

Impact of changes in nitrogen and energy inputs at farm level

Efficiency and Environmental impact



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Innovative and practical management approaches to reduce nitrogen excretion by ruminants





Introduction (1)

- Challenge for farmers
 - Produce sufficient food
 - Reduce environmental impacts
- Dairy farm challenges
- Data source
 - De Marke ... Data since 1992



Experimental dairy farm “De Marke”



- Strict environmental objectives
- Whole farm approach for sustainable dairy farming
- Dry sandy soil



Objectives De Marke



Objective	Maximum	%reduction
Nitrogen (N)		
Ammonia	30 kg/ha, animal manure	70
Nitrate	50 mg/liter, upper groundwater	75
Nitrous oxides	3 kg/ha	66
Surplus farm balance	128 kg/ha, incl. deposition and symbiotic fixation	74
Phosphorus (P)		
Runoff / leaching	0.15 mg/liter, upper groundwater	?
Surplus farm balance	0.45 kg/ha, incl. deposition	99

Characteristics De Marke



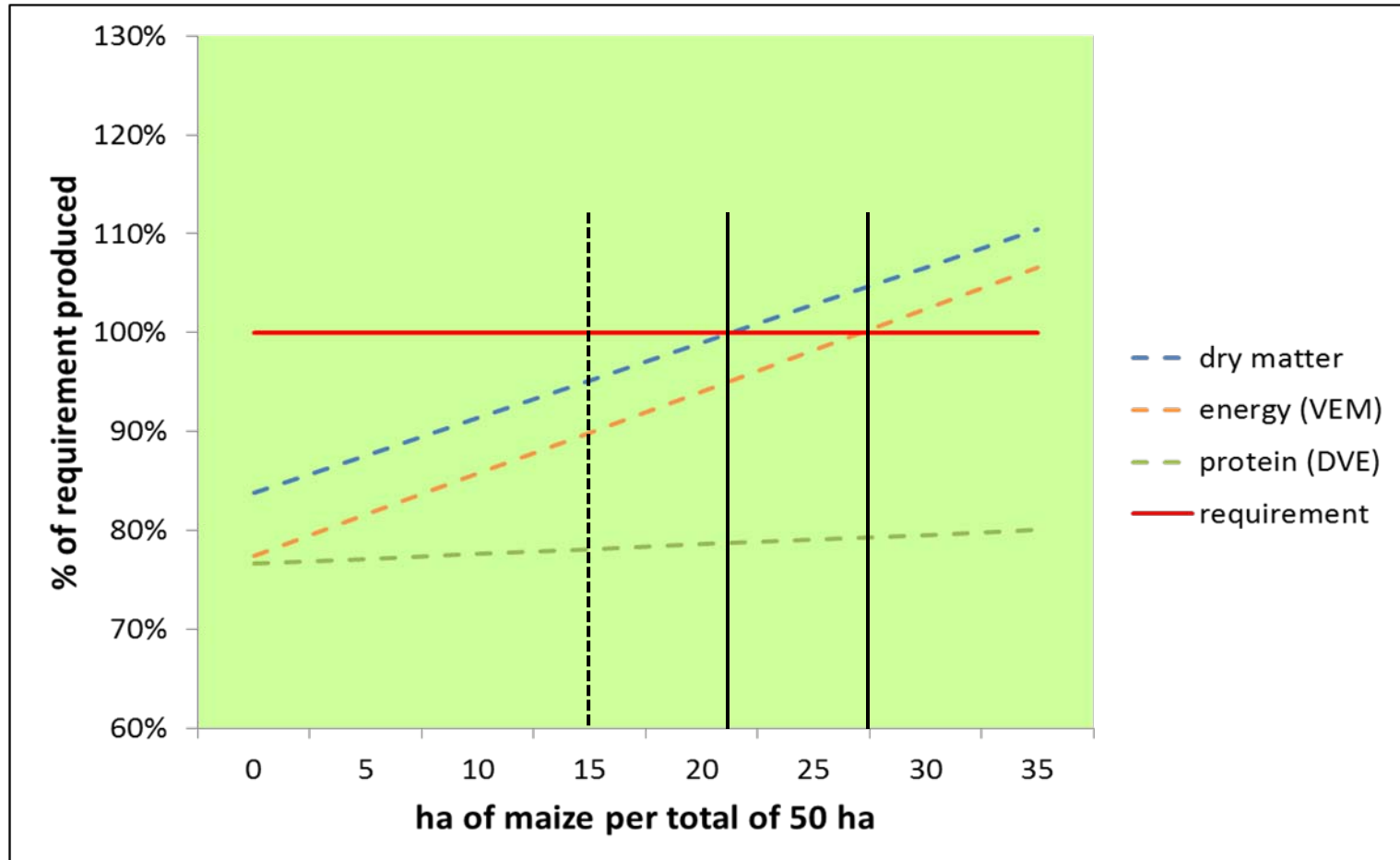
Animals		Animal production		Crop production	
Milking cows	78	Kg milk per cow	8720	Farm area (ha)	54.9
Young stock > 1 year	25	Kg milk per ha	12363	Grass (ha)	31.7
Young stock < 1 year	26	Fat content (%)	4.30	Maize (ha)	16.1
		Protein content (%)	3.42	Whole crop silage (ha)	7.1
Young stock / milking cow	0.65				
Milking cows per ha	1.4				
Livestock Units per ha	1.7				



Introduction (2)

- Dairy farm challenges
 - Food production (milk and meat)
 - Feed production (energy and protein)

Feed production on 50 ha of sandy soil using grass and maize (given a milk production of 13.000 kg per ha)

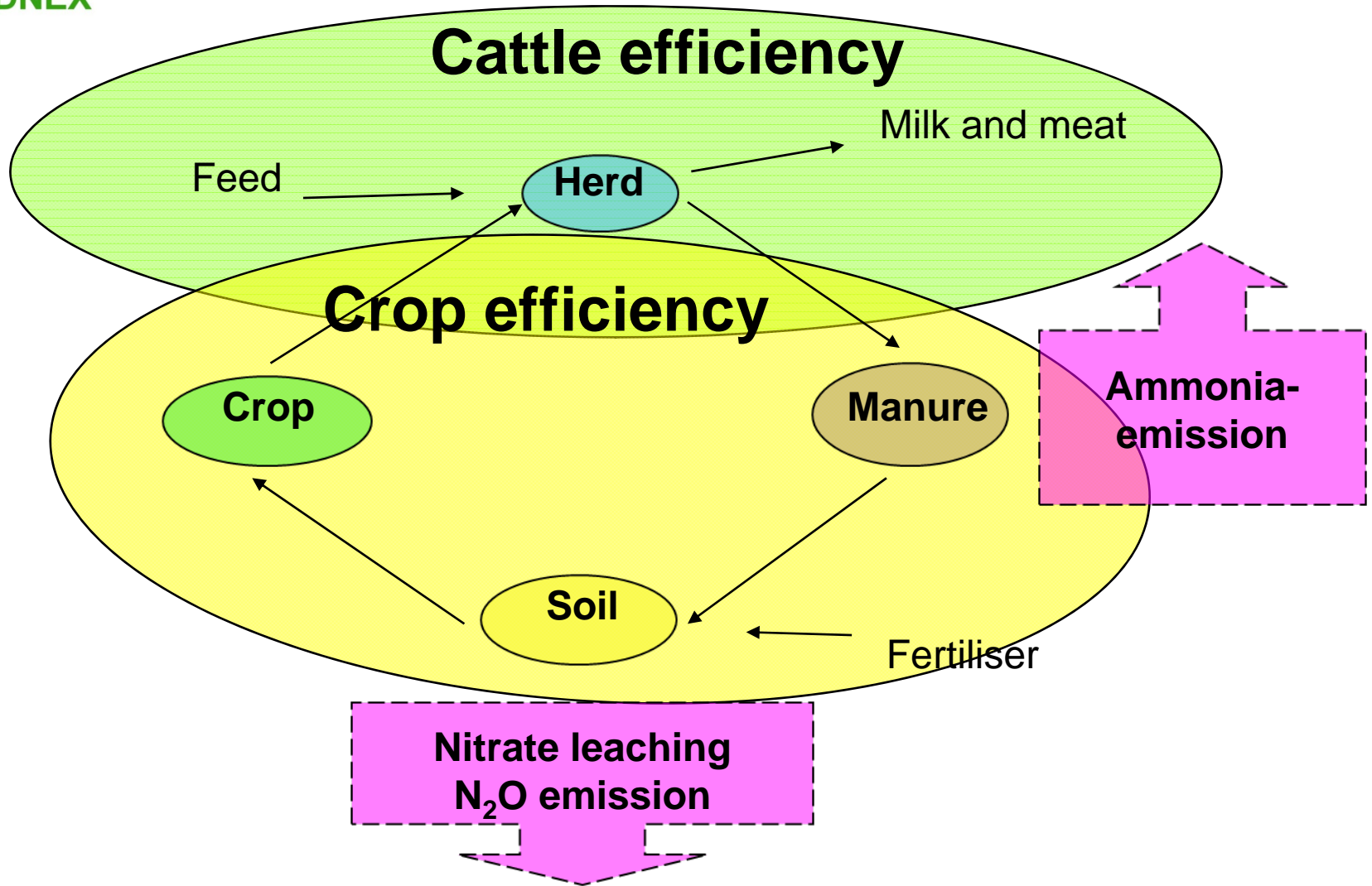


Feed production for >10.000 kg milk/ha

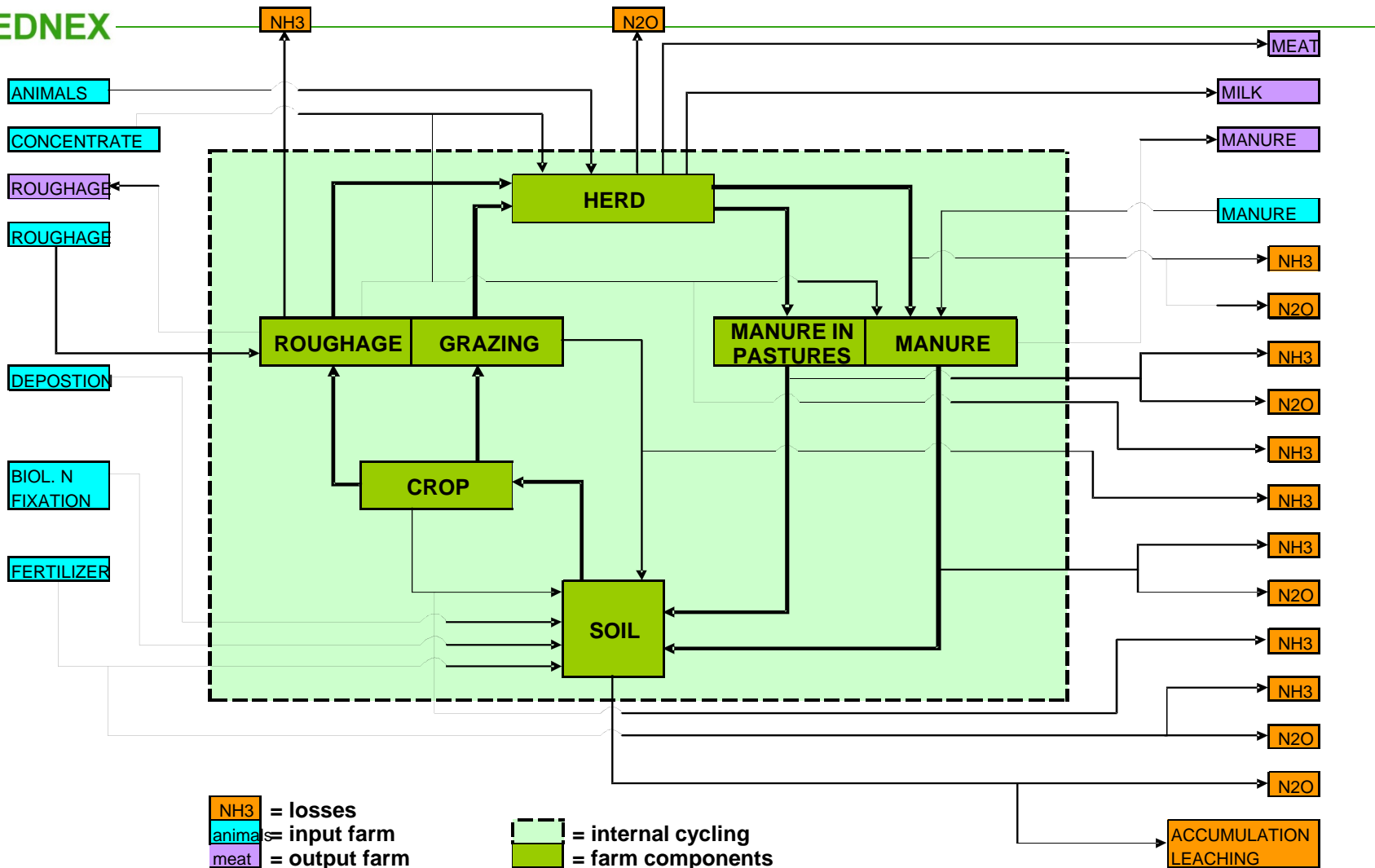


- Feed purchase needed
 - Protein (DVE)
 - Energy (> 15.000 kg milk/ha)
- Impact on environmental burdens?
 - N-cycle

Nitrogen cycle



Farm N cycle

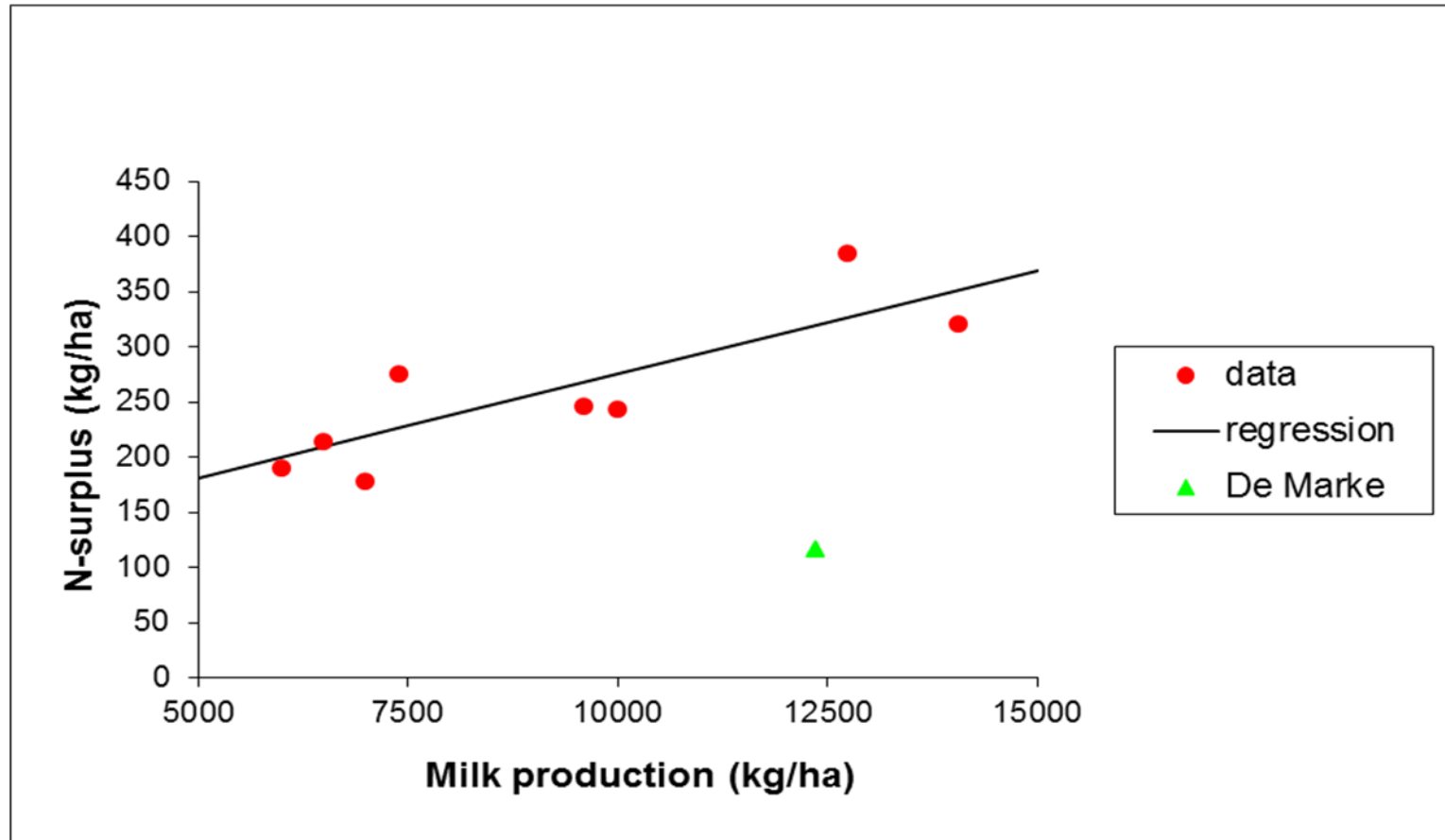


Goals for sustainable dairy farming



- Maintain or increase food production
- Minimise environmental impact
 - Minimise fertiliser purchase
 - Minimise feed purchase
 - Minimise N-surplus
- How to combine with feed production challenge?

Relationship between N-surplus and N-output



Source: J. Bos et al., 2005. *Nutrientmanagement at farm scale*. First workshop of the EGF, Quimper, France 2003.

How was the low N-surplus achieved?



Feeds
Fertilisers

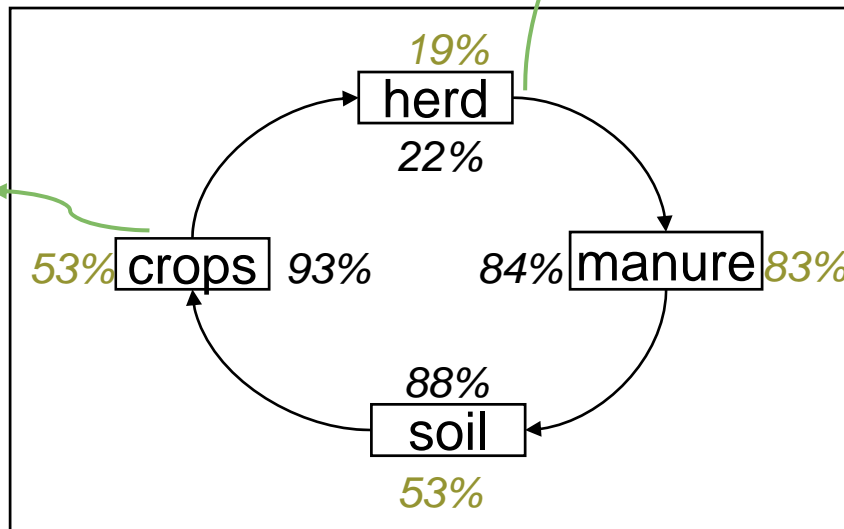
Efficiency

N-efficiencies De Marke 2009



*Feeding, milk production,
number young stock*

*Low harvest
losses*



37%
26%

Legislation (method)

*Crop rotation
Restricted grazing
Optimal supply (timing, dose)*

Legend:

N-efficiency De Marke

N-efficiency common Dutch practice

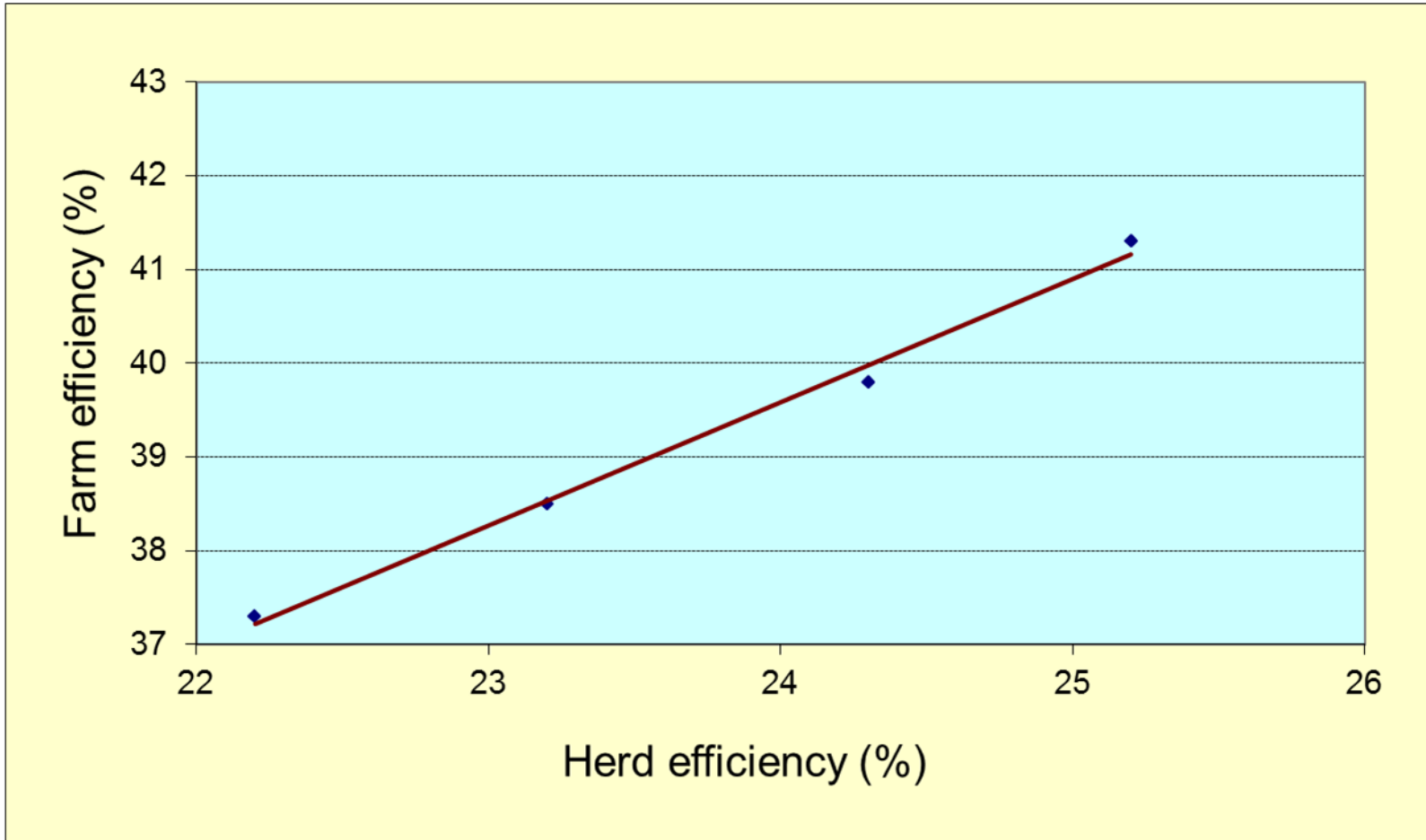


Herd efficiency relevant?

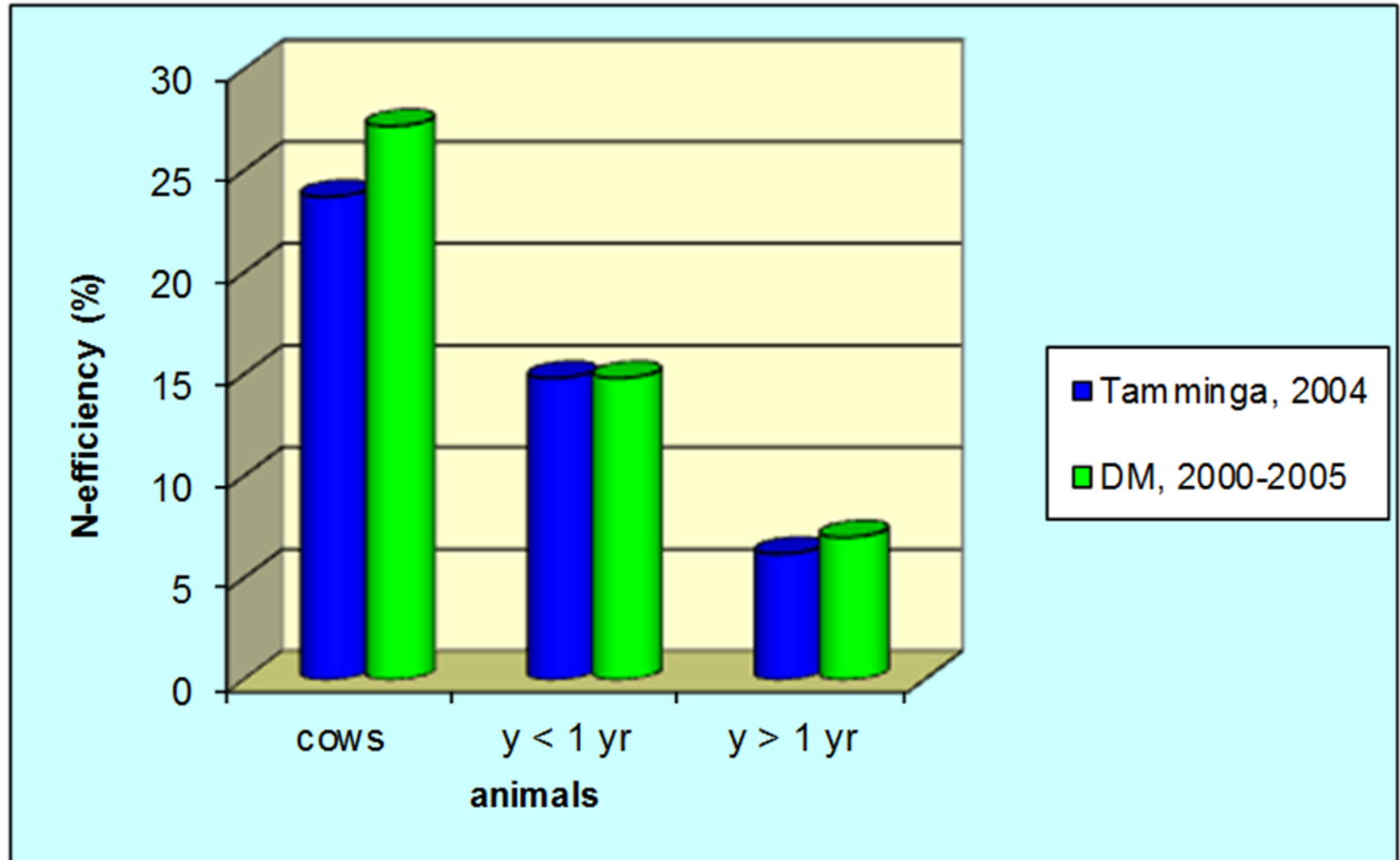




Impact herd efficiency on farm efficiency

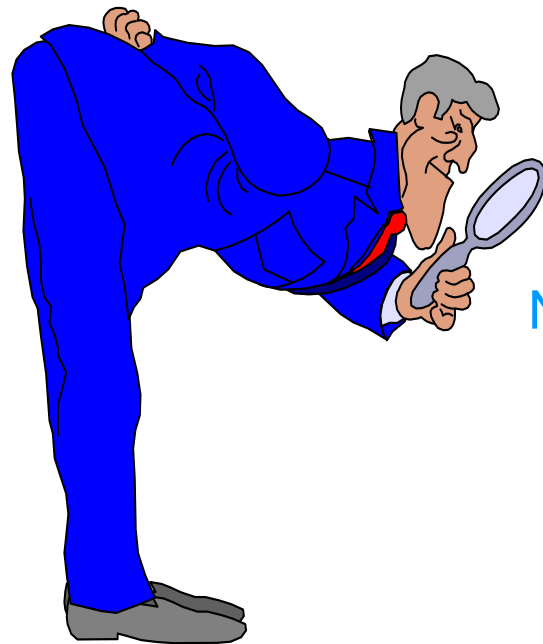


Efficiencies of cows and young stock



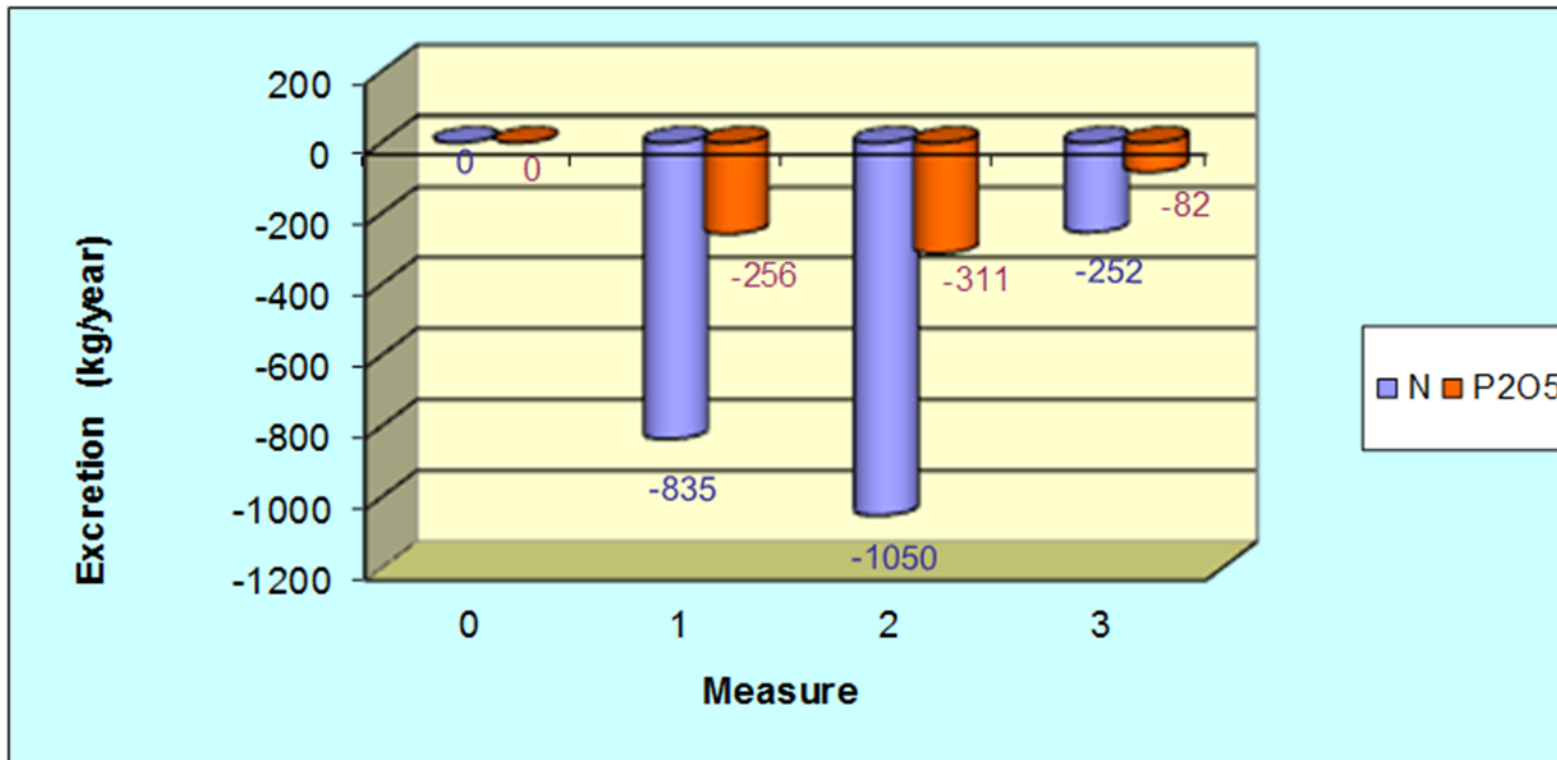


Impact herd efficiency on



N-excretion

Excretion herd = 14.418 kg N, 4.550 kg P₂O₅



Measure 0

Quotum 600.000 kg

80 milking cows

7,25 young stock per 10 cows

Measure 1

Young stock from

7,25 to 5,5

Measure 2

N-efficiency
milking cows

2% increase

Measure 3

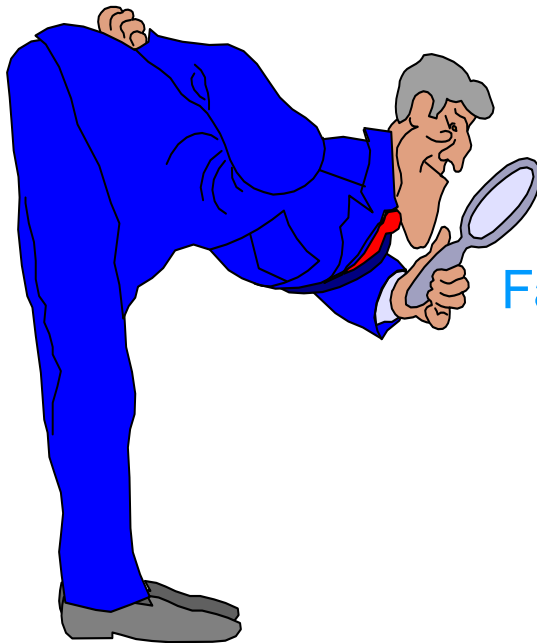
N-efficiency

Young stock

2% increase

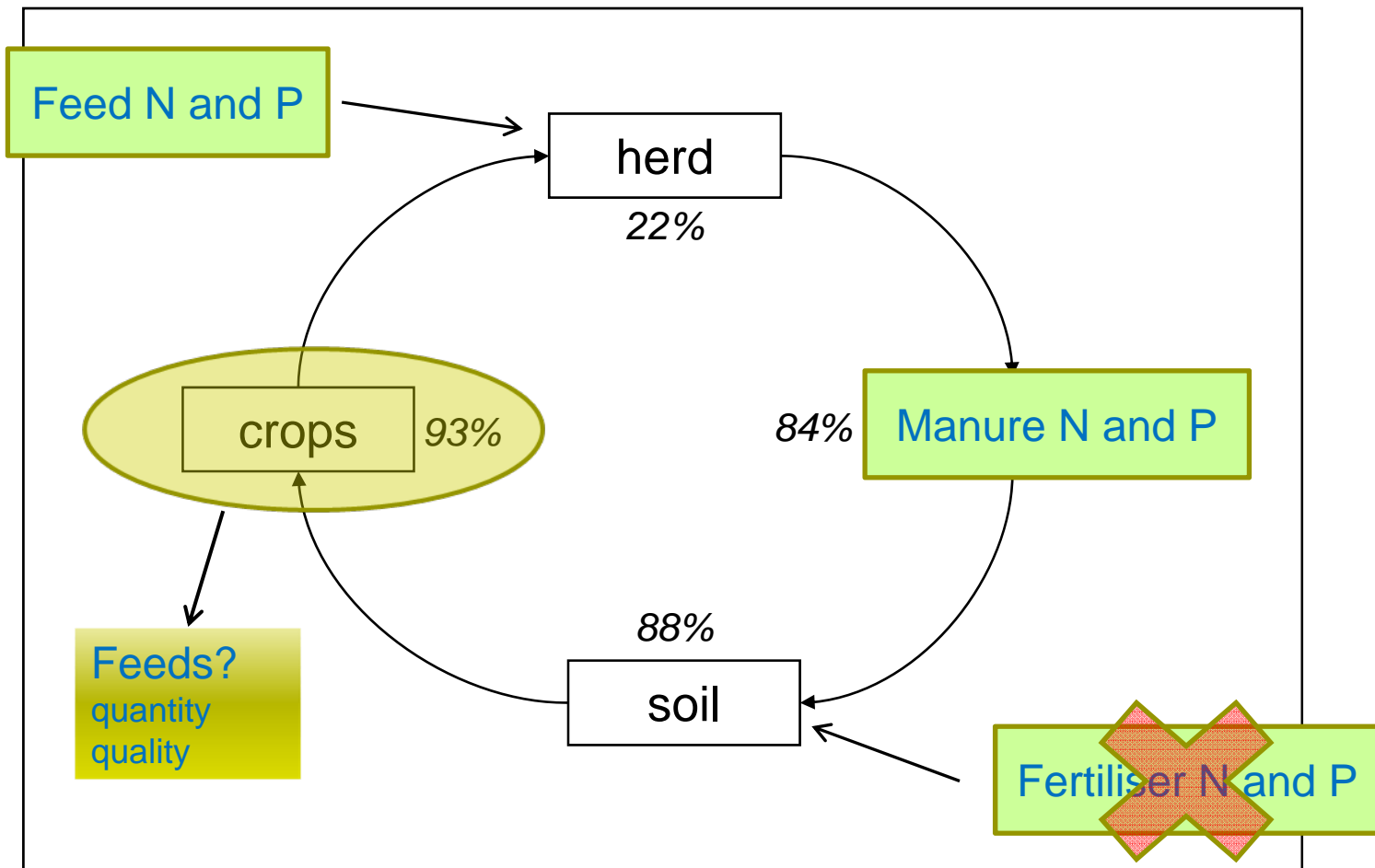


Impact low N-inputs on



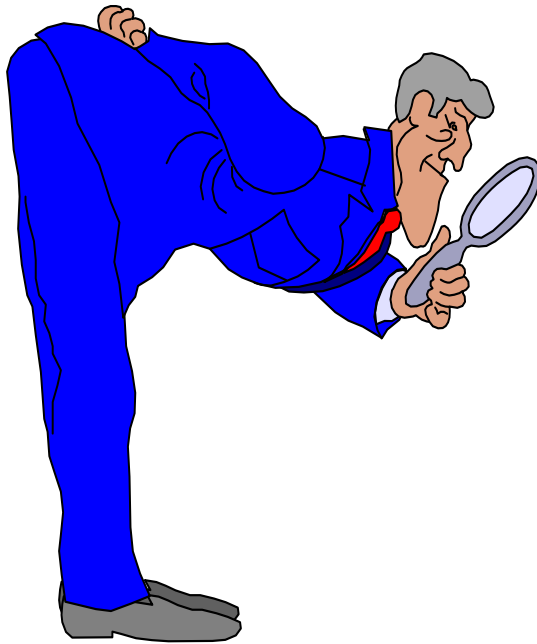
Farm N-cycle

Decreasing inputs De Marke





Impact low inputs on

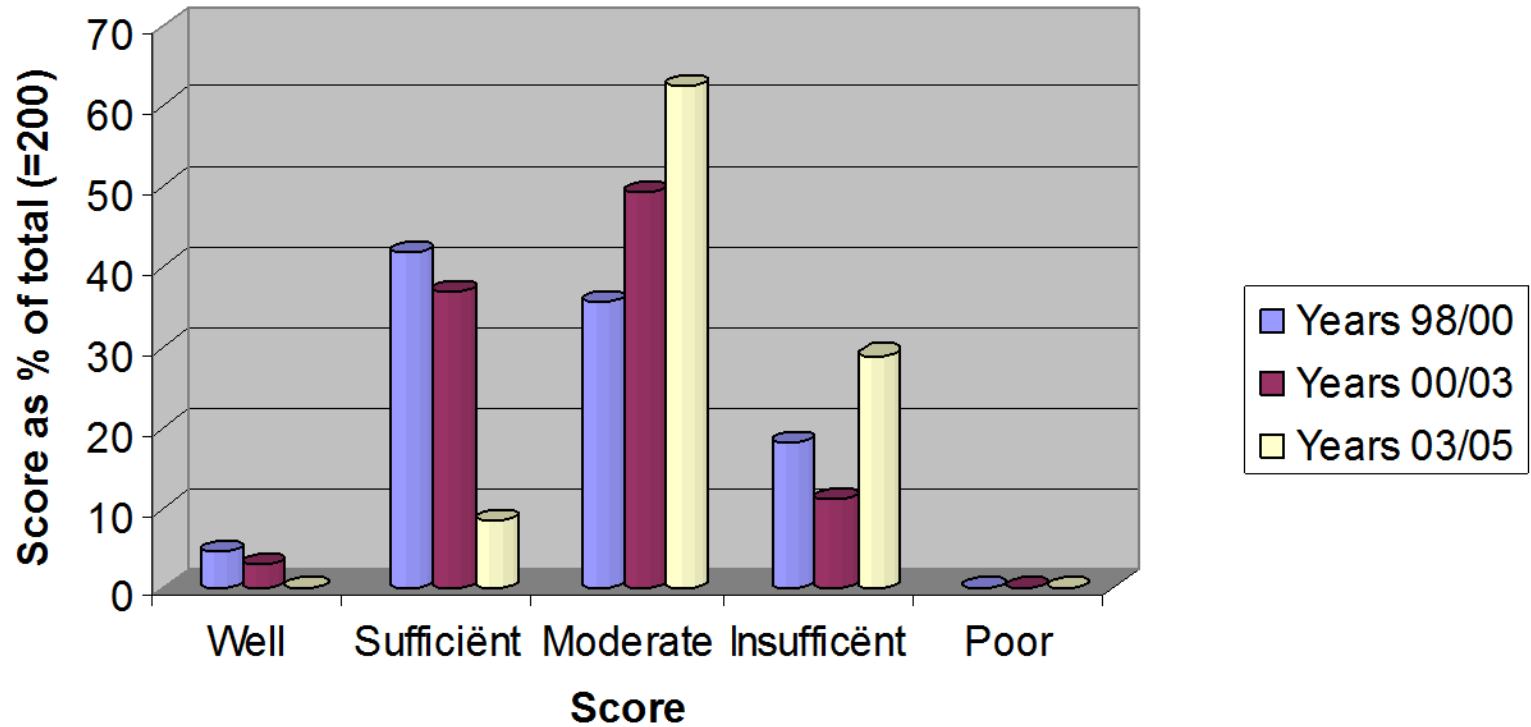


Rumen functioning

Decreasing N-surplus and rumen fermentation

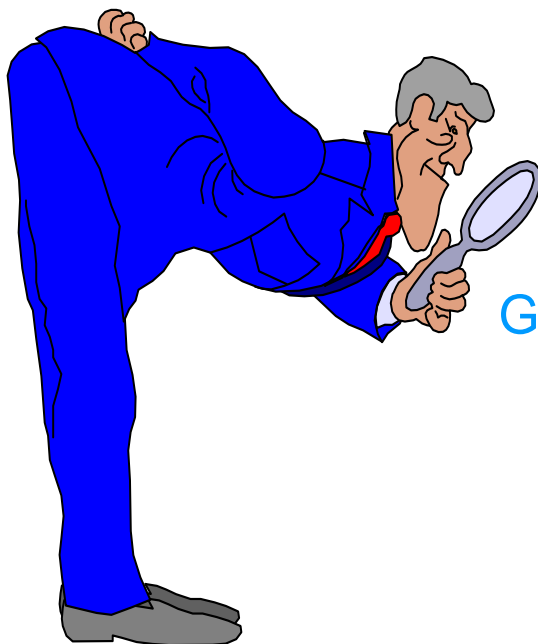


Rumen fermentation according to manure quality





Impact low inputs on

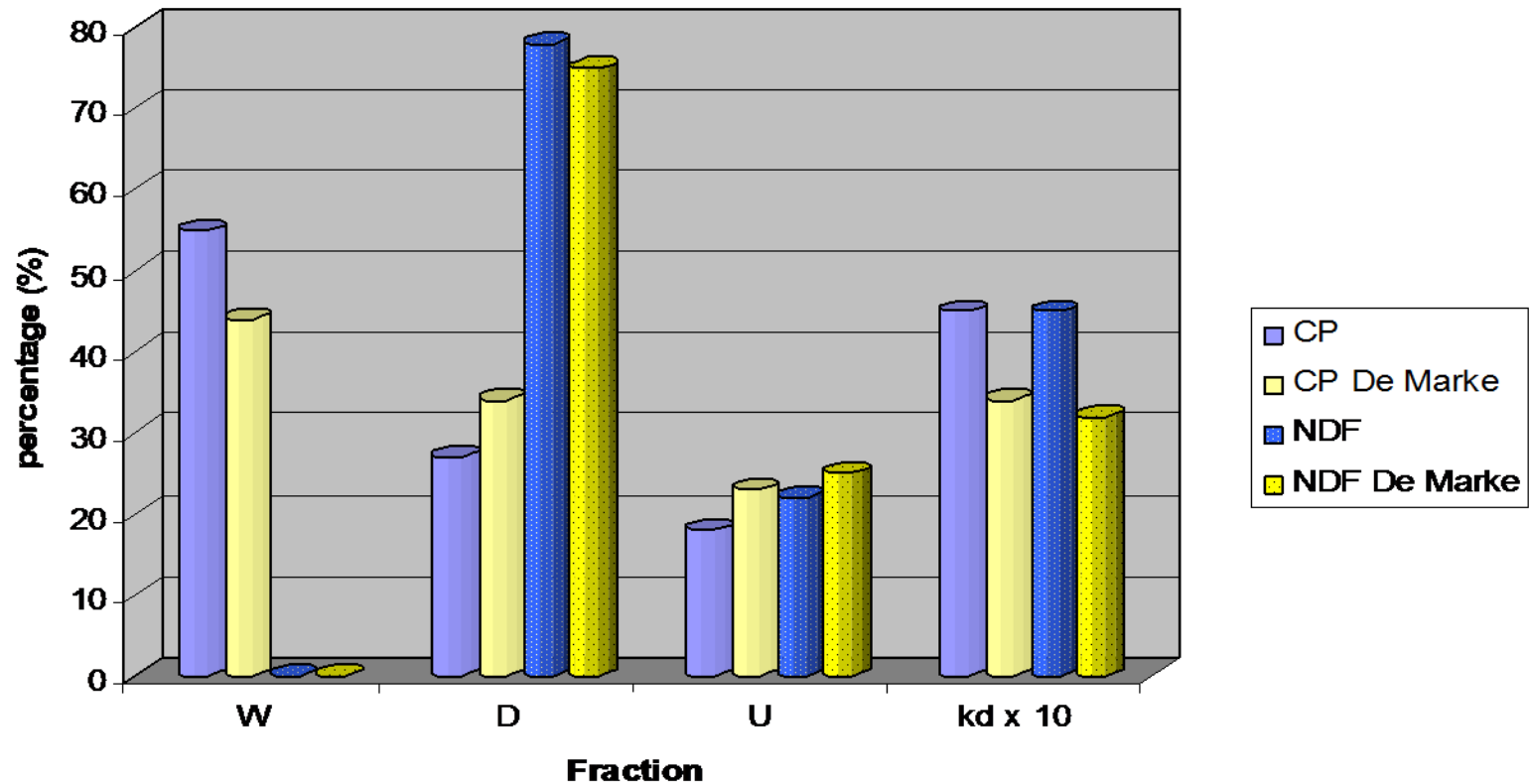


Grass quality

Impact decreased fertiliser use on grass quality



Degradation characteristics ensiled grass



Effect of decreasing grass quality

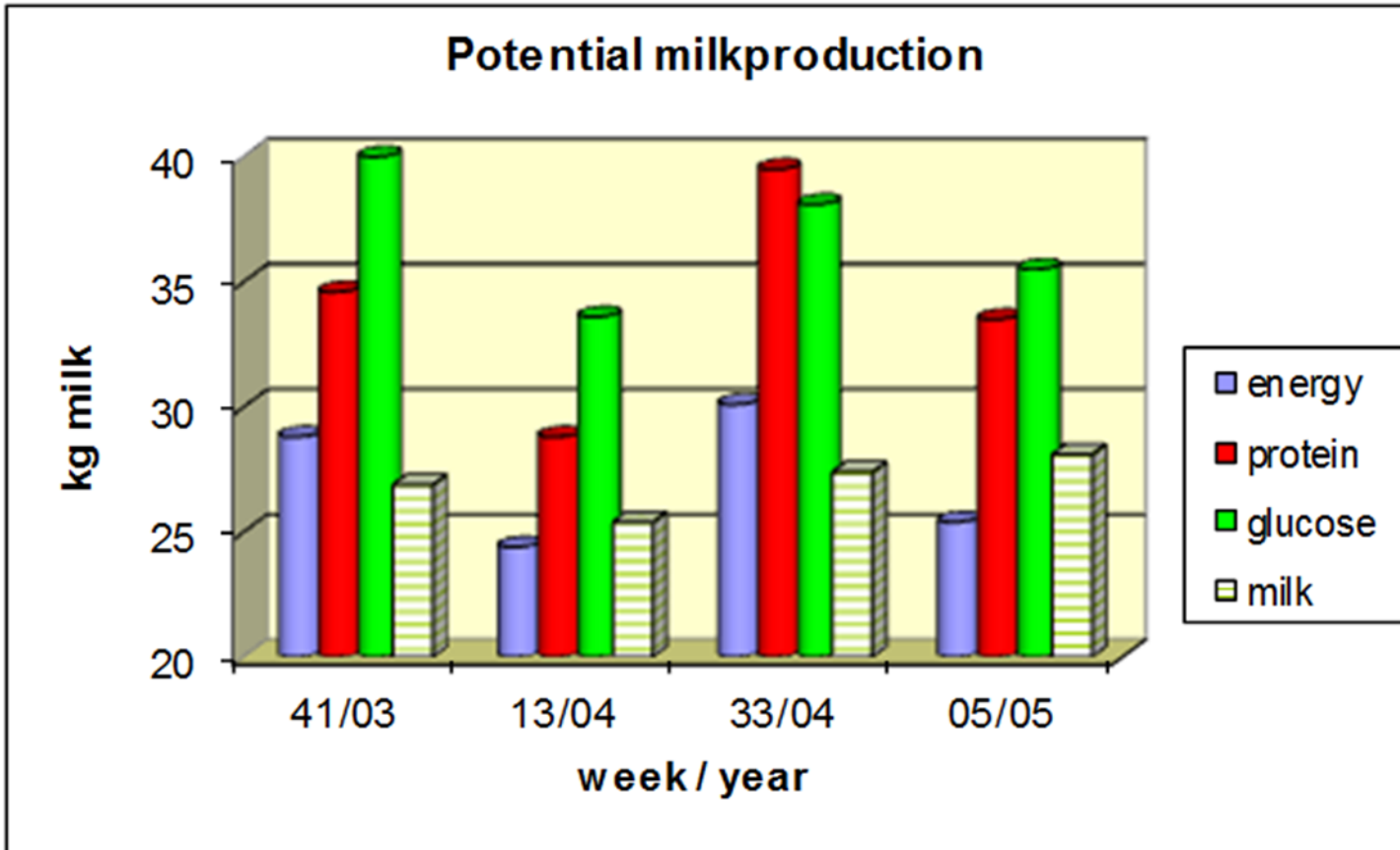


- High feed intake (> 110% of requirements)
- Milk production (protein) drop
- Less protein (DVE) available

- Problem also occurs at commercial farms that minimise environmental burdens



Simulation of rumen fermentation



Bannink et al, 2006.

Estimation of the stoichiometry of volatile fatty acid production in the rumen of lactating cows.
Journal of Theoretical Biology: 238, 36-51.

Feeding challenges resulting from decreased grass quality



- Problem
 - Seems protein shortage
 - Is (also) energy shortage
- Possible solutions
 - Decrease passage rate through rumen
 - Increase N fertiliser
 - Pre-treatment of grass



Conclusions (1)

- High milk production per ha needs farm input of feed (protein)
- Environmental burdens decrease by lowering farm inputs
- Farm outputs (food) stay high by increasing efficiencies in farm cycles
 - Herd, manure, soil and crops
- Herd efficiency is relevant
 - Cow more efficient than young stock



Conclusions (2)

- Decreasing N and P excretion influences all (ex- and internal) farm cycles
- Feed quality (grass) difficult to maintain
 - Lowers milk production
 - Due to lack of both energy and protein
 - Increases feed and/or fertiliser input
- Solution not yet clear
 - Nutritional challenge
 - Technical challenge



Thank you
for your
attention!



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It does not necessarily reflect its view and in no way anticipates the Commission's future policy in this area.



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