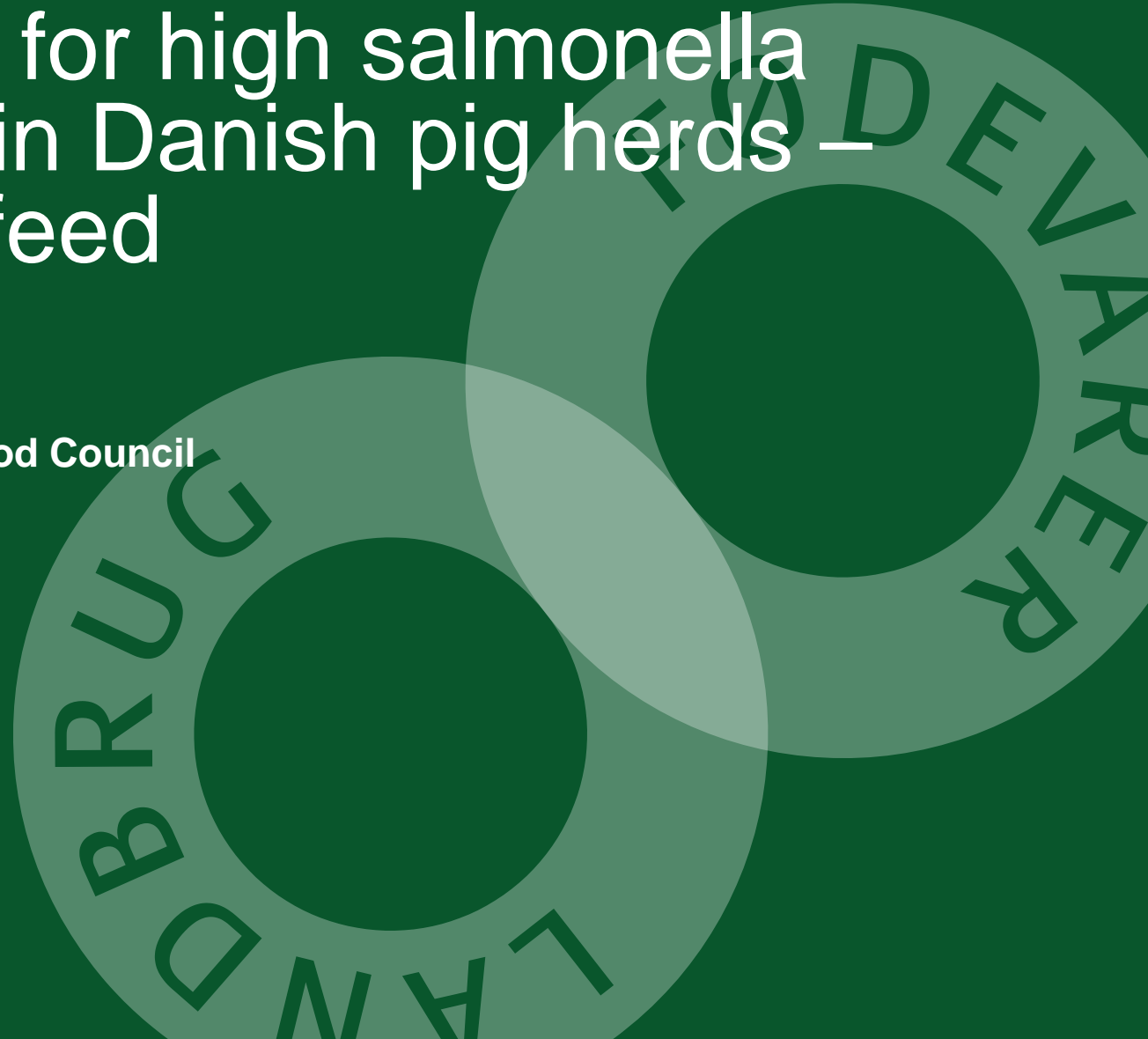


Risk factors for high salmonella prevalence in Danish pig herds – The role of feed

Jan Dahl, DVM

Danish Agriculture and Food Council





Risk factors for introduction

Improved management/hygiene

Feed related risk factors and interventions

Documented factors

Expected effects in problem herds

The big picture

Jan Dahl

Epidemiologist

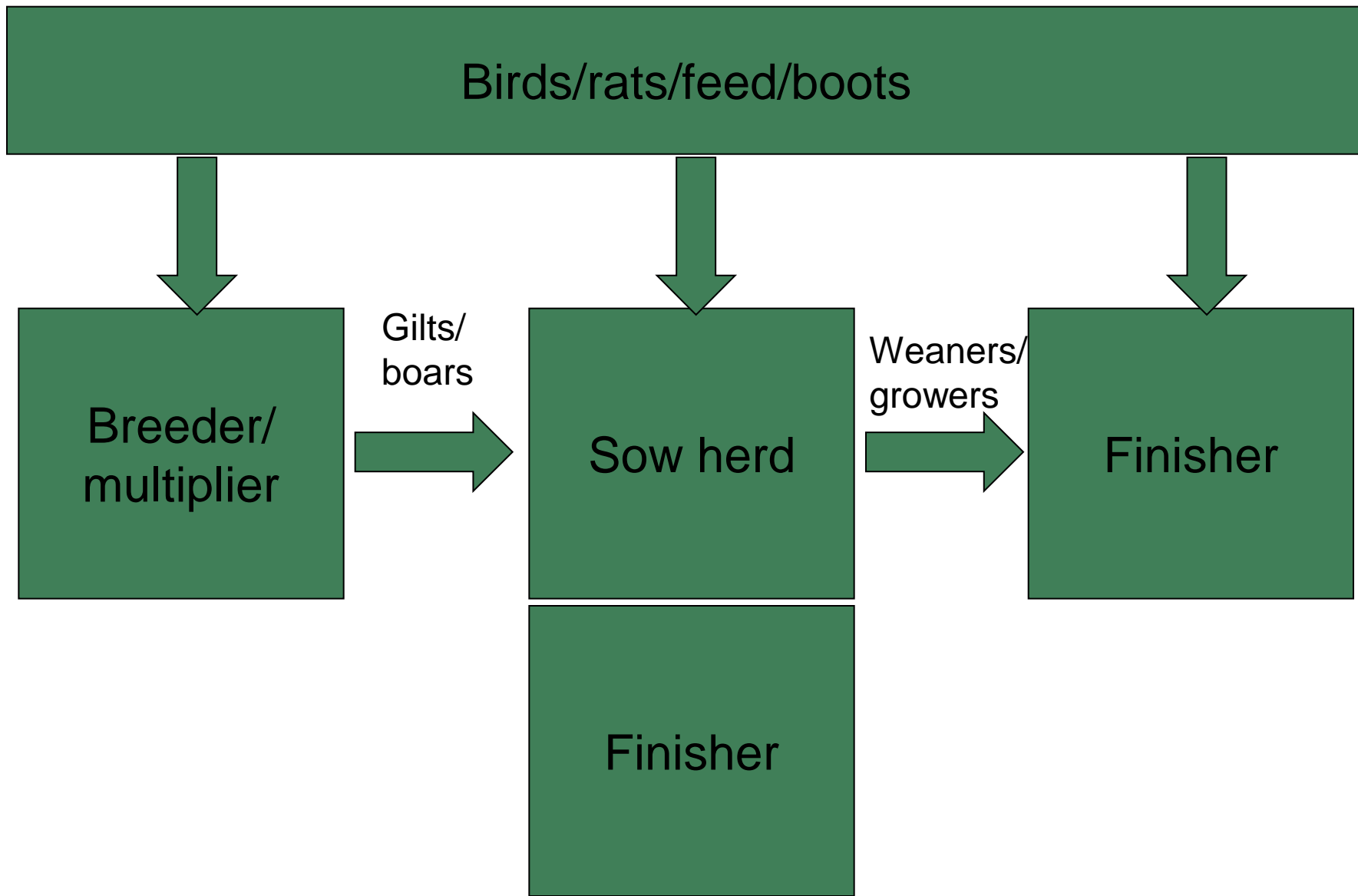
1993 Employed by the Danish Agriculture and Food Council

- Salmonella reduction in Danish pig herds

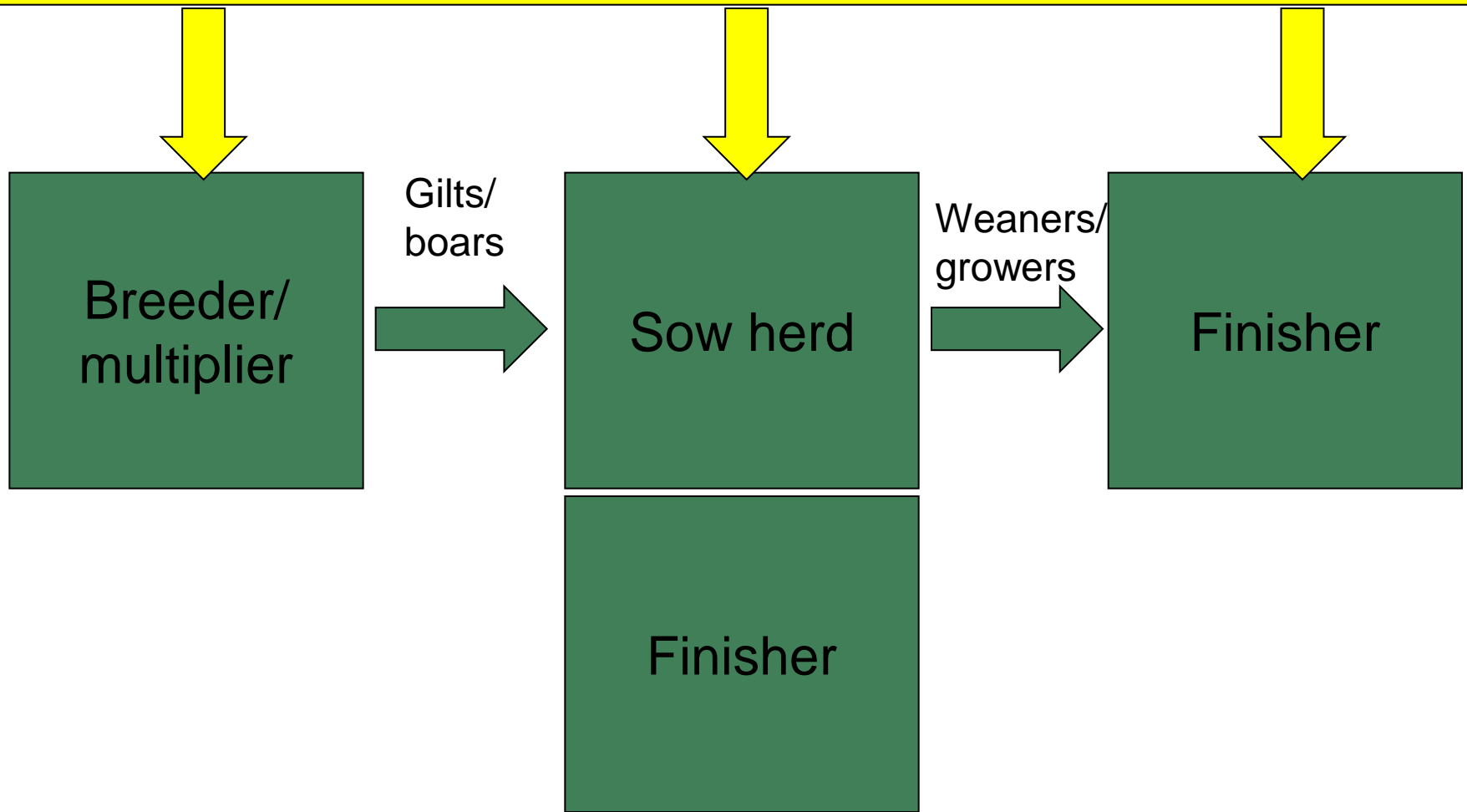
The role of feed

- Feed as an intervention
 - The interaction between feed based interventions, hygiene and control of trade between herds

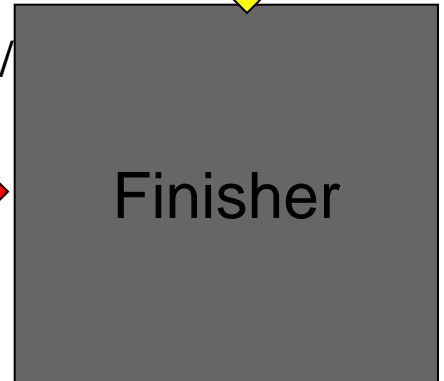
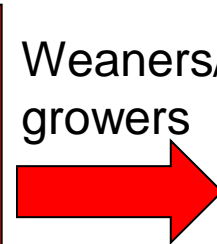
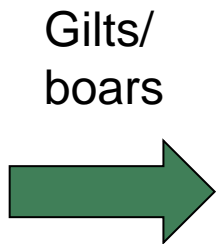
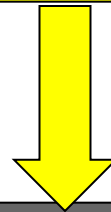
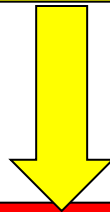
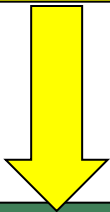
NOT A LECTURE ON HOW TO PRODUCE SALMONELLA FREE FEED!!



Birds/rats (probably more important for maintaining infection)
Feed (most serotypes are of lesser importance)
Boots (circumstantial evidence that vets have spread salmonella)

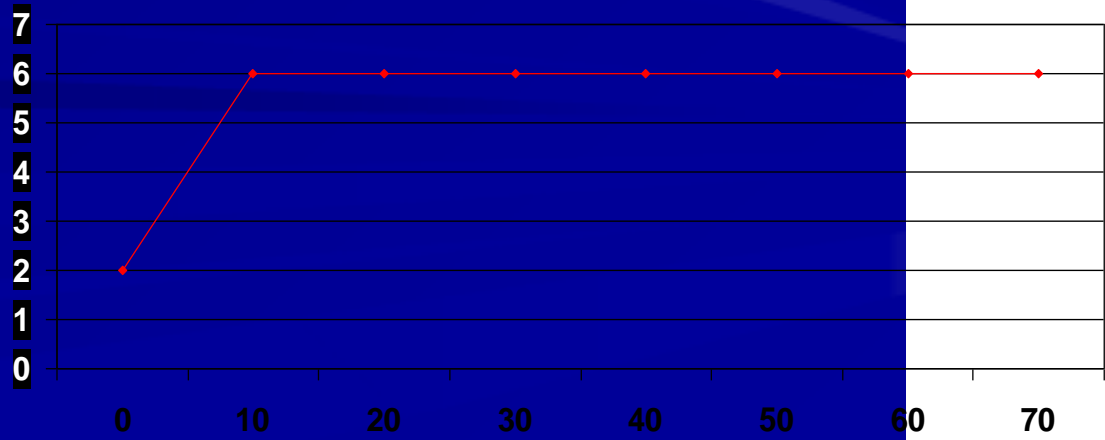


Birds/rats
Feed
Boots





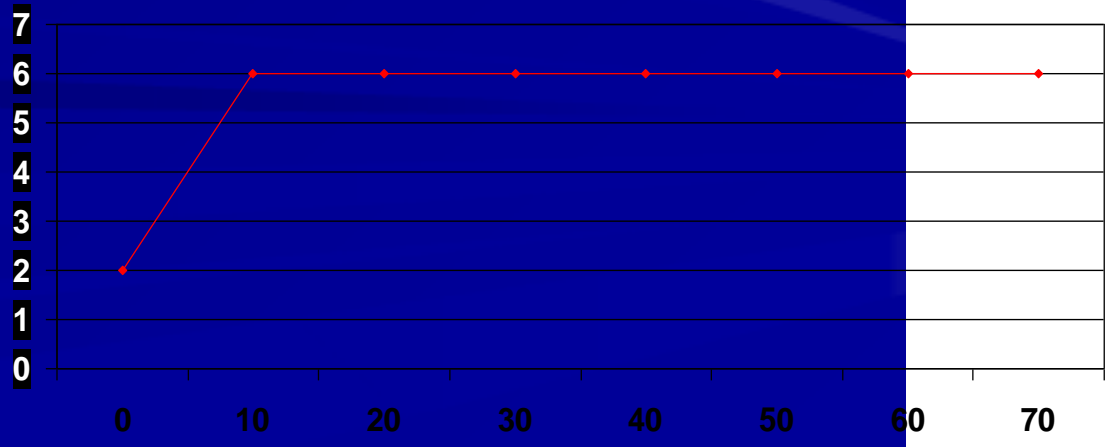
Percent positive meatjuice samples



Percent positive typhim. pensamples (weaners)

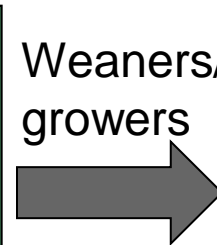
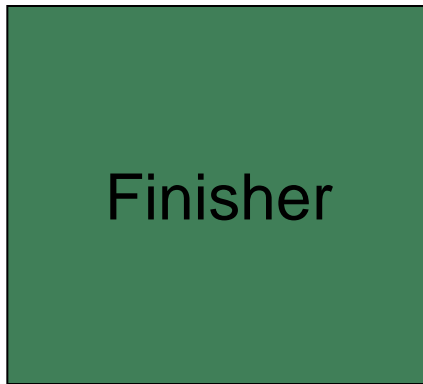
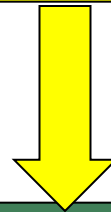
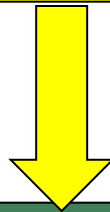
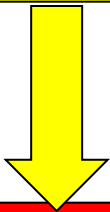


Percent positive meatjuice samples

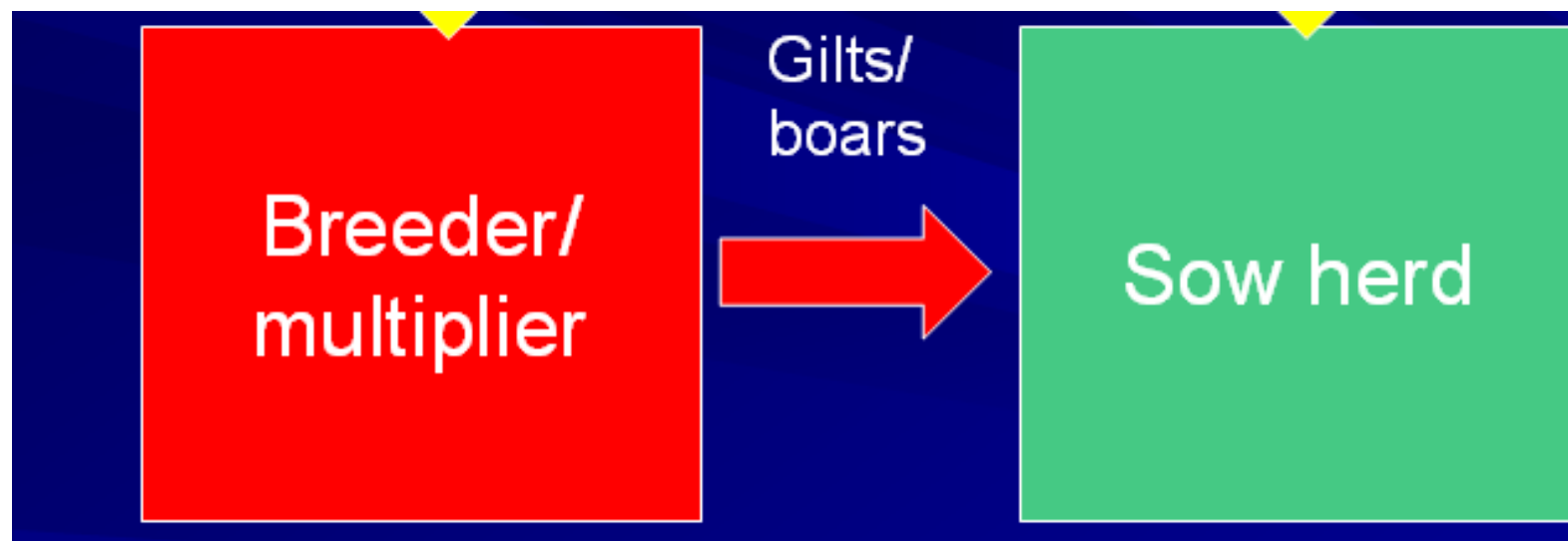


Percent positive typhim. pensamples (weaners)

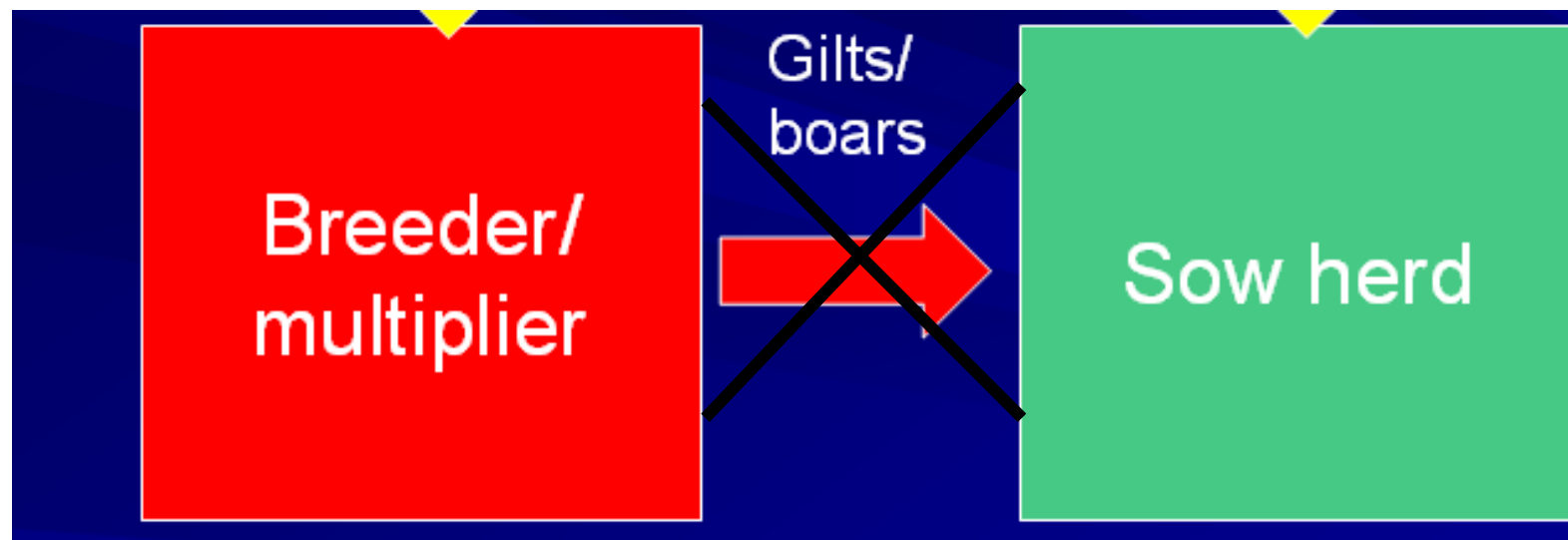
Birds/rats
Feed
Boots



2.4 times greater risk for Typhim. positive sow herd if breeder positive



2.4 times greater risk for Typhim. positive sow herd if breeder positive



Conclusion

Buying in pigs is an important source

- Typhimurium and Derby
- Others probably less often a trade-related problem

Management and hygiene

All in-all out by room

Improved hygiene and disinfection

No moving of pigs between rooms

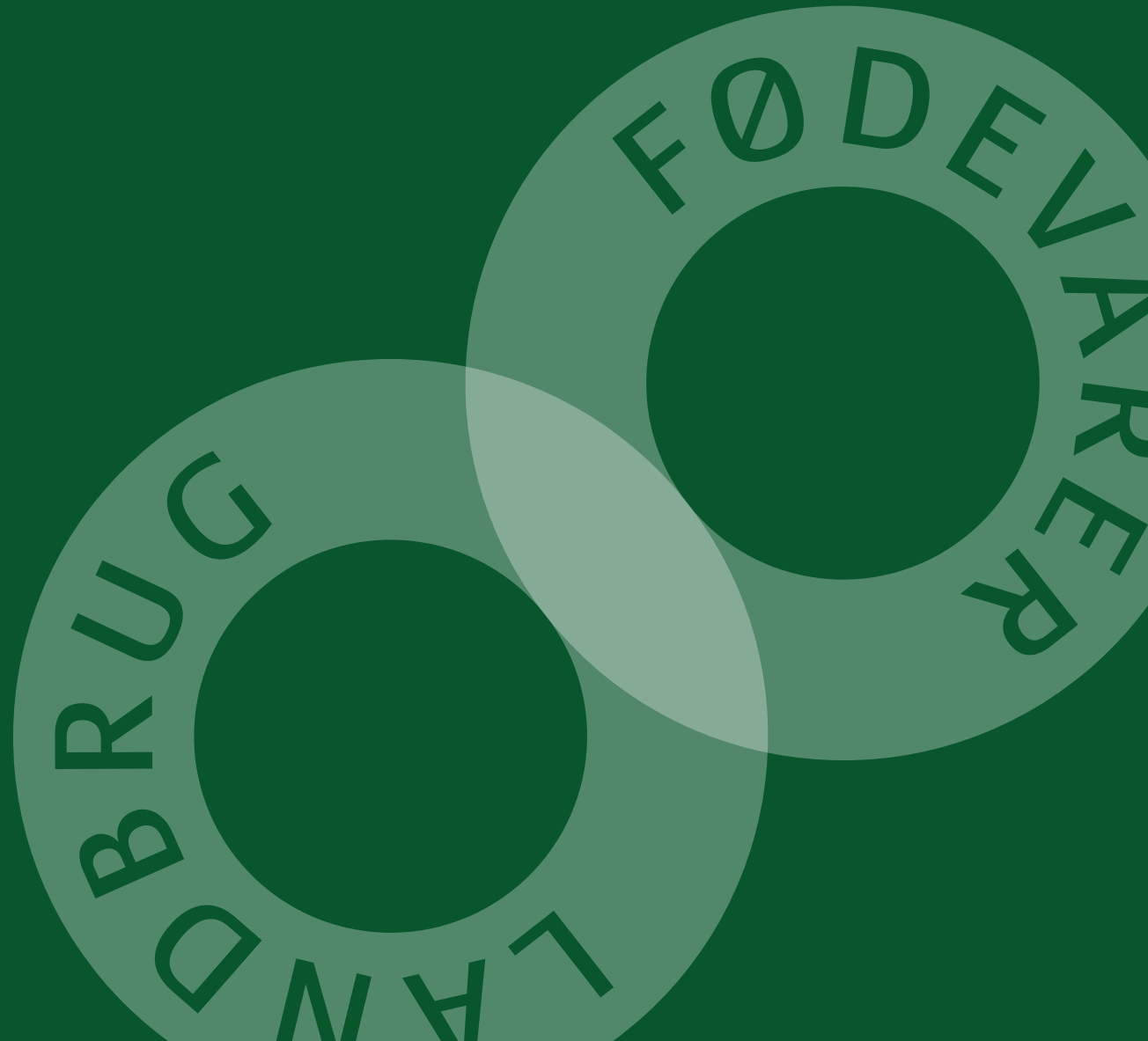
Rodent and bird control

Good effect under experimental conditions

Unreliable as only intervention under practical conditions

Necessary to use other types of intervention

Feed interventions



Two feed sources in Denmark

Homemixed

- Not heattreated – meal
- Partly heattreated – meal
- Not salmonella controlled

Pelleted

- Heat treated
- Salmonella controlled



Discussion in 1994

Should we ban home-mixing?

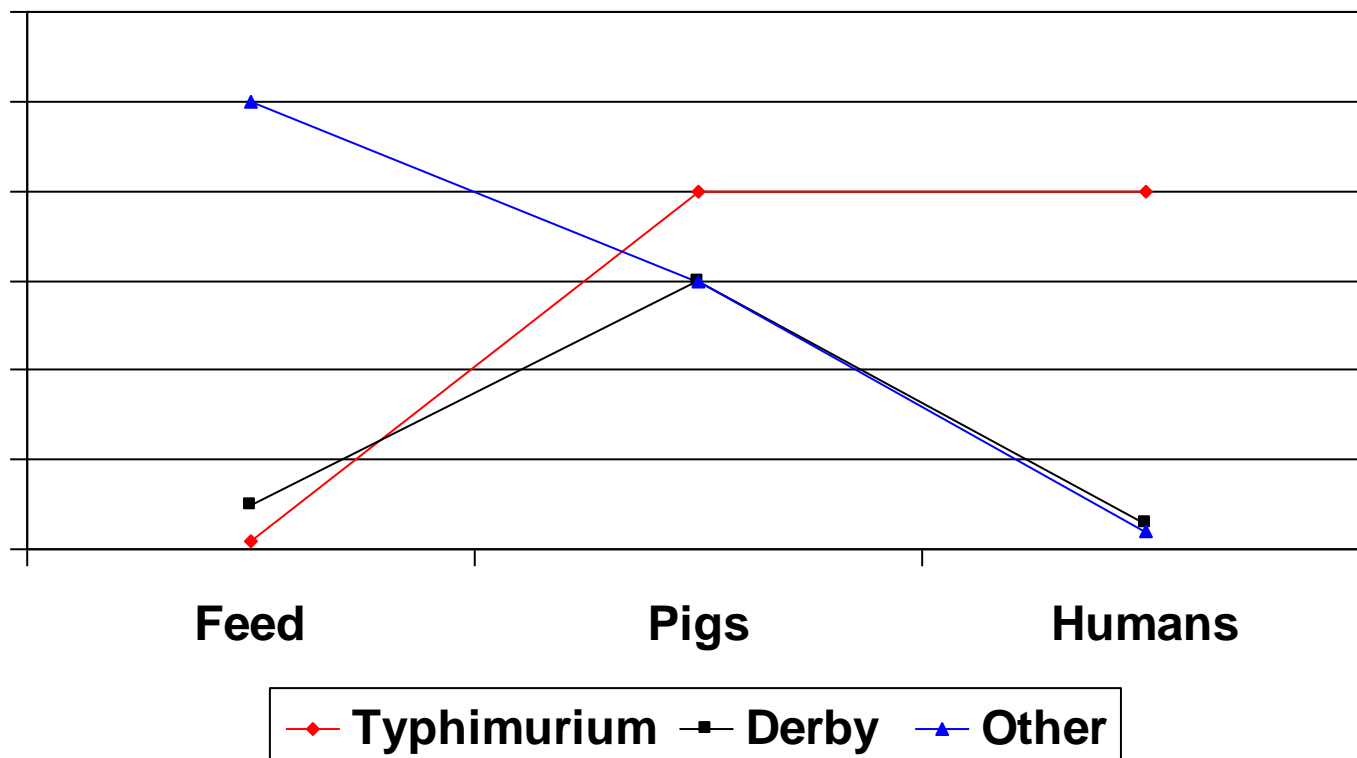
Epidemiological results

Pelleted feed/meal	Liquid feed/dry feed	Relative risk
Pellets	Dry	9
Meal	Dry	3
Pellets	Liquid	3
Meal	Liquid	1



Use of pelleted (=salmonella controlled) feed was a risk factor!!

Serotype distributions





Types from feed are relatively rare as a source of human salmonellosis

Typhimurium rare in feed, but frequent in pigs and most important source of human salmonellosis from pigs

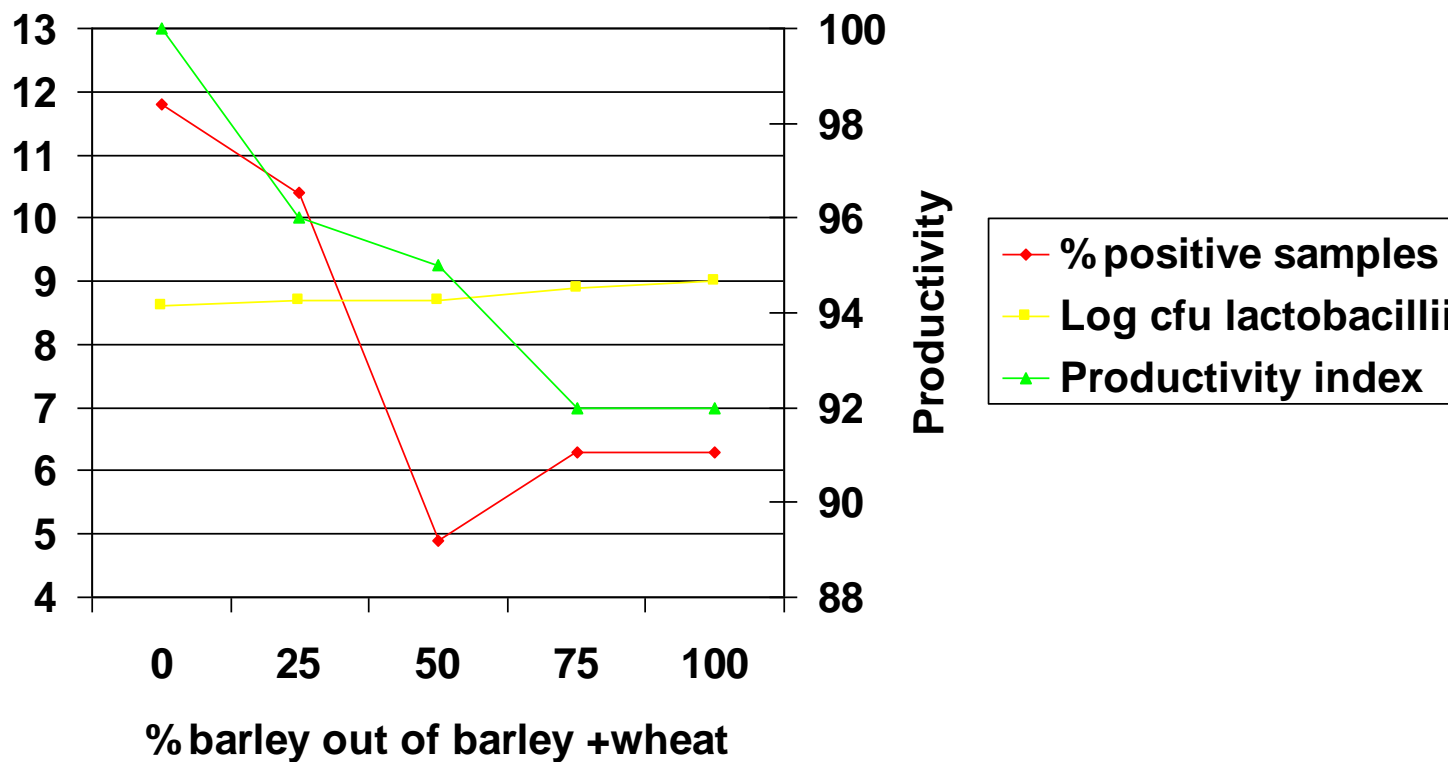
(Enteritidis is a poultry problem)

So the feed had other effects than just being a source of Salmonella

Clinical trial-finishers

Feed	RR Salmonella	Productivity	Coli-forms in ventricle	Organic acids in ventricle
Fine pellets	2.3	100	High	Low
Crude pellets	1.8	94	Medium	Medium
Fine meal	1.3	89	Medium	Medium
Crude meal	1	85	Low	High

Barley/wheat for finishers



Mechanism

Meal – coarse ground

Increase in viscosity of gut content

Increase in lactobacillii

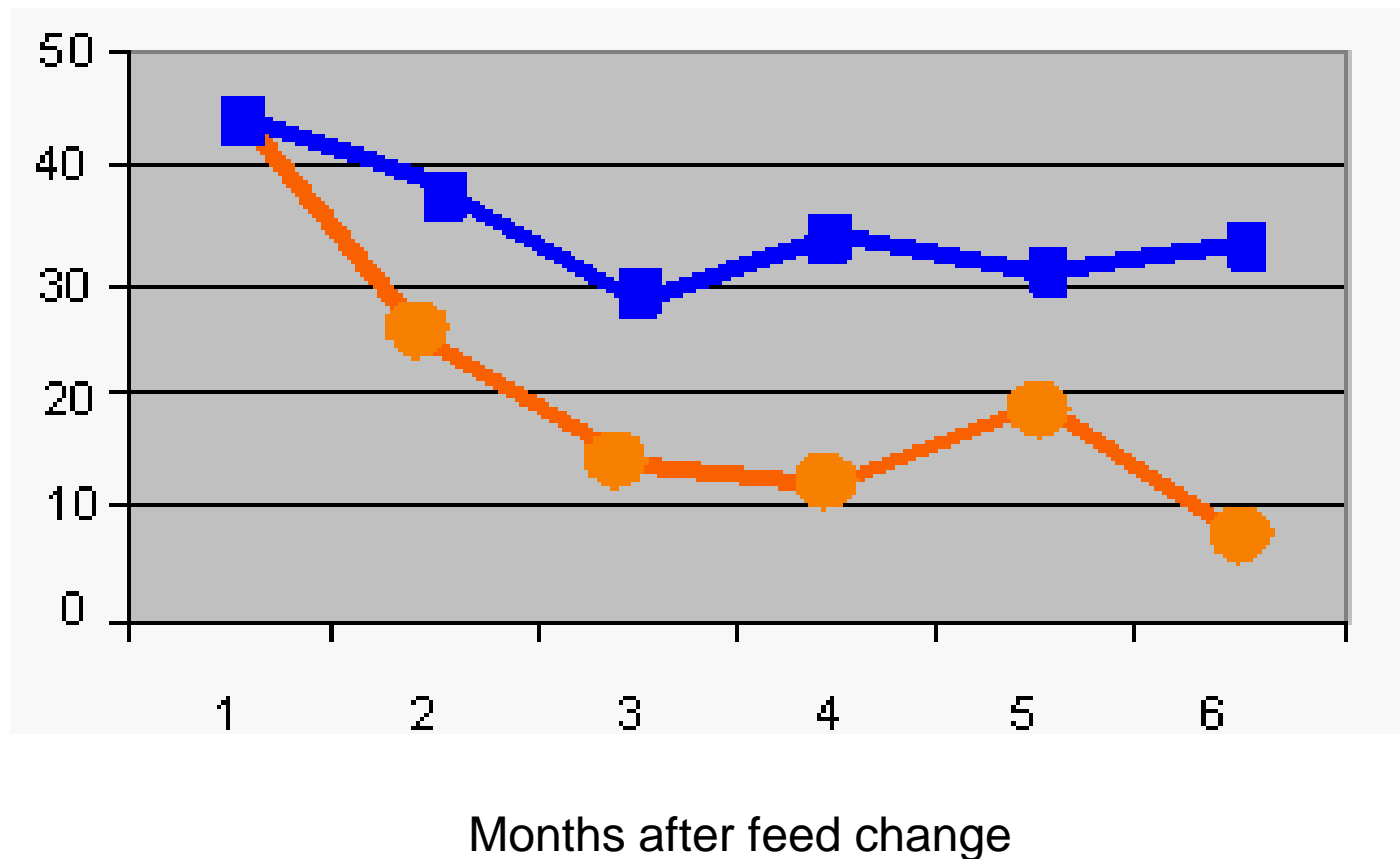
Increase in organic acids

Decrease in coliforms

Decrease in salmonella

Decrease in productivity

Effect of adding non-heattreated barley or wheat to pellets



Percent positive



Organic acids for finishers

0.5-1 percent in feed

Formic acid/lactic acid has been tested

Benzoic acid promising

Formic acid in drinking water

NB EU-regulations



Sows and weaners

Feed interventions have less effect compared to finishers

Cannot achieve a very low level

Liquid feed

Protective effect

Probably depending on pH (fermentation)

pH<4.5 essential

If not

Increase steep time

Increase residual

Water temperature

Starter cultures?

Organic acids

Guidelines for Salmonella interventions

First time in level 2 or 3

Management and hygiene

- Pig flow
- Strict all in-all out by room
- No moving of pigs between units
- Cleaning and disinfection

Add 0.5-1 % formic or lactic acid to finisher diet or 0.1-0.2 formic acid to water (NB fresh water?)

Wait



1. time continued problems

More barley in diet

Increase particle size in pellet

Adding non-heattreated barley or wheat to diet



Recurring problems

Reevaluate management and hygiene
Change into home mixing

Effects on salmonella and productivity

Intervention	Salmonella	Productivity
Manag. and hygiene	?	++
Organic acids	+	?
Crude grinding	+	-
Adding non-heat treated barley or wheat	++	-
Change to home-mix	+++	?
Improve liquid feed	+++	+



Feed interventions

Only reduction

From level 2 and 3 to top of level 1

Negative impact on productivity



Conclusion

High prevalence herds can reduce the level

But not to 0

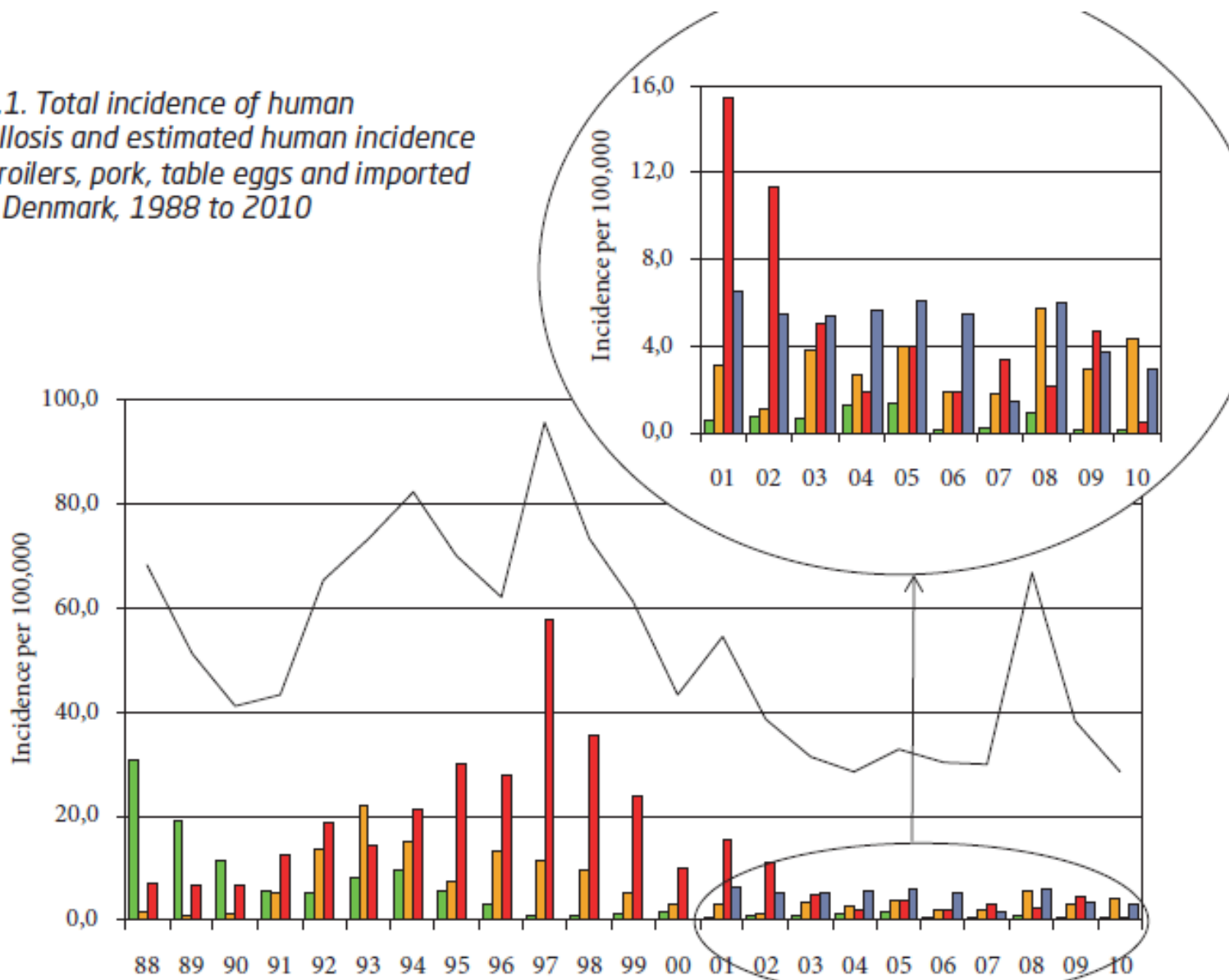
Feed interventions are effective

**Most of the interventions have negative impact on
productivity**

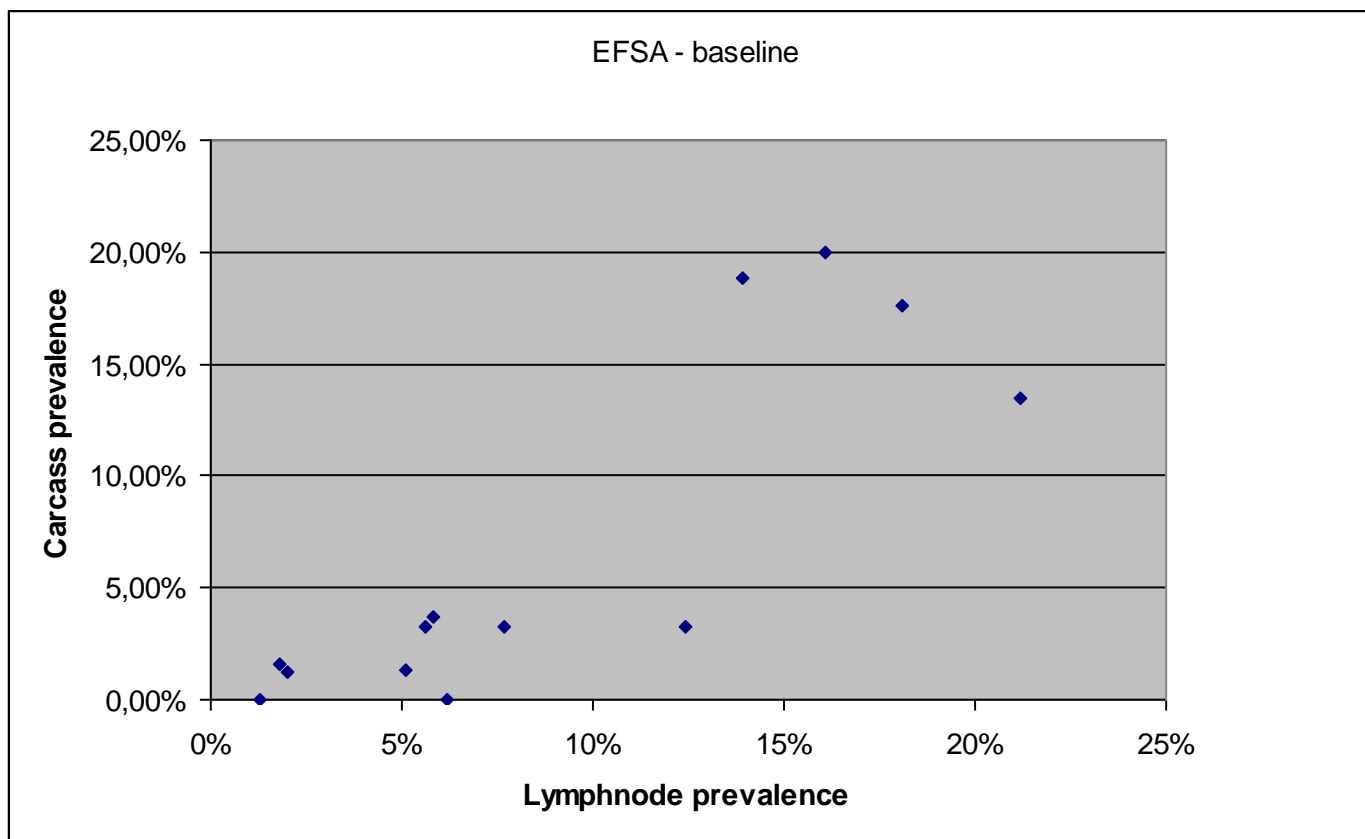
Putting things into perspective



Figure 1.1. Total incidence of human salmonellosis and estimated human incidence due to broilers, pork, table eggs and imported foods in Denmark, 1988 to 2010



Most of this reduction in human cases due to improved slaughter hygiene



Cost-benefit

EFSA reports

- QMRA
- CBA for finishers
- CBA for breeding pigs

Effects of herd interventions variable and uncertain

Cost of herd interventions exceeds benefits

Danish QMRA and CBA

Prevalence in primary production	Prevalence in slaughter house	Slaughter house size	Cost-effective
High	High	Large	Slaughter house
Low	Low	Small	Primary production