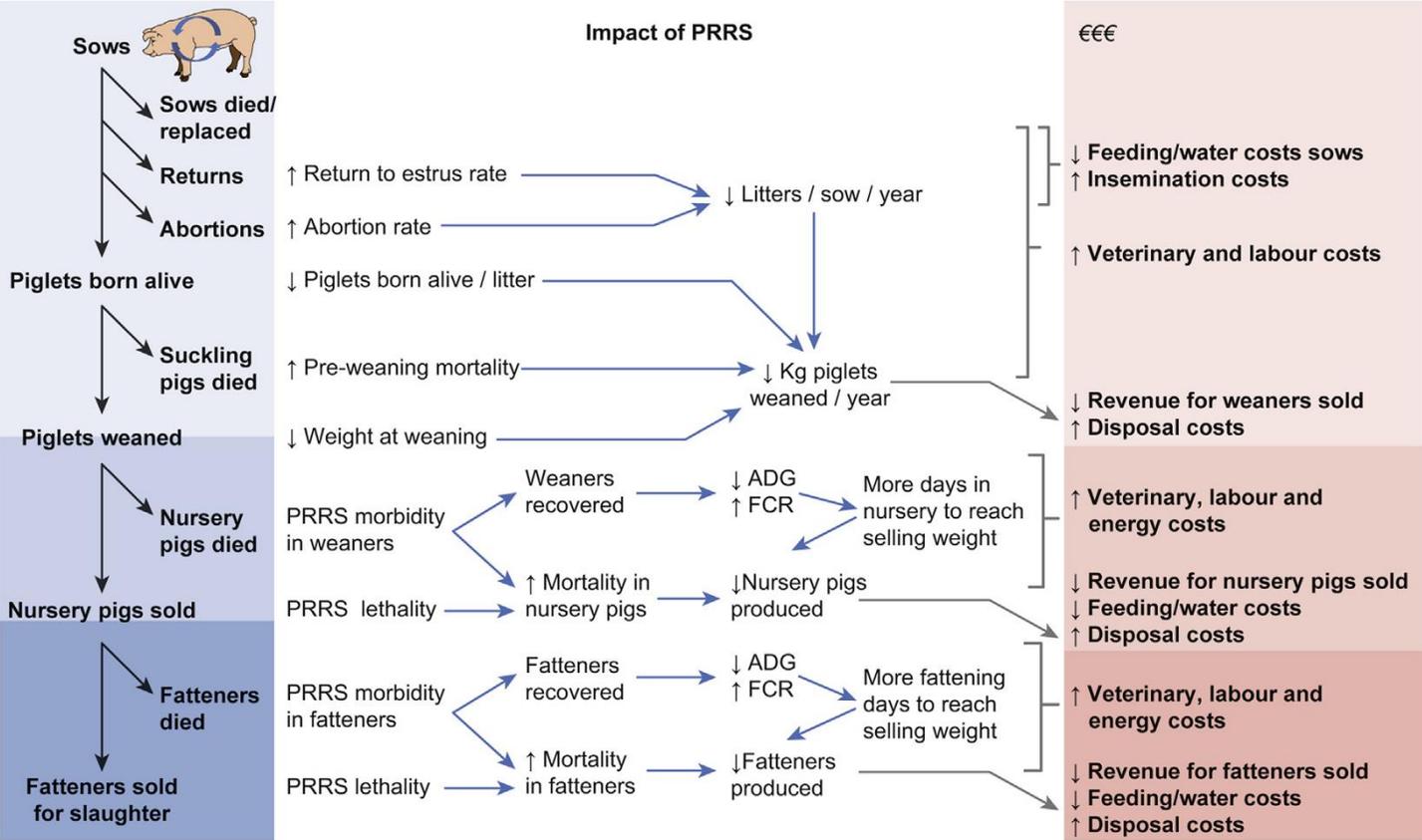


Fig. 3. Flow diagram depicting the production process (left), the influence of PRRSV at the different stages of the production process (middle) and the resulting impact on costs (right). (ADG = average daily weight gain, FCR = feed conversion ratio).

Impacto económico de las enfermedades sobre la producción porcina: **variabilidad**

- **Modelo Nathues (2017):**

Table 3

Parameters with general change in a PRRS affected farm and their minimum (Min), most likely (ML) and maximum (Max) values used in PERT distributions.

Parameter	Min	ML	Max	Reference
Veterinary cost				expert opinion
Increase in vet cost per sow due to PRRS (%)	8.0	25.0	50.0	
Increase in vet cost per weaner due to PRRS (%)	5.0	25.0	300.0	
Increase in vet cost per fattener due to PRRS (%)	2.0	10.0	50.0	
Labour cost				expert opinion
Extra labour cost per sow per 1 point of severity score (%)	1.0	3.0	10.0	
Increase in labour cost per weaner due to PRRS (%)	2.0	15.0	100.0	
Increase in labour cost per fattener due to PRRS (%)	0.0	5.0	20.0	
Feed consumption				
Days of reduction in feed consumption of a PRRS returned sow	3	7	10	assumption
Reduction in feed consumption of a PRRS returned sow (%)	30.0	50.0	70.0	assumption
Increase in average FCR until sale for a PRRS-diseased weaner (%)	3.0	5.0	8.0	Anonymous (2013b) , Anonymous (2017, n.d.) ; Neumann et al. (2005)
Increase in average FCR until slaughter for a PRRS-diseased fattener (%)	5.0	8.0	10.0	
Lethality in PRRS-diseased pigs				expert opinion
Lethality in PRRS-diseased weaners (%)	0.0	5.0	30.0	
Lethality in PRRS-diseased fattener (%)	0.0	3.0	10.0	

Impacto económico de las enfermedades sobre la producción porcina: **variabilidad**

• Modelo Nathues (2017):

Table 4

Different example scenarios used to parametrize the production model of a PRRS affected farm and corresponding default baseline values for a negative farm, assumed to be constant over one year (values for the parameters in sows are per sow group, values for the parameters in suckling, weaning and fattening pigs like morbidity and mortality are cumulative figures over the whole indicated period that animals spend in nursery or fattening).

Parameter	Negative farm	Example scenarios for clinical affectedness in a diseased farm								
	Baseline values ^a	Repro – slightly	Respi – slightly	Repro – moderately	Respi – moderately	Repro & Respi – mod.	Repro & Respi – slightly	Repro – severely	Respi – severely	Repro & Respi – sev.
Return-to-estrus rate (%)	10.0	11.0	10.0	13.5	10.0	13.5	11.0	15.0	10.0	15.0
Abortion rate (%)	2.0	2.5	2.0	3.9	2.0	3.9	2.5	5.0	2.0	5.0
Average piglets born alive per sow per litter ^b	12.7	12.1	12.7	11.4	12.7	11.4	12.1	10.8	12.7	10.8
Pre-weaning mortality (%)	11.0	12.0	11.0	13.5	11.0	13.5	12.0	15.0	11.0	15.0
Weight at weaning (kg)	6	6	6	5.5	6	5.5	6	5	6	5
Days in nursery	45	45	48	45	50	50	48	45	55	55
PRRS morbidity in weaners (%)	0.0	0.0	10.0	0.0	20.0	20.0	10.0	0.0	30.0	30.0
Mortality in weaners (%)	3.0	3.0	5.0	3.0	10.0	10.0	5.0	3.0	15.0	15.0
Days in fattening	119	119	122	119	127	127	122	119	135	135
PRRS morbidity in fatteners (%)	0.0	0.0	10.0	0.0	20.0	20.0	10.0	0.0	30.0	30.0
Mortality in fatteners (%)	1.5	1.5	2.0	1.5	3.0	3.0	2.0	1.5	5.0	5.0

^a Anonymous (2014a,b,c, 2012).

^b In the practical use of the model, the corresponding baseline value will be linked to the sow genetic.

Impacto económico de las enfermedades sobre la producción porcina: **variabilidad**

- **Modelo Nathues (2017):**

Table 7

Median gross margins (GM) and enterprise budgets (EB) per sow per year for the different scenarios, first the outcome for the diseased farm (diseased model) and below in italic the corresponding value if this farm was PRRSV-negative (negative model).

	Negative/healthy	Repro slight.	Respi slight.	Repro & Respi slight.	Repro mod.	Respi mod.	Repro & Respi mod.	Repro sev.	Respi sev.	Repro & Respi sev.
GM (€)										
Diseased	682	603	625	549	493	515	351	403	389	174
<i>Negative^a</i>	<i>682</i>	<i>704</i>	<i>713</i>	<i>735</i>	<i>712</i>	<i>723</i>	<i>751</i>	<i>718</i>	<i>736</i>	<i>766</i>
EB (€)										
Diseased	-232	-311	-289	-365	-421	-399	-563	-511	-525	-740
<i>Negative^a</i>	<i>-232</i>	<i>-184</i>	<i>-189</i>	<i>-141</i>	<i>-171</i>	<i>-178</i>	<i>-120</i>	<i>-151</i>	<i>-166</i>	<i>-90</i>

^a For an explanation of the differences in the negative model outcomes between the scenarios please refer to Section 3. Economic modelling of disease impact.

Impacto económico de las enfermedades sobre la producción porcina: **variabilidad**

- **Modelo Nathues (2017):**

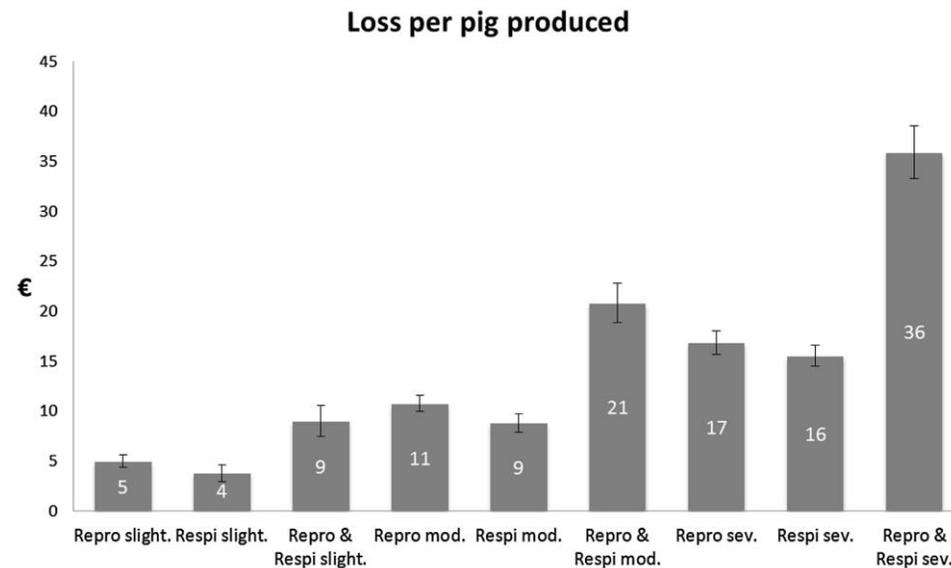


Fig. 5. Median loss per pig produced in a farrow-to-finish herd for different PRRS disease scenarios (5%ile – 95%ile as error bars).

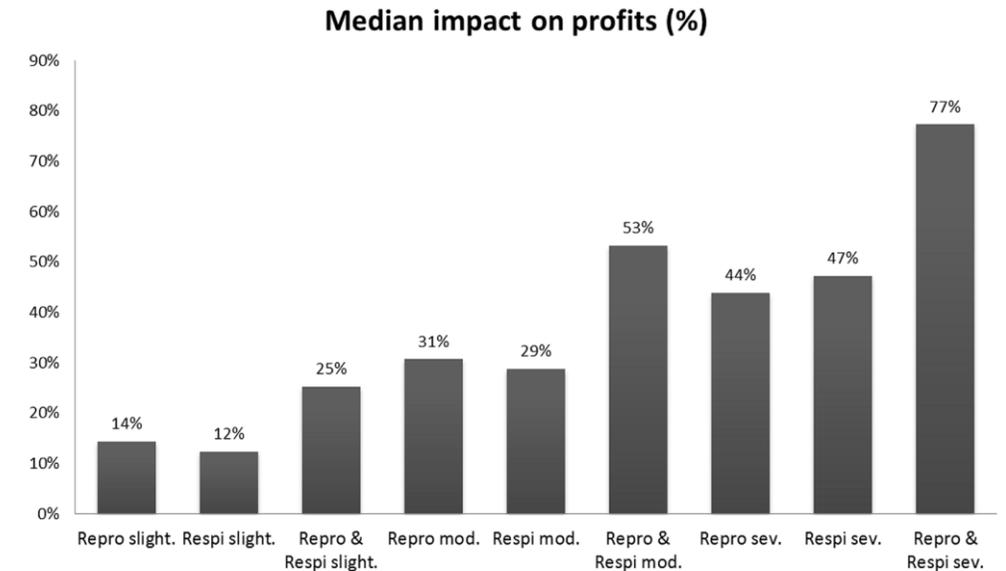
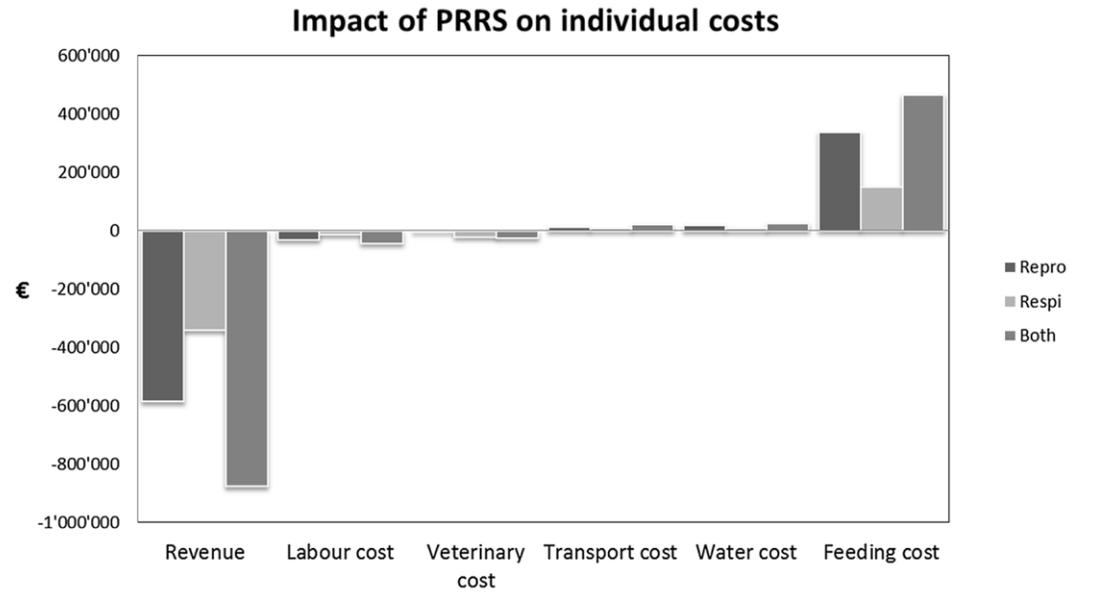
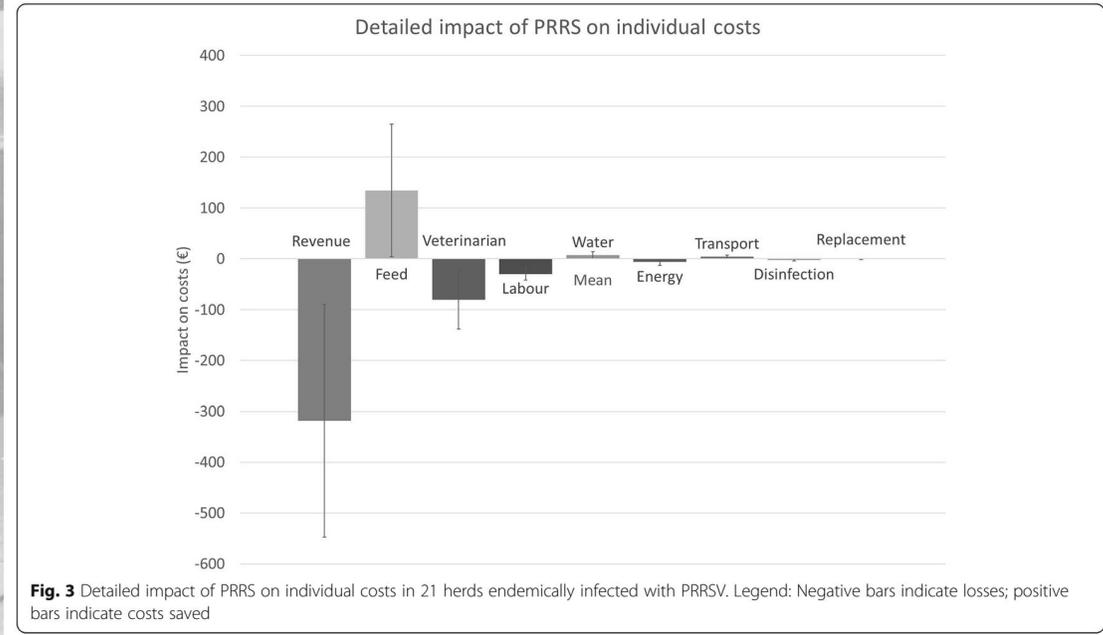


Fig. 6. Median percentage of overall farm profit lost due to PRRS in a farrow-to-finish herd for different PRRS disease scenarios.

Impacto económico de las enfermedades sobre la producción porcina: **variabilidad**

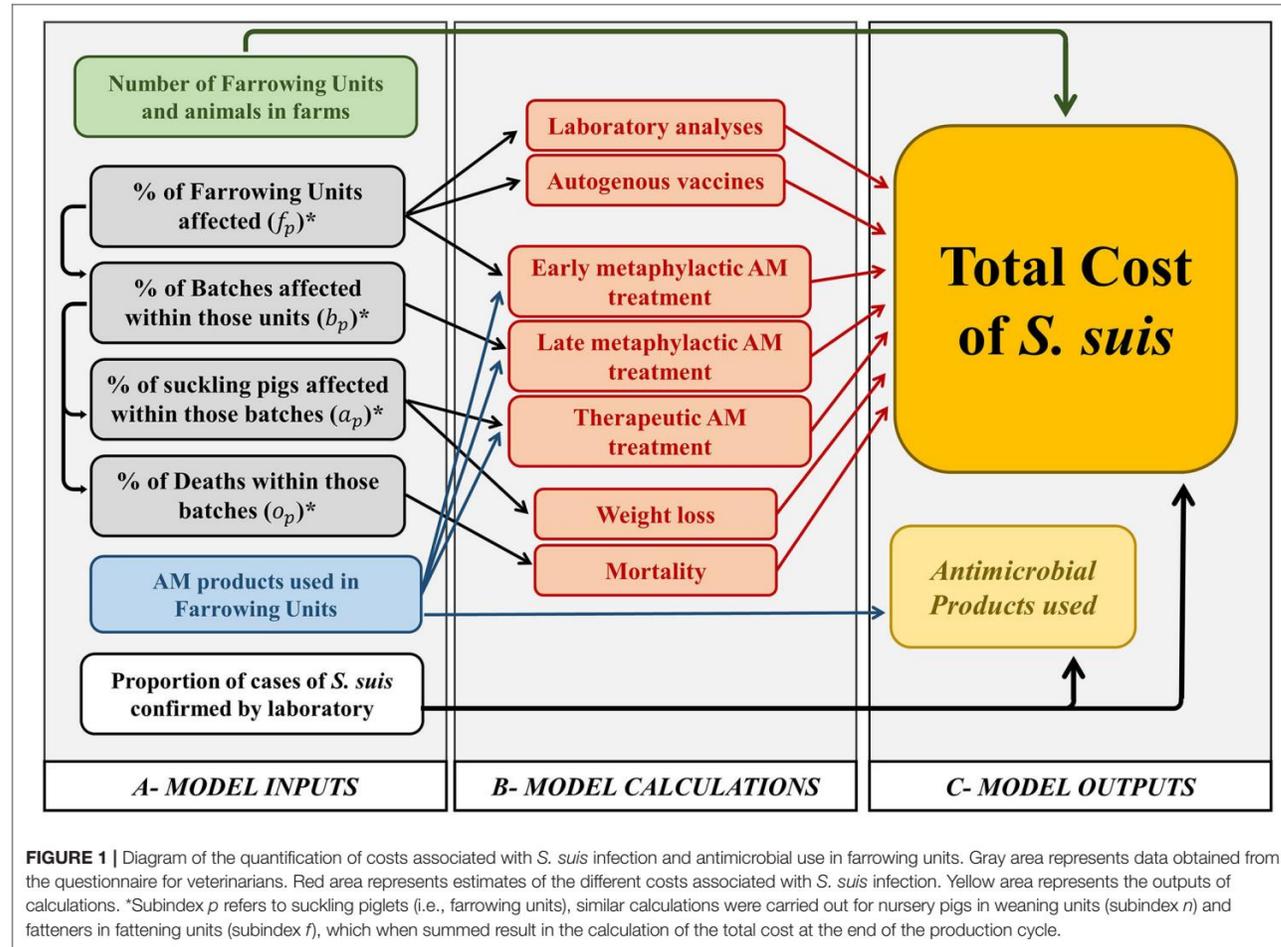
- **Modelo Nathues (2017):**



Metodologías estocásticas



Valoración estocástica del impacto económico causado por *Streptococcus suis* en cerdos



Valoración estocástica del impacto económico causado por *Streptococcus suis* en cerdos

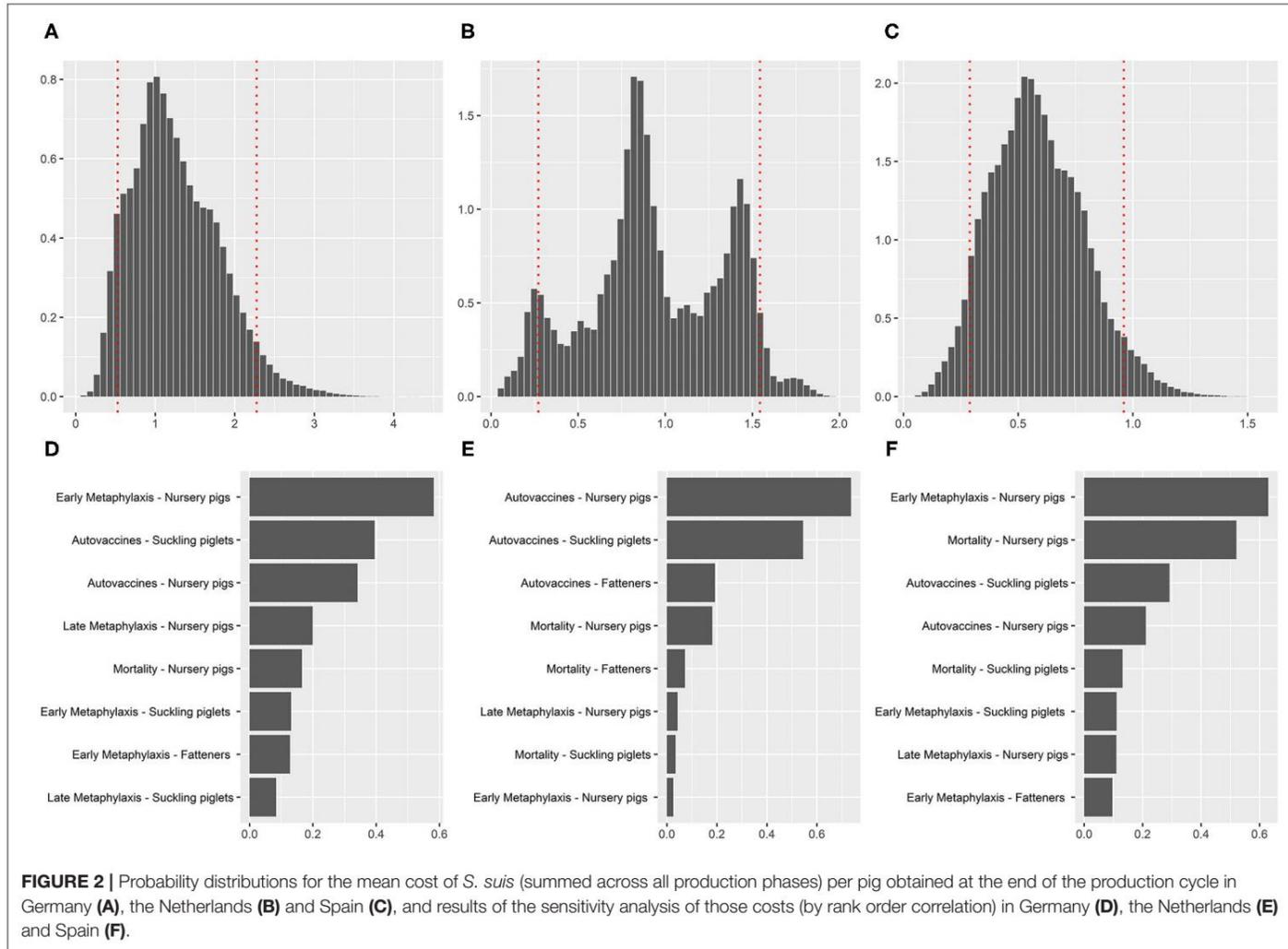
- Cuestionario para la estimación de enfermedad

TABLE 2 | Mean losses, expenditures and total cost per animal in affected production units (in euros) for the different production phases in the countries of study.

Phase	Country	Mortality	Early Metaph.	Late Metaph.	Therap.	Autogenous vaccines	Analyses	Total
Suckling piglets	Germany	0.05 (0.00–0.15)	0.15 (0.00–0.50)	0.06 (0.00–0.20)	0.01 (0.00–0.02)	0.59 (0.23–0.92)	0.01 (0.00–0.02)	0.86 (0.31–1.39)
	Netherlands	0.03 (0.00–0.06)	0.00 (0.00–0.02)	-	0.00 (0.00–0.02)	0.57 (0.00–0.91)	0.00 (0.00–0.01)	0.61 (0.03–0.96)
	Spain	0.05 (0.00–0.10)	0.02 (0.00–0.12)	0.01 (0.00–0.04)	-	0.03 (0.00–0.36)	0.00 (0.00–0.01)	0.11 (0.01–0.40)
Nursery pigs	Germany	0.24 (0.05–0.70)	0.44 (0.00–1.34)	0.17 (0.02–1.81)	0.04 (0.00–0.24)	0.17 (0.00–0.92)	0.01 (0.00–0.02)	1.06 (0.19–2.49)
	Netherlands	0.24 (0.05–0.38)	0.01 (0.00–0.04)	0.02 (0.00–0.10)	0.02 (0.00–0.07)	0.44 (0.00–0.91)	0.00 (0.00–0.01)	0.73 (0.15–1.32)
	Spain	0.19 (0.03–0.38)	0.29 (0.04–0.67)	0.05 (0.00–0.08)	0.01 (0.00–0.01)	0.04 (0.00–0.22)	0.00 (0.00–0.01)	0.57 (0.24–0.94)
Fatteners	Germany	0.02 (0.00–0.05)	0.14 (0.00–0.41)	0.05 (0.00–0.53)	0.01 (0.00–0.03)	-	0.00 (0.00–0.02)	0.22 (0.01–0.54)
	Netherlands	0.05 (0.00–0.11)	0.00 (0.00–0.02)	0.00 (0.00–0.01)	0.00 (0.00–0.01)	0.04 (0.00–0.52)	0.00 (0.00–0.01)	0.11 (0.01–0.54)
	Spain	0.04 (0.01–0.17)	0.02 (0.00–0.07)	0.01 (0.00–0.05)	-	-	-	0.07 (0.01–0.23)

In brackets, 90% confidence interval (CI) of the corresponding cost.

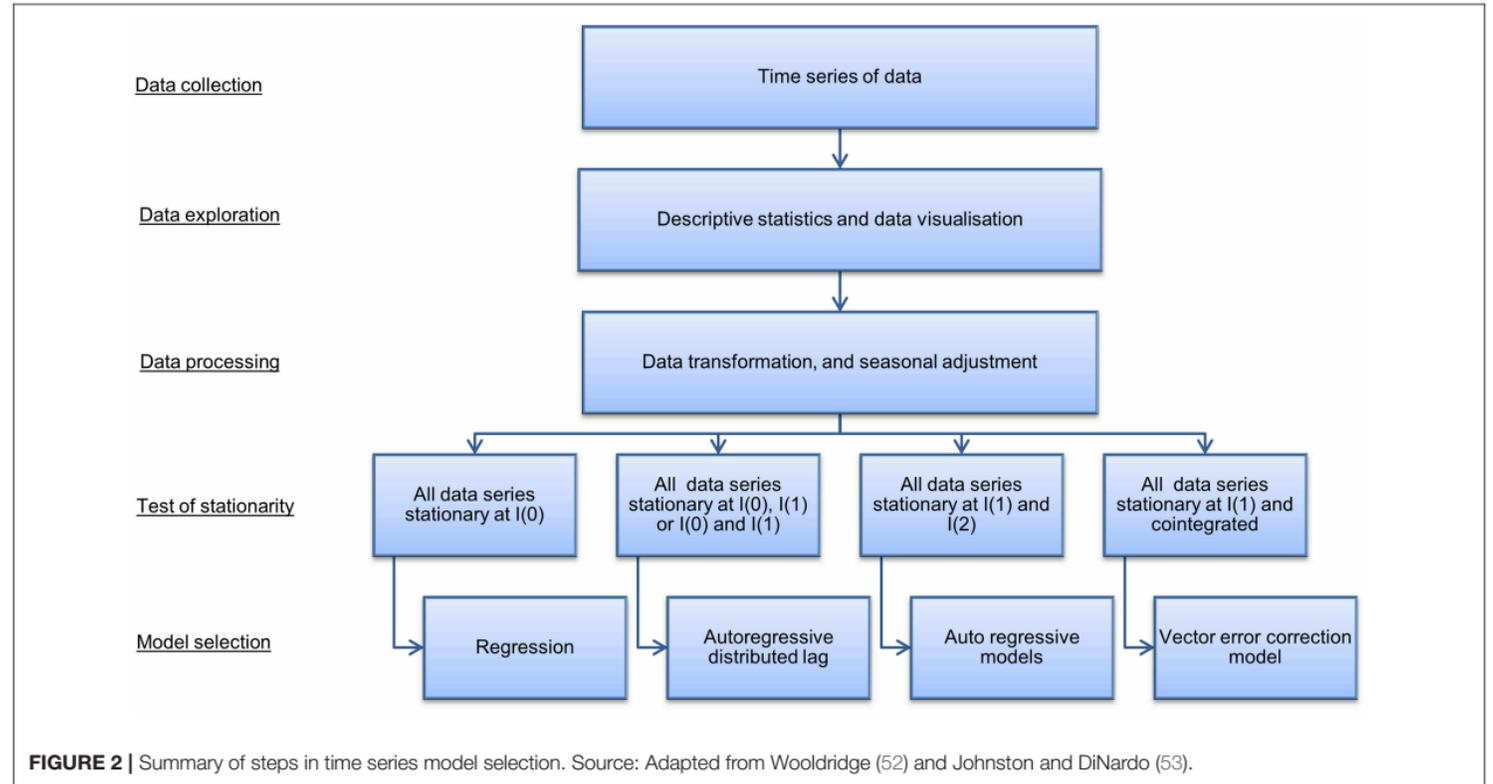
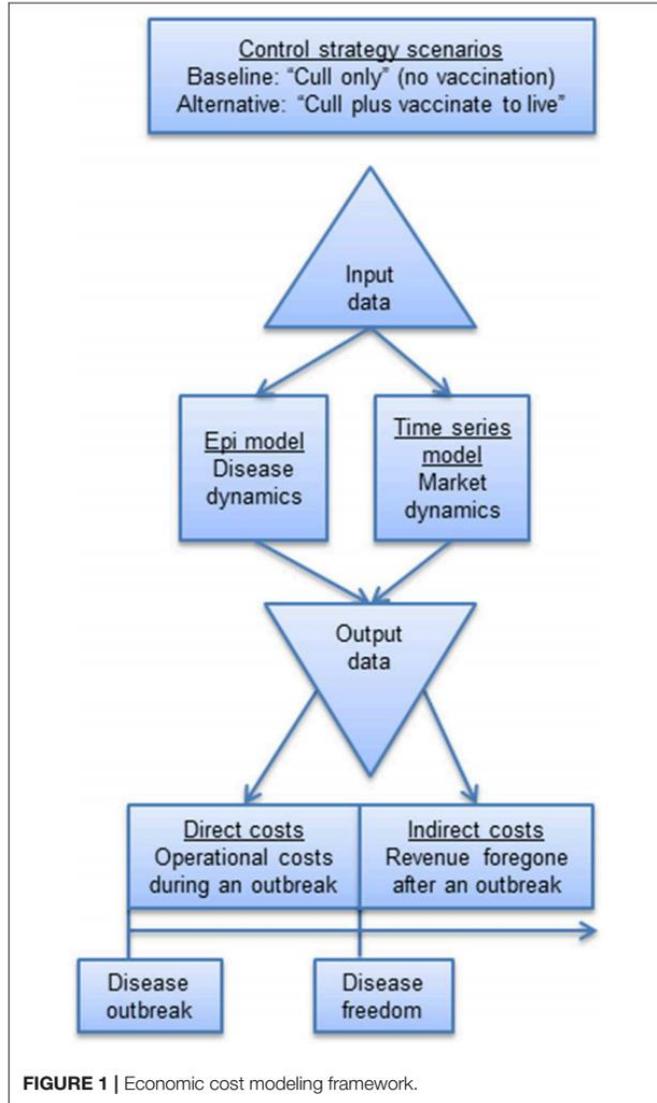
Valoración estocástica del impacto económico causado por *Streptococcus suis* en cerdos



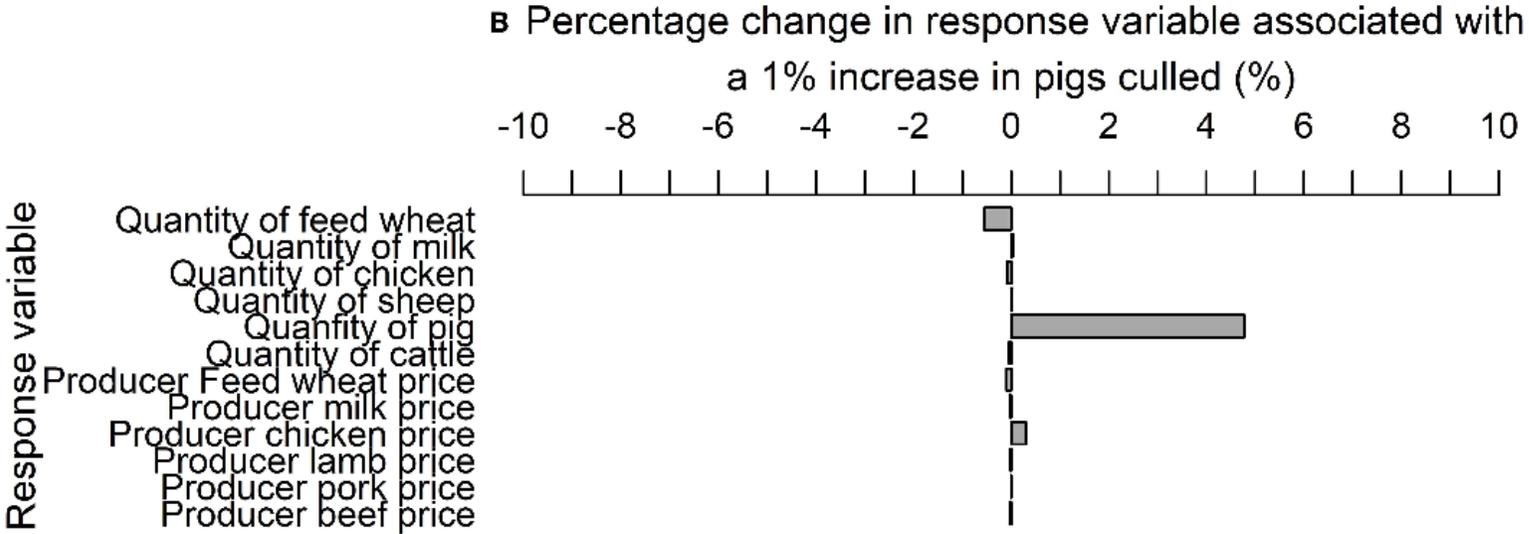
Otros métodos:

- **Population Dynamic P-system (PDP models)**

El uso de series temporales para estimar costes indirectos en salud animal: series temporales



El uso de series temporales para estimar costes indirectos en salud animal: series temporales



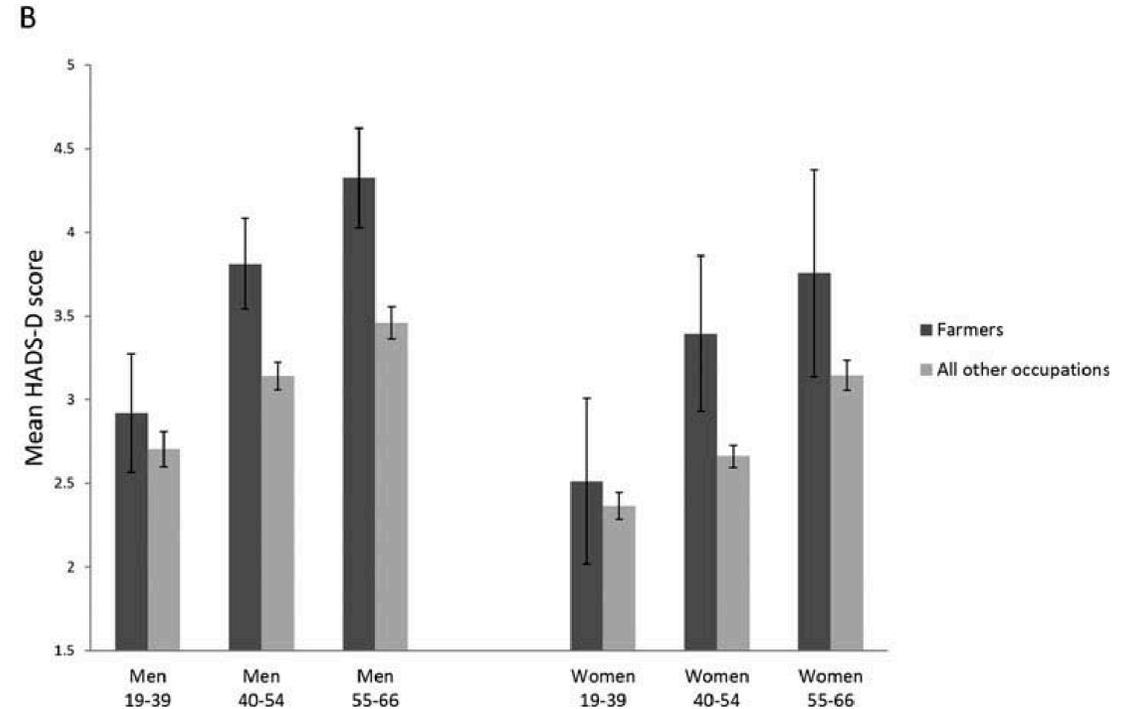
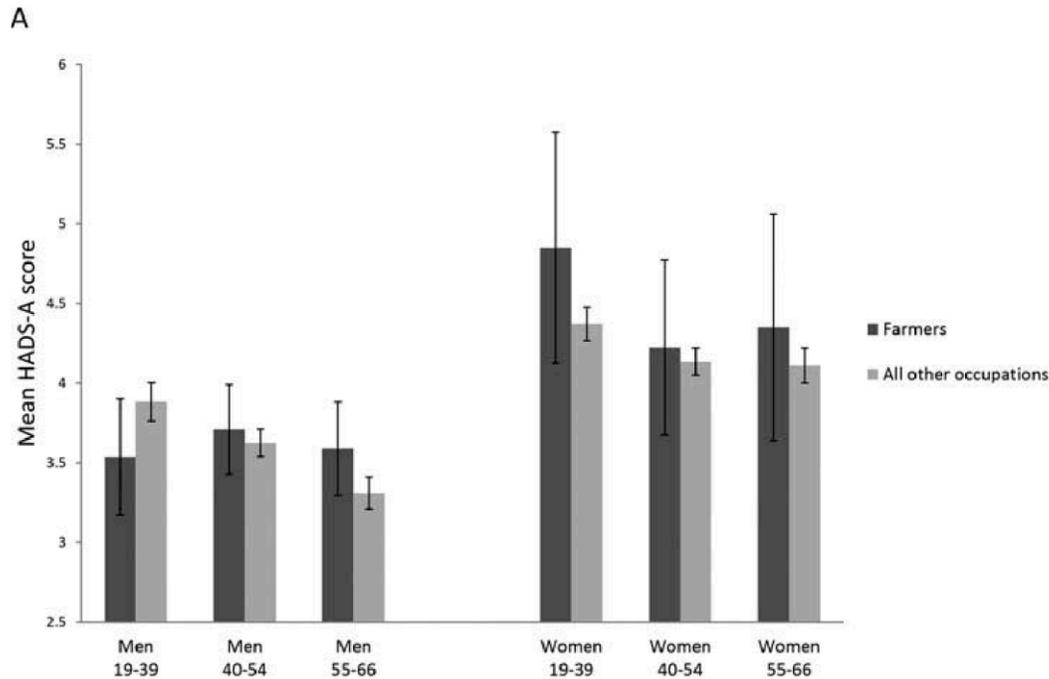
Repercusiones sociales y psicológicas en los granjeros cuando sus animales están enfermos

- Sufrir una enfermedad en el ganado no es fácil ni para el propietario ni para los empleados de la granja
- USA y UK programas de ayuda como:
 - Mind your head: Libro de ayuda, <https://www.yellowwellies.org/wp-content/uploads/2019/05/The-Little-Book-of-Minding-Your-Head.pdf>
 - Farm state of mind: <https://www.fb.org/land/fsom>

Repercusiones sociales y psicológicas en los granjeros cuando sus animales están enfermos

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- El estrés provoca que el personal trabaje por debajo de sus posibilidades y con desgana por no ser capaces de revertir las situaciones
- Suicidios
- Afectaciones del nivel emocional
- Absentismo laboral

Repercusiones sociales y psicológicas en los granjeros cuando sus animales están enfermos



A: Medias de las puntuaciones HADS-A estratificadas por sexo y grupo de edad.

B: Medias de las puntuaciones HADS-D estratificadas por sexo y grupo de edad.

2006-2008. Las barras de error representan el 95% del intervalo de confianza.

Conclusión

- Todos los modelos contienen errores...
... aunque algunos son útiles.

Metodología propuesta

CRISP-DM: Cross Industry Standard Process for Data Mining

- Comprensión del negocio
- Comprensión de los datos
- Preparación de los datos
- Modelado
- Evaluación
- Despliegue

