Can pig breeding contribute to the sustainability of low input production systems?

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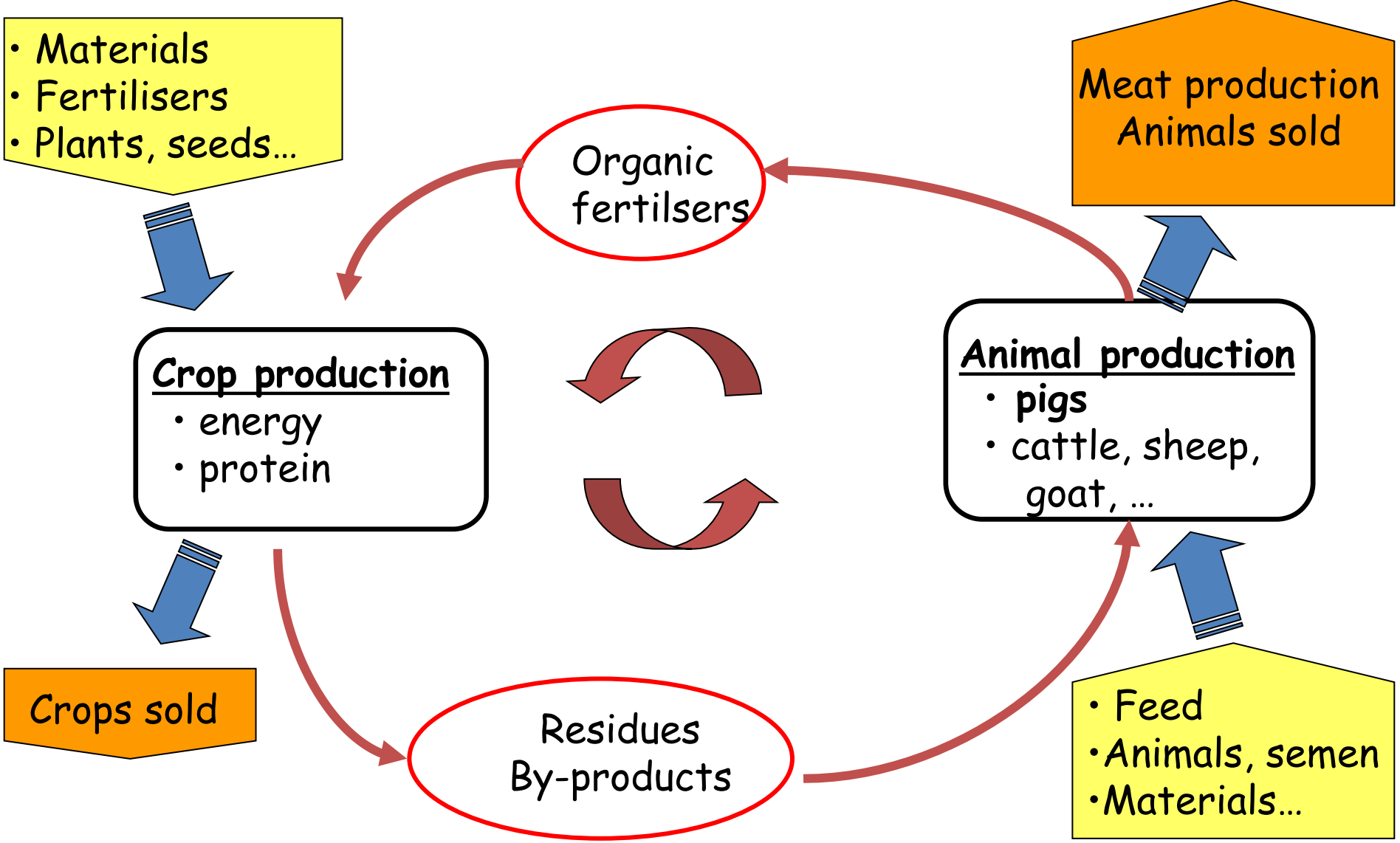
What is a “low input production system”?

Parr et al (1990): Low input farming systems “seek to optimize the management and use of internal production inputs (i.e. on-farm resources)… and to minimize the use of production inputs (i.e. off-farm resources)”

A closed nutrient cycle


• Materials
• Fertilisers
• Plants, seeds…
Organic fertilsers
Meat production
Animals sold
Crop production
• energy
• protein
Animal production
• pigs
• cattle, sheep, goat, …
Crops sold
Residues
By-products
• Feed
• Animals, semen
• Materials…

Internal resources

optimize

land for feed production
feed

waste and by-products

manure
land for pasture
water
biofuel, biogas
labour
animals for replacement

External resources

minimize

equipment, construction material

feed (soya!)
feed additives
waste and by-products
pesticides, herbicides
fertilizers

fossil fuels, electricity

animals for replacement, semen
drugs, antiseptic products

A variety of low input systems

1. Low input system as a consequence of lack of external resources

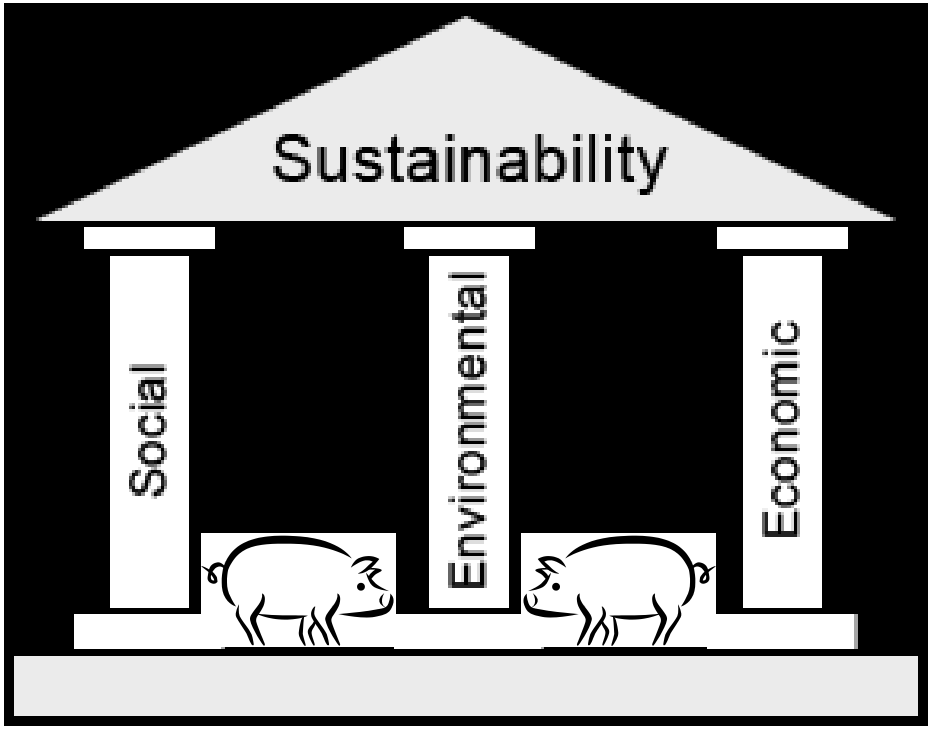
2a. Low input system based on specific added values such as cultural and regional traditions

2b. Low input system based on stated principles, e.g. organic production

Commission regulation No 889/2008 on organic production: “Preference is to be given to indigenous breeds and strains.”

Low inputs systems have a lower output of pig meat. But all systems have to be efficient, to be sustainable

Efficient in producing a combination of different goods



Wish-list of breeding goal traits for low input systems

- feed efficiency
- ability to efficiently use local feed, waste and by-products
- ability to graze and use marginal land
- stay healthy and fertile
- maternal ability
- thrive in their climate

Heat resistance in Creole and Large White sows

↑ Ambient temperature

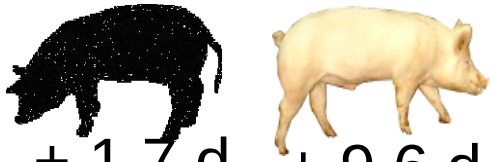
↓ Appetite

- 14 % - 20 %

↑ Mobilisation of body reserves

+ 0.3 kg + 10 kg

↓ Weaning-to-conception interval

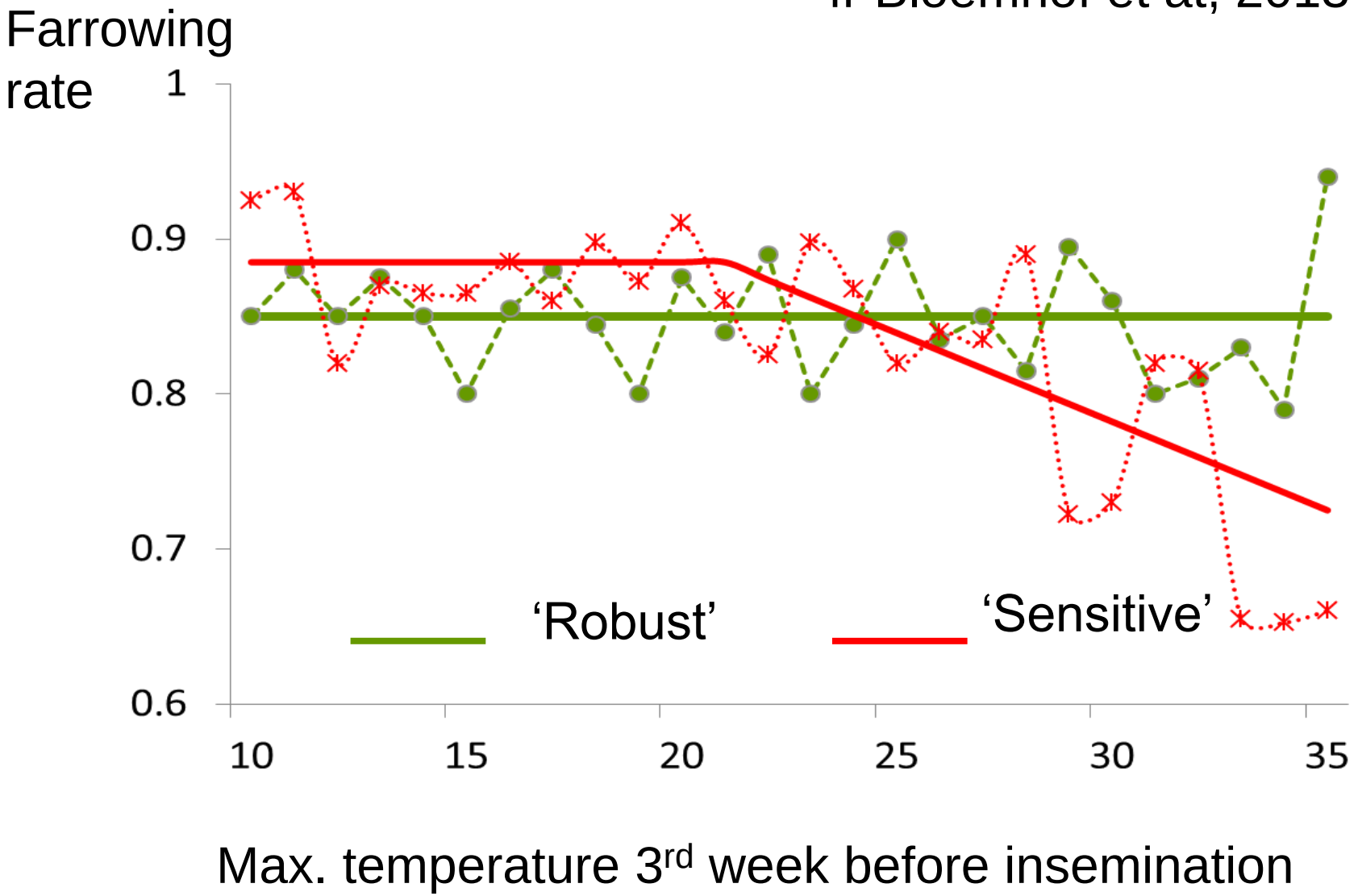


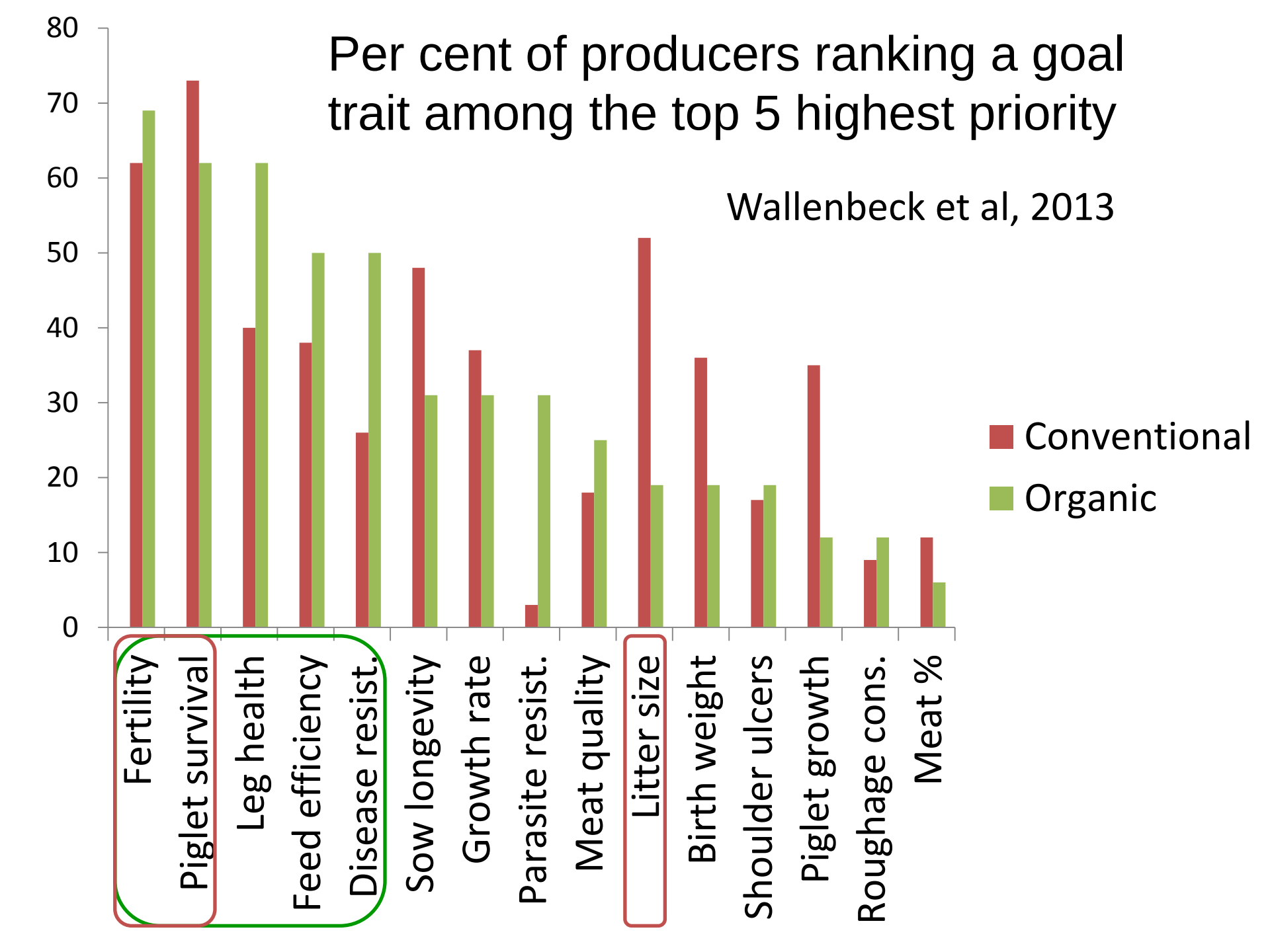
+ 1.7 d + 9.6 d

Gourdine et al, 2006

Heat resistance

fr Bloemhof et at, 2013




Per cent of producers ranking a goal trait among the top 5 highest priority
Wallenbeck et al, 2013
80
70
60
50
40
30
20
10
0
Conventional
Organic
Fertility
Piglet survival
Leg health
Feed efficiency
Disease resist.
Sow longevity
Growth rate
Parasite resist.
Meat quality
Litter size
Birth weight
Shoulder ulcers
Piglet growth
Roughage cons.
Meat %

Genetic trends from selection index, based on economic weights given by producers

	Conventional	Organic	Sign.
Piglet survival, % of live born	+	+	n.s.
Litter size, born alive	-	-	n.s.
Sow longevity, d	+	+	n.s.
Meat percentage	-	-	n.s.
Growth rate, g/d	+	+	n.s.
Disease resistance, % healthy	+	++	0.09
Parasite resistance, % healthy	+	++	0.001

Wallenbeck et al, 2012

Pig farmers opinions on 15 goal traits. Associations to

pig welfare

Leg health
Disease resistance
Shoulder ulcers
Parasite resistance
Sow longevity
Piglet survival
Piglet birth weight
Roughage consumption

environmental impact

Feed conversion
Growth rate
Piglet growth rate
Piglet survival
Roughage consumption
Disease resistance
Sow longevity

>75 % of farmers consider these goal traits important for pig welfare and environmental impact, respectively

Wallenbeck et al, 2013

Who pays for less progress in production traits?

Breeding for welfare in outdoor pig production:
A simulation study
Growth rate, lean%, litter size, piglet mortality, piglet growth, weaning-service-interval, growth rate, strong legs

To avoid deterioration:

- 3 x ‘conv. weight’ for legs
- 2 x ‘conv. weight’ for piglet mortality
- 7 x ‘conv. weight’ for weaning-service-interval

Cost in growth rate, lean% and litter size

Gourdine et al, 2010

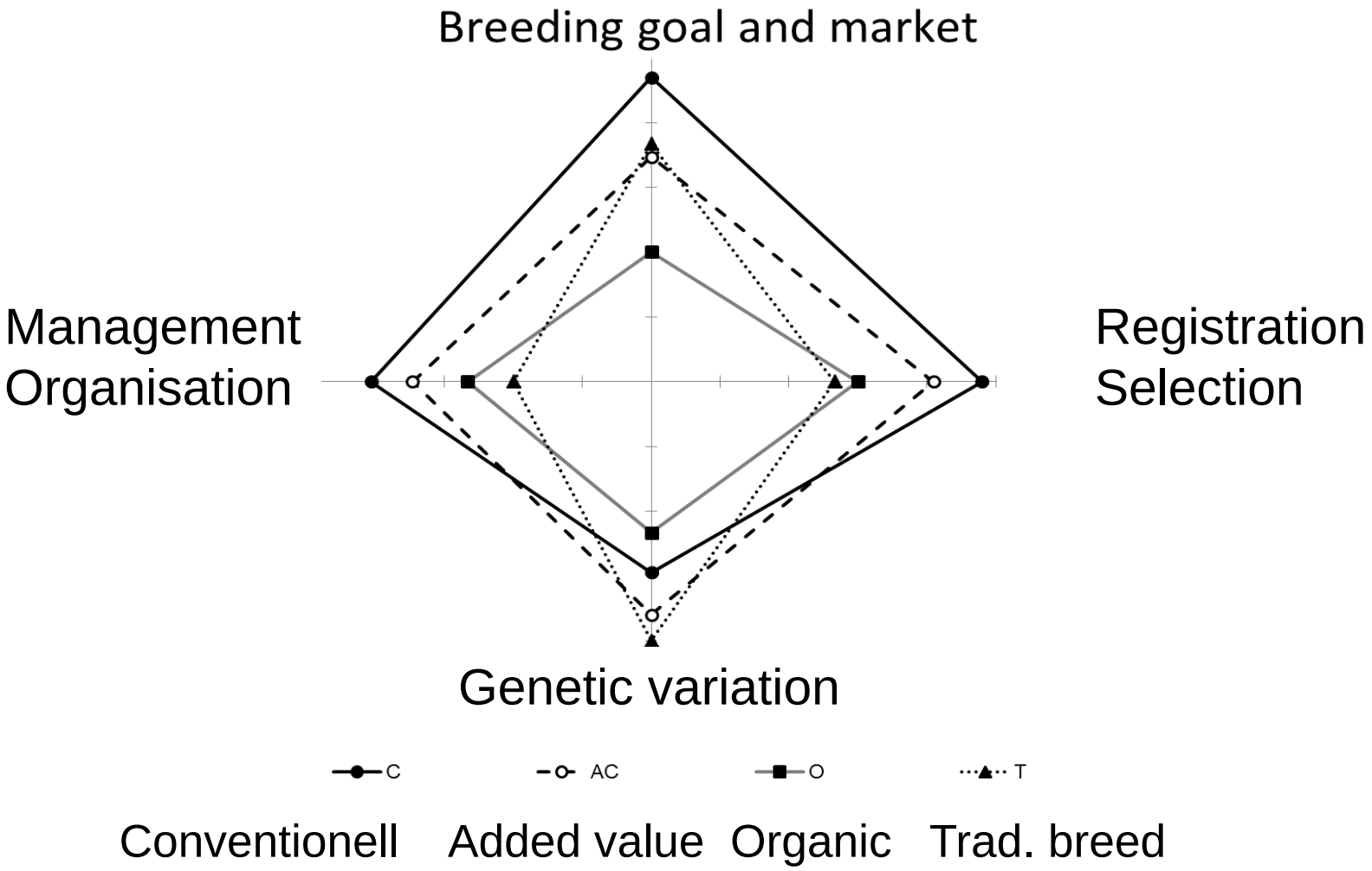
Evaluation of sustainability of 15 European farming systems in QPorkChains

High input (?)
5 conventional
1 adapted conv. - animal welfare
2 adapted conv. - meat quality
1 adapted conv. - meat quality, conv x local breed
1 adapted conv. – meat quality + environment friendly

Low input (?)
3 traditional - local breed
2 organic – conv. breed

Bonneau et al, 2011

Evaluation of sustainability of breeding activities



Rydhmer et al, 2013

Small scale of low input systems

Selection is less efficient for small populations
Less financial, human and technical resources
Cooperation!
“European Saddleback pig breeder network”

Larger risk of inbreeding in small populations?
Yes - but large awareness, and interest in the future of ‘my breed’

Optimal contribution selection

Local breed, 30 herds, 1 boar and 10 sows/herd, natural mating, some exchange of boars, one selection trait, $h^2 = 0.2$

Genetic gain per year, inbreeding rate per generation

Scheme	ΔG, gen std	ΔF, %
No selection	0.00	0.80
Truncation sel.	0.35	5.70
Opt. Contr. Sel.	0.24	0.95

No selection – no genetic gain and inbreeding increases

Only EBV – highest progress, but high inbreeding increase

Optimum contribution selection – high progress and acceptable inbreeding increase

Gourdine et al, 2012

G x E

Growth and carcass traits, conventional and organic

Several **breed** x environment interaction studies

Brandt et al (2010): "Although statistically significant GxE exist … no special breeding programme is necessary for organic production systems"

Few genotype x environment interaction studies based on individual data records

Wallenbeck et al (2009): "our results indicate weak GxE for both growth rate and carcass leanness … An organic breeding index within a conventional breeding program is better than a separate organic breeding program"

G x E

What about reproduction and health traits?

Sow line selected outdoors for
high postnatal survival HS, compared with control, C

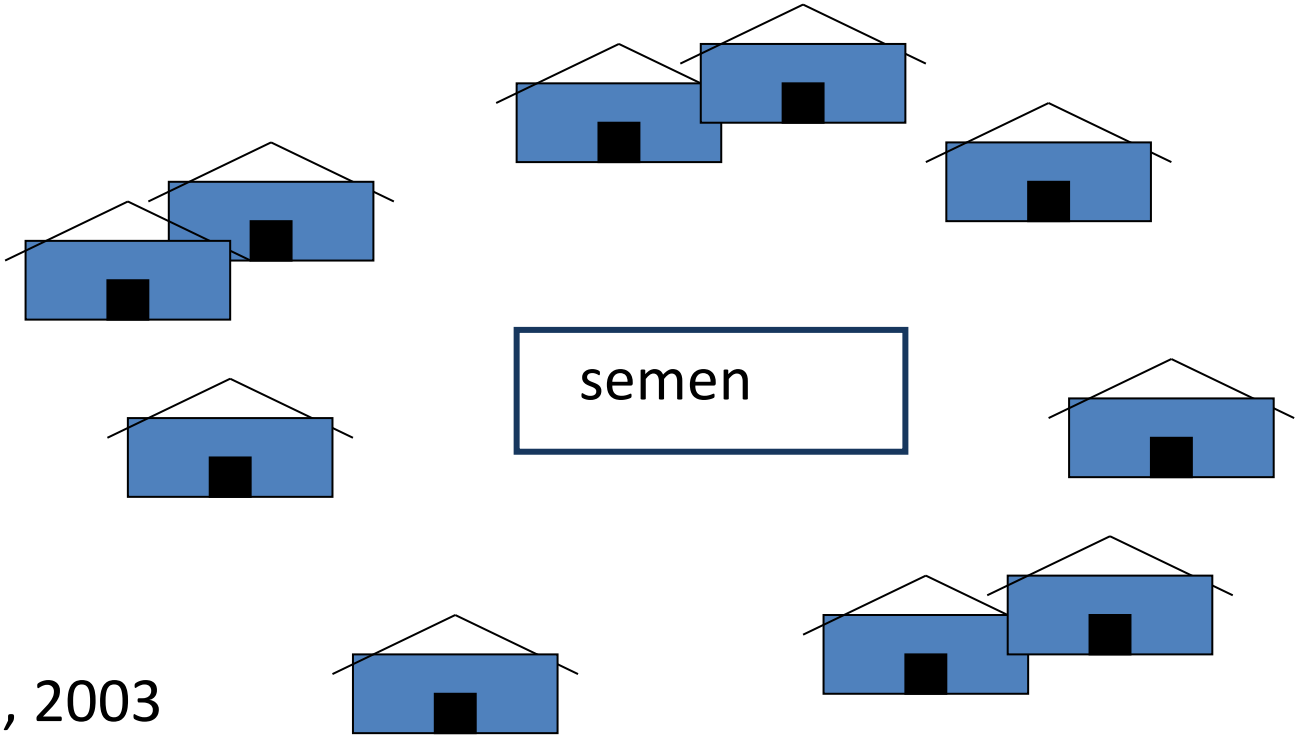
	HS out	C out	HS in	C in
Total mortality, %	12.2	17.9	14.9	12.3
	Less crushing!		More savaging!	

HS gilts indoors showed piglet-directed aggression suggesting a genetic effect on environmental sensitivity

Baxter et al, 2011

Organisation of a special breeding program for low input systems

The Flower breeding system



Merks, 2003

Use the conventional breeding program and choose the best suited animals

‘MaxLegs Hampshire’ - AI boars recommended to Swedish producers with organic production

200 boars at AI station
Conventional economic weights
Ranking based on EBV for osteochondrosis and movements
Semen from the 15% with highest EBV for legs sold as ‘MaxLegs‘

www.qgenetics.se

Concluded at Organic Animal Breeding workshop, 2012

Nauta et al, 2012

Evaluate the balance between farm conditions and animals' demands

Not good enough?

1. Change the environment Remember: Low input!

Not enough?

2. Choose the most suitable males and females

Are there no suitable animals?

3. Change breed

Is there no suitable breed?

4. Develop a special breeding program

Unrealistic?

5. Change species

Can pig breeding contribute to the sustainability of low input production systems?
Genetic progress in traits important for environment and market
Choose the most suitable animals
Traditional breeds – optimum contribution selection

Can low input production systems contribute to the sustainability of pig breeding?
Raise new questions and stimulate discussions

- Ask for new goal traits
- Ask for changed economic weights and a longer time perspective

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