

Economic Cost of Nitrogen Management in Agriculture

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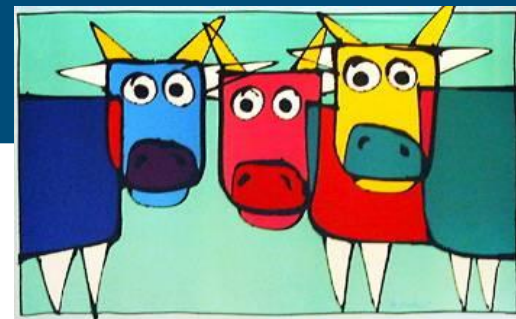
What is 'Nitrogen management'?

- 'A coherent set of activities related to nitrogen use in agriculture to achieve objectives/targets':
 - agronomic objectives
 - environmental/ecological
- In Annex IX, N management is defined in terms of
 - decreasing the N surplus of the input-output balance
 - increasing the N use efficiency (NUE),



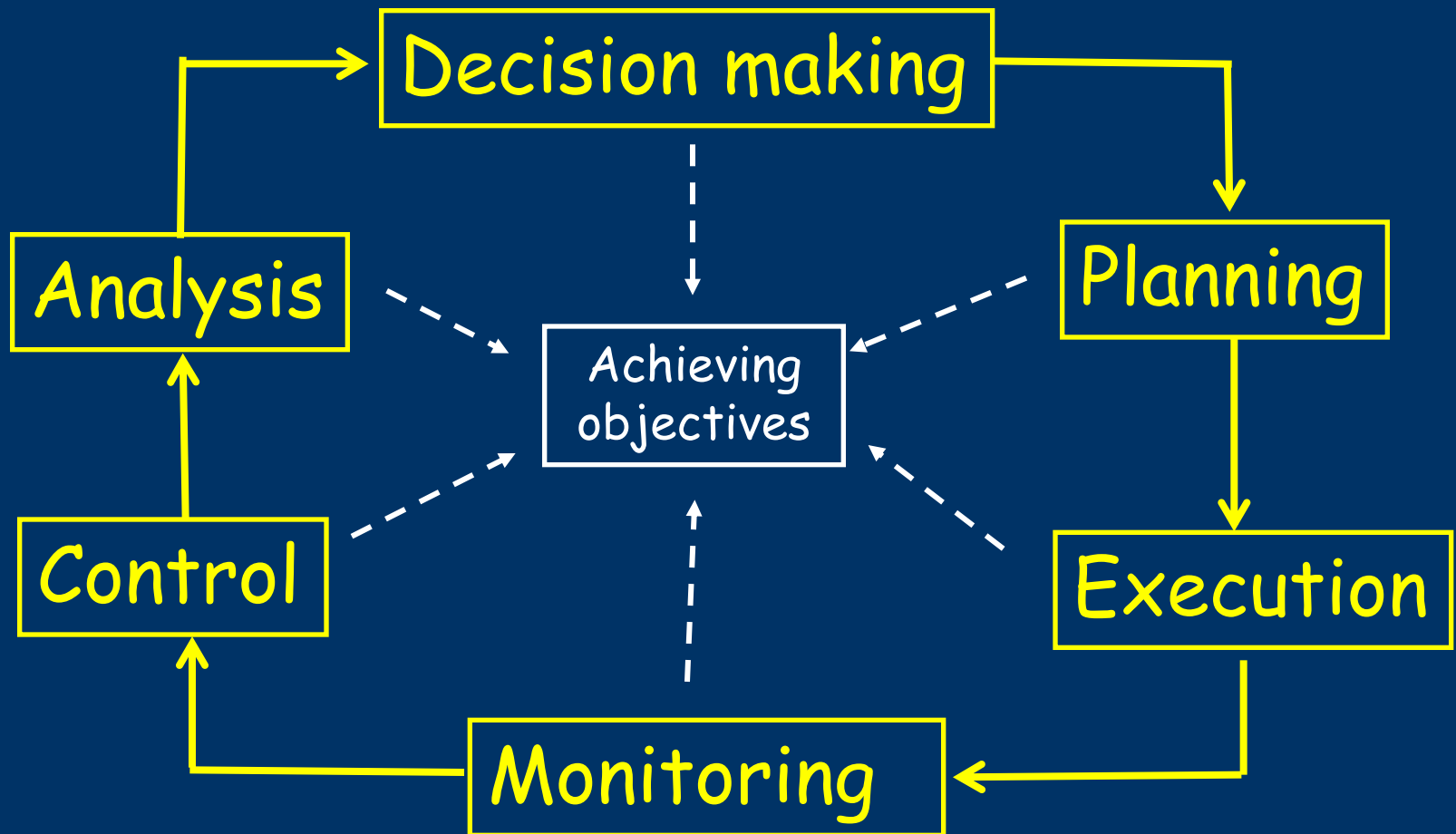
Annex IX of the Gothenburg Protocol

- (a) Nitrogen management, taking into account the full N cycle;
- (b) Livestock feeding strategies;
- (c) Low-emission manure spreading approaches;
- (d) Low-emission manure storage systems;
- (e) Low-emission manure processing and composting systems;
- (f) Low-emission animal housing systems;
- (g) Low- emissions mineral fertilizer application



Nitrogen management

...cyclic process with specific activities...



Economic costs of Nitrogen management

In the Background Document perceived as:

- (i) the economic costs of making a N input-output balance sheet of a farm, and
- (ii) the economic costs of decreasing Nsurplus and increasing NUE through optimization (improved selection, allocation, timing, etc. mainly through knowledge, i.e. software).



Economic costs of making a Nitrogen balance

Economic costs depend on:

- Farm-gate balance < soil-surface balance
- Structure of the farm (mixed versus specialized)
- Data availability (accountancy data)
- Labour cost per hour
- Who is doing it (farmer or accountant)



Economic costs of making a Nitrogen balance

Economic costs of Farm-gate balance:

- In NL and DK about 2 to 4 hrs per farm (500 euro per farm, when done by accountants)
- In Czech, about 16 hrs per farm (500 euro per farm (pers. communication dr. Pavel Cermak))
- Net cost are lower, because
 - Costs can be deducted from taxable farm income
 - Farmers learn and benefit from the results



Economic costs of decreasing Nsurplus

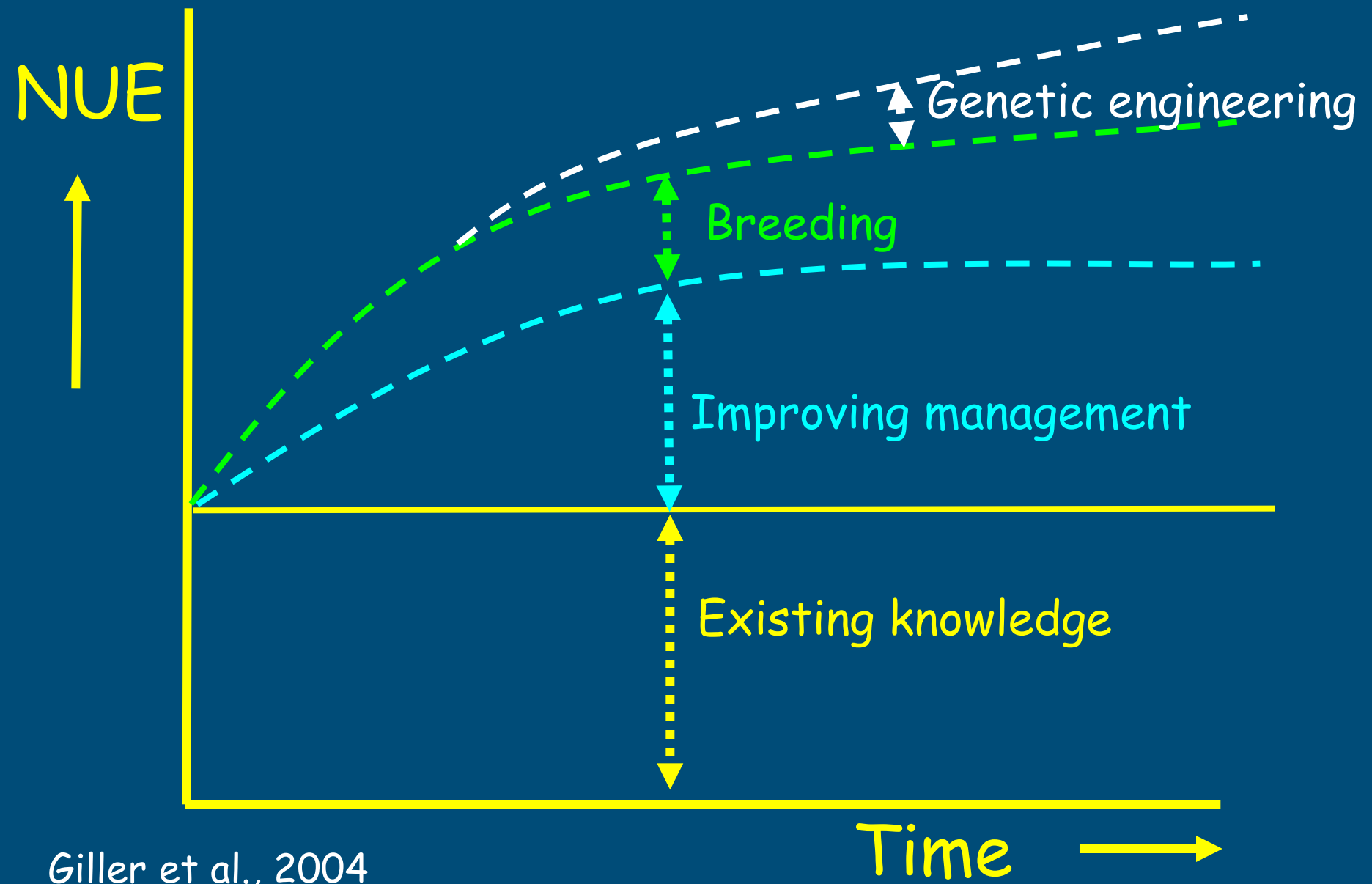
- Most empirical data from DK and NL
- Wide range of estimates (-1 euro to 10 euro per kg N) depending on:
 - Type of measures (e.g. measures from ND)
 - Farm type (crop vs animal systems)
 - Intensity of production (total N input)
 - Knowledge level (learning costs)
- Governments will also have costs for establishing the knowledge infrastructure and for MRV (likely > 1 million per country)



Estimates of costs tend to decrease over time

- Ex-ante estimations of economic costs of measures are larger than ex-post estimations (empirical data) because of:
 - Developments in science and technology (most things become cheaper over time);
 - Farmers are 'learning by doing'; they find 'easy solutions';
 - Single measures are considered within the whole farm business development plan and often combined with other measures and developments
 - Small farmers and farms with poor economic performance are taken over by larger farms with better economic performance.





Decreasing Nsurplus (& increasing NUE) is costly.....

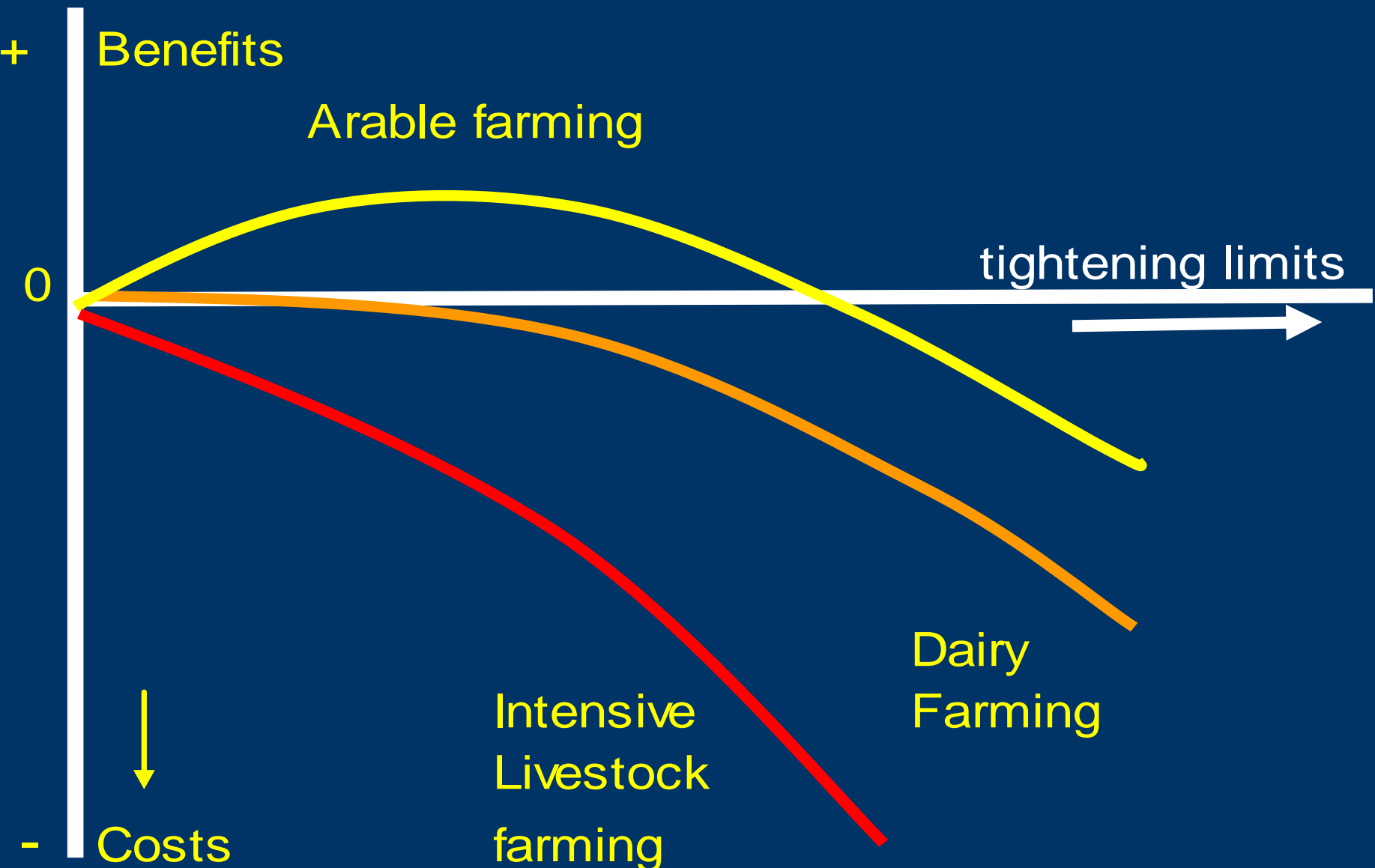
When:



- Livestock farms have to export animal manure
- Yield and quality of crops with high market value decrease



Economic costs high for intensive livestock farms

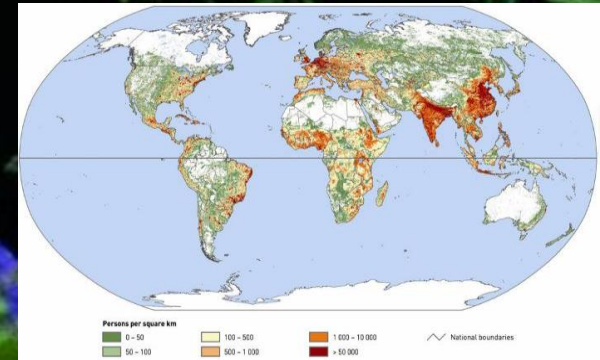


Summary Economic Costs N Management

- Making a nitrogen balance per farm: ~500 euro
- Decreasing N surplus and increasing NUE:
 - -1 to 1 euro per kg as long as yield and quality of produce remain unaltered (depending on changes in fertilizer costs and learning costs)
 - > 1 euro when yield and quality of produce starts to decrease
- Additional costs for governments (> 1 Meuro)
 - Establishing the knowledge infrastructure
 - Costs for monitoring, reporting and verification



Thanks



Economic Cost of low-protein (low NH₃-emissions) animal feeding

Ad van Vuuren
Livestock Research
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Process

- Literature study; exploring websites
- Two requests for information were sent out via email
- Conversations via telephone
- Drafting the report (not completed yet)

Dietary protein intake affects manure N output

dietary protein

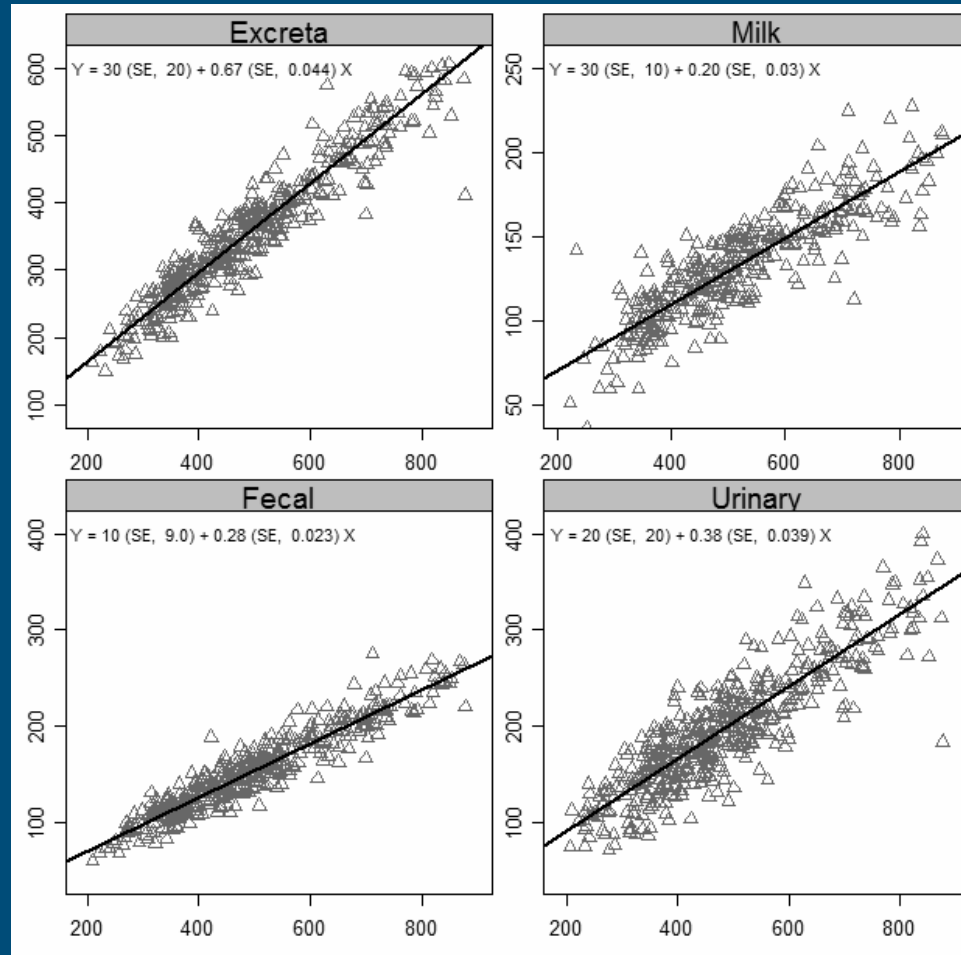


Meat, milk & egg

manure N

N intake and excretion in dairy cattle

N output, g/d



N intake, g/d

Kebreab et al., 2010

Feeding strategies to reduce ammonia

- Reduce urea concentration and excretion
 - Reduce total N output
 - Shift N excretion urine towards N excretion faeces
- Reduce ammonia production and volatilisation
 - Reduce urinary pH

Study on the costs of feeding strategies

- Pigs
- Poultry
- (Dairy) cattle

- Technical results well documented
- Economic effects: hard data scarcely reported!
 - Confidential within feed companies
 - Local publications

Economic costs of low-N feeding strategies

- Costs depend on:
 - Reference situation
 - Costs of feed ingredients in the market
 - Management skill of farmer
 - Effects of changing diets on animal performance
 - Changes in the farm related to the feed harvesting

Reducing crude protein intake **pigs**

- Less ingredients rich in protein-rich (soybean meal)
more ingredients rich in carbohydrates (grains)
- Price of grains < price of soybean meal
- Restrictions: amino acid supply!
- Price of soybean meal < price of synthetic AA's

Costs of low N feeding strategies in pigs

Relative NH ₃ reduction	Costs		Reference
	/pig place	/kg NH ₃ red	
10% Phase feeding	€1.520	€4.800	Piñeiro
15%	-€2.070	-€0.552	Aarnink
30% (unfav. market)	€0.005	€1.700	Piñeiro
30% (fav. market)	-€0.006	-€2.000	Piñeiro
30%	€5.910	€0.788	Aarnink

Costs of feeding strategies acidifying pig' urine

Relative NH ₃ reduction	Costs	
	/pig place	/kg NH ₃ red
16% (benzoic acid)	€9.94	€2.48
3% (anions)	€4.38	€0.73
6% (anions)	€8.77	€1.00

Aarnink et al., 2010

Reducing crude protein intake & NH₃ emissions **poultry**

- Less ingredients rich in protein-rich (soybean meal)
more ingredients rich in carbohydrates (grains)
supplemented with synthetic amino acids
- Increase dry matter of litter
(mainly affected by divalent cations)
- Decrease pH of litter
(dietary fibre yield short-chain fatty acids)
- No economic data!

Reducing crude protein intake (dairy) cattle

- Decrease intake high-protein roughage (grass, grass silage) through
 - Lower fertilizer N application rate
 - Harvesting at higher sward yields
 - Changes in grazing management
 - Balanced 'whole feed mixtures'
- Dilute / replaced with ingredients rich in carbohydrates (grains, maize silage)
- Synthetic amino acids:
 - protected against ruminant degradation
 - required only under specific feeding management

Costs for low-N feeding strategies (dairy) cattle

- Direct feed costs
- Labour costs
 - harvesting / processing maize silage and grass silage
 - indoor feeding
 - manure application
- Direct benefits
 - Increased milk yield
 - Increased animal health and life expectation

Effect low N-feeding strategies **dairy farm**

	base	siesta grazing	strict to requir.	maize indoor
N surplus, kg/ha	242	221	219	155
Extra costs, /kg N red.	-	€0.12	€0.44	€0.90
Extra costs. /100kg milk	-	€0.02	€0.08	€0.64

De Haan, 2001

General comments

- Ethanol production
 - Increase price of carbohydrate-rich ingredients (grains, in future also of fibrous-rich ingredients!)
 - More relatively cheap high-N by-products
- Cell factory (produce e.g. enzymes)
 - More relatively cheap high-N by-products (biomass)

Conclusions (1)

- Economic data are scarce
- Low N feeding strategies in pigs:
 - € -1.5 to € 6.0 per pig place
 - € - 0.6 to € 4.8 per kg ammonia reduction
 - applied in practice, based on prices of protein, grains and synthetic amino acids
- Feeding strategies for low urinary pH in pigs
 - € 0.7 to € 2.5 per kg ammonia reduced
 - applied in practice, also because of improved intestinal health / performance

Conclusions (2)



- Low N feeding strategies in poultry
 - no economic data retrieved!
 - applied in practice, based on prices of protein, grains and synthetic amino acids
- Low N feeding strategies in (dairy) cattle
 - € -1.4 to € 2.4 per kg N reduction
 - Feed costs + labour costs!
 - Low-N concentrates cheaper than high-N concentrates!