

# Sustainable dairy production

Low N and P input incompatible with high outputs?

Dr. L.B.J. Šebek

EPSO workshop on the European Feed Value Chain  
26-27 june 2007



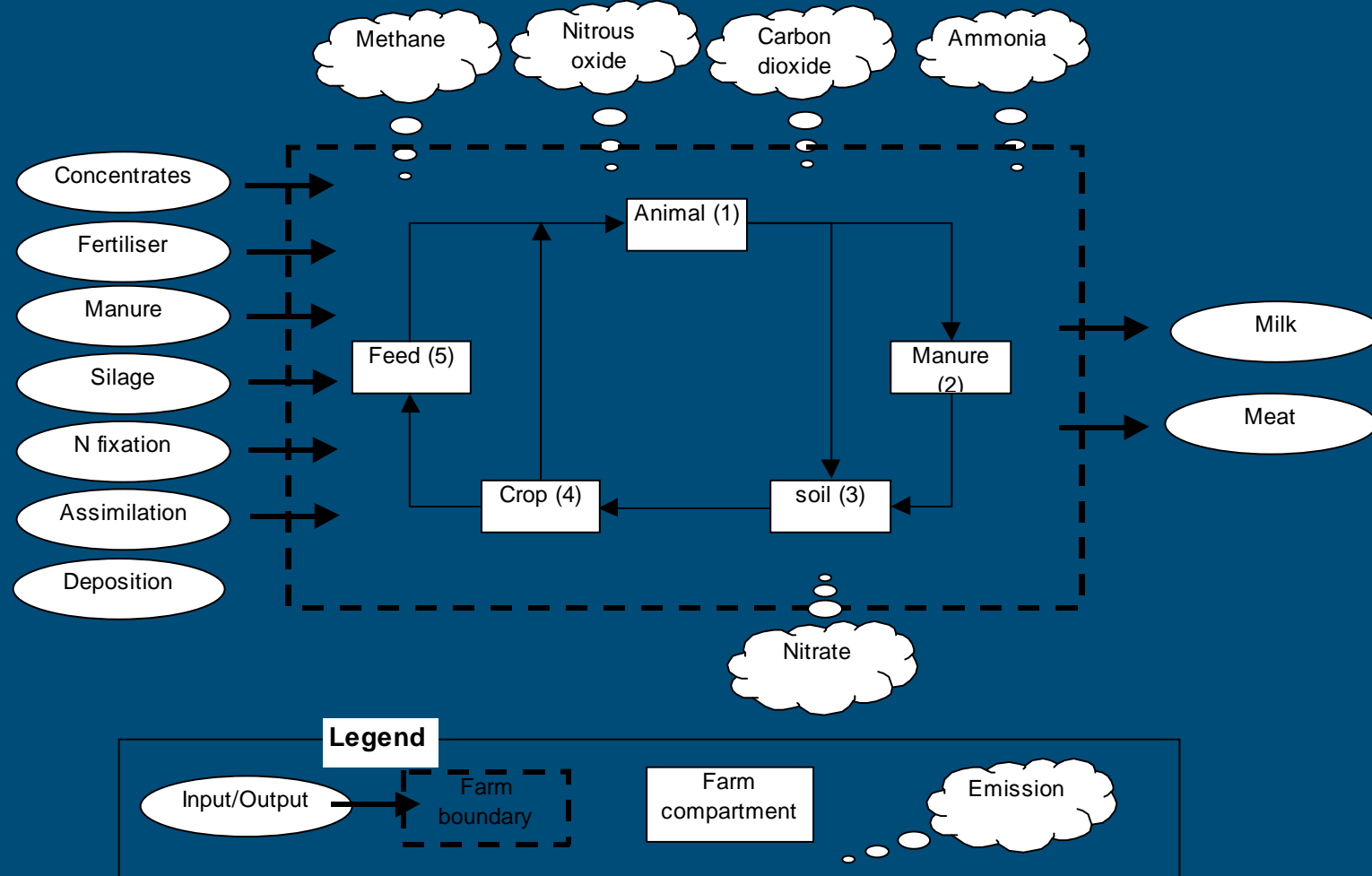
ANIMAL SCIENCES GROUP  
WAGENINGENUR

# Content

- Introduction
  - Environmental load dairy farms
  - Impact nutrition
- Nutrition and excretion
- Nutrition and emission
- Integrated whole farm approach
- Productivity and low input
- Conclusions and challenges



# Introduction (1): Environmental load dairy farms



Schils et al, 2005. Alterra-WUR, The Netherlands

# Introduction (2): Impact of nutrition

## ■ Animal efficiency

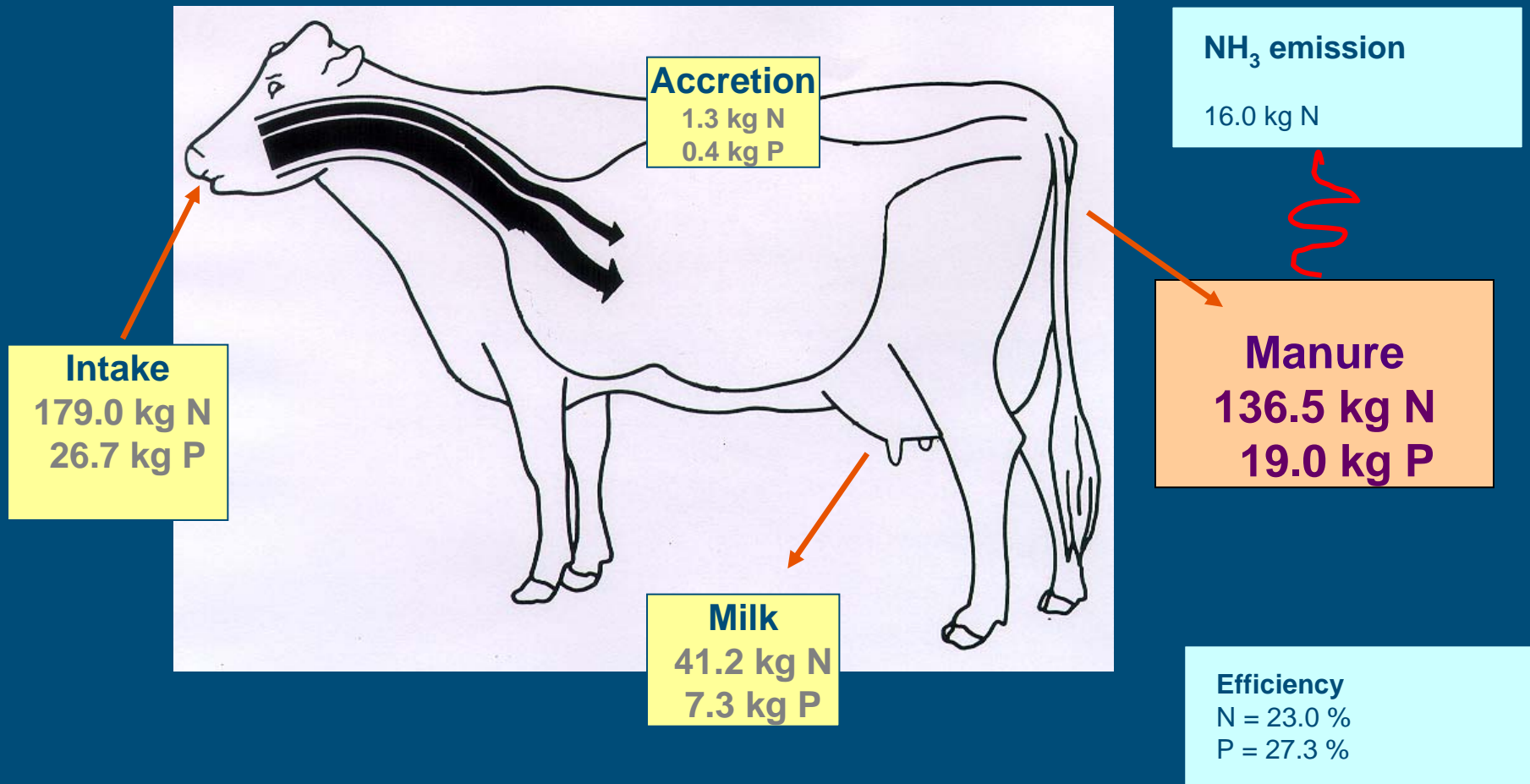
- Defining requirements
- Diet formulation
- Feeding strategy

## ■ Farm efficiency

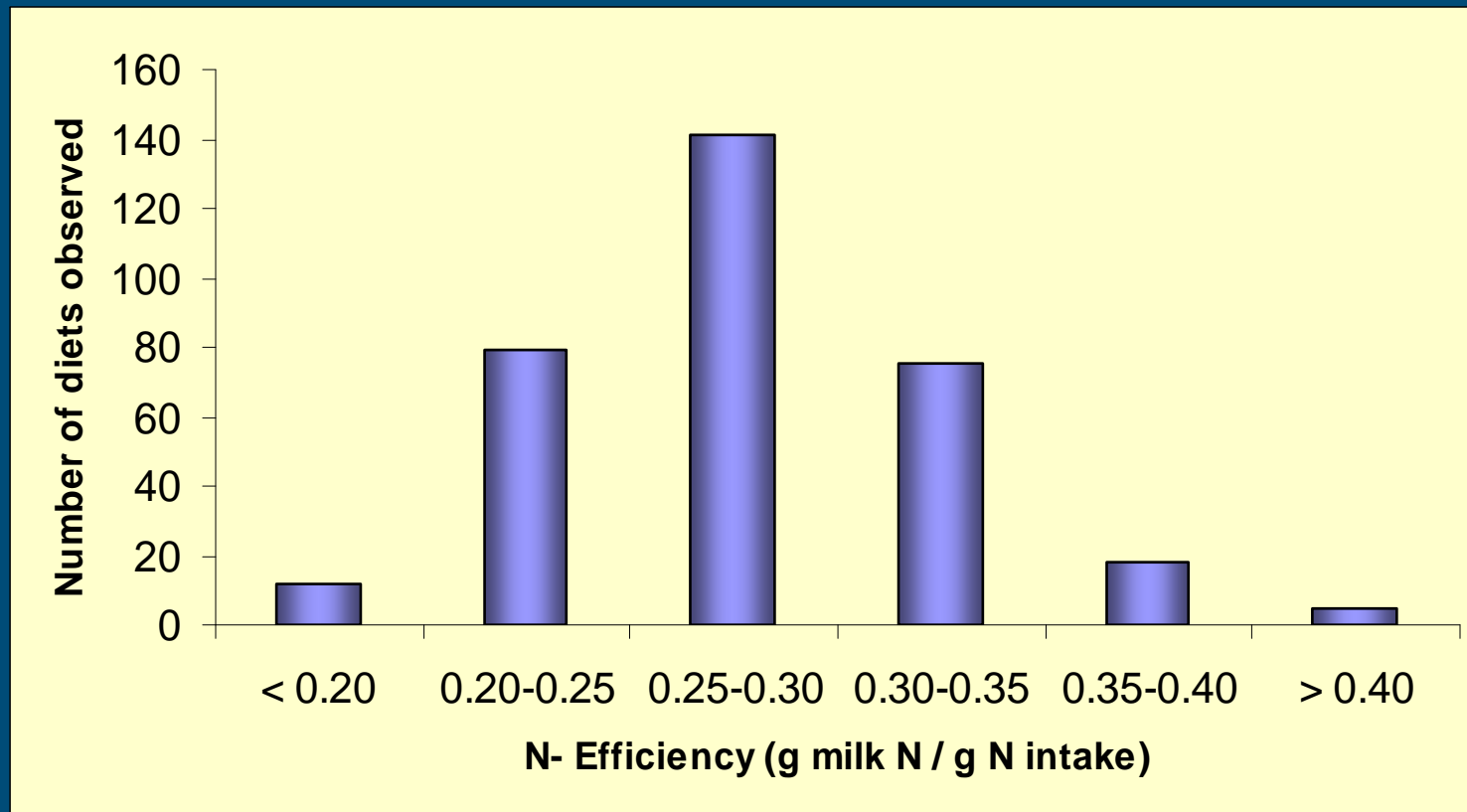
- Interacting components (animal, soil, manure and crop)
- Prevention of swapping excretion and emission
- Farm management



# Nutrition and excretion (2): N and P flow in dairy cows



## Nutrition and excretion (3): N efficiency dairy cows



Chase, 2003. Cornell USA



# Challenges nutrition and excretion

- Decreasing intake of N + P
  - Composition and amount of concentrates
  - Composition of roughages
- Crop production with less manure and fertilizers
  - Dry matter production
  - Nutrient content
  - Digestibility
- Milk production level
  - Requirements and animal health

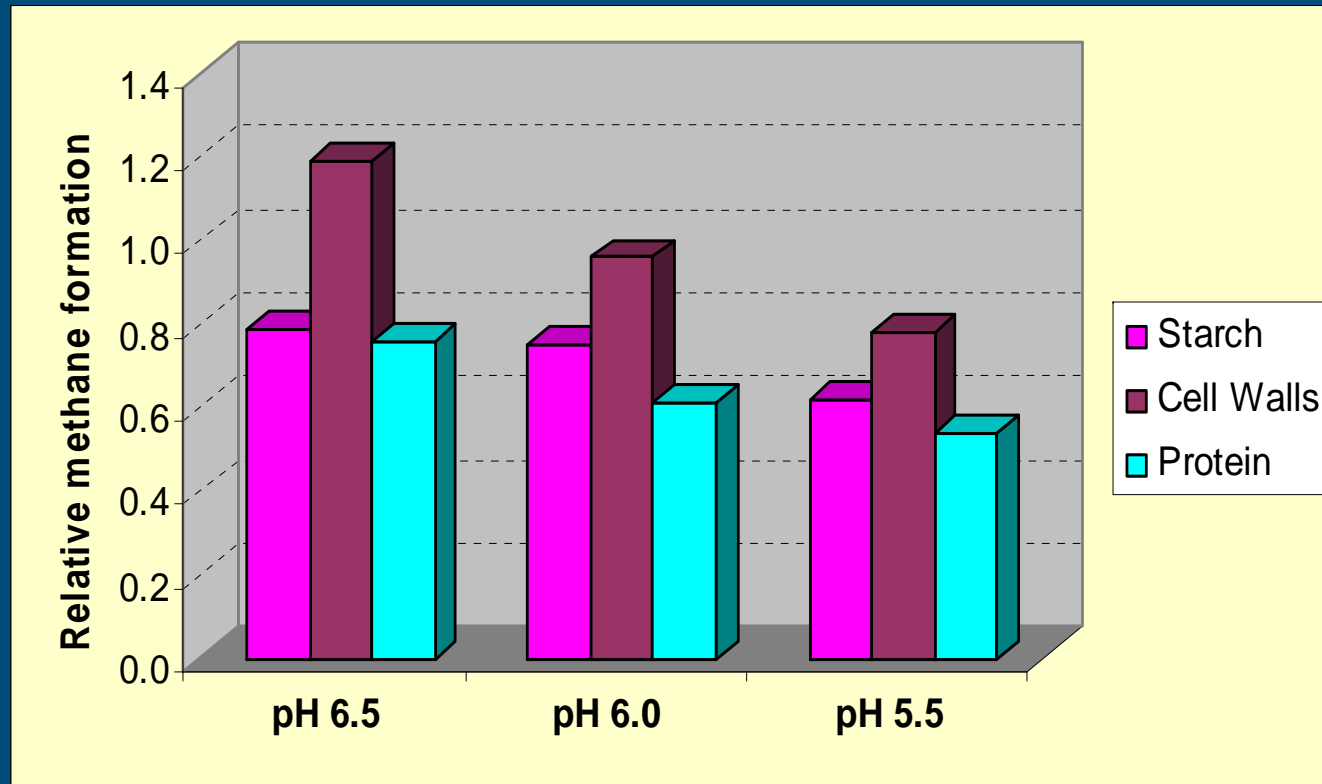


# Nutrition and GHG emission (1): CH<sub>4</sub> and N<sub>2</sub>O

	CH <sub>4</sub> kg/ha	N <sub>2</sub> O kg/ha
■ Rumen	268.0 (73.8%)	0.02 (0.3%)
■ Meadow	2.7	2.90
■ Housing	92.0	0.01
■ Soil	-0.6	0.90
■ Manure application	0.0	0.70
■ Fertilizer	0.0	2.00
■ Total	363.0	6.61
■ CO <sub>2</sub> equivalents	7623 (78.8%)	2049 (21.2%)



# Nutrition and GHG emission (3): Methane



Methane formation of starch, cell walls and protein relative to that of sugars

Dijkstra and Bannink, 2006. ASG-WUR, The Netherlands



# Challenges nutrition and methane emission

- Increase diet quality
  - Increase amount of concentrates in diets
  - Increase amount of starch in diets
  - Increase amount of corn silage in diets
  - Increase roughage quality
  - Decrease amount of grass in diets
  - Decrease harvest en conservation losses
- Increase milkproduction per cow

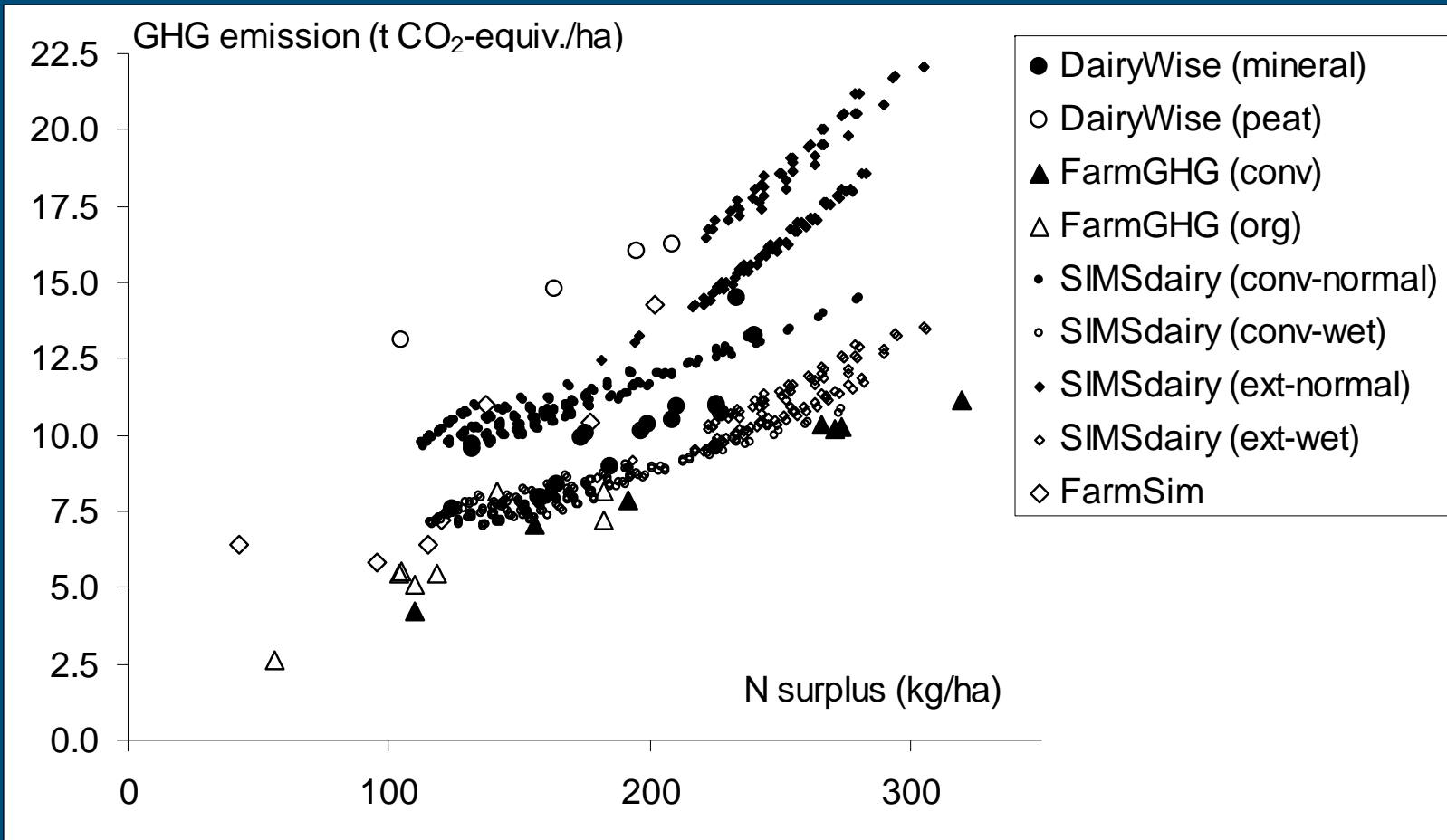


## Nutrition and emission (4): NH<sub>3</sub> and N<sub>2</sub>O

	NH <sub>3</sub> kg/ha	N <sub>2</sub> O kg/ha
■ Rumen	0.0	0.02
■ Meadow	1.4	2.90
■ Housing	25.2	0.01
■ Soil	0.0	0.90
■ Manure application	18.5	0.70
■ Fertilizer	2.4	2.00
■ Total	47.5	6.61



# Farm management and GHG emission



Schils et al, 2006. ASG-WUR, The Netherlands



# Challenges nutrition and emission: $\text{NH}_3$ and $\text{N}_2\text{O}$

- Decrease N surplus (kg/ha)
  - Decrease N intake animals from purchased feeds
  - Increase N output animals
  - Decrease N input from manure and fertilizers
- Decrease system losses
  - harvest en conservation
  - manure application



# Emission swapping

- Decrease N and P excretion
  - Minimize N and P content of the diet
  - Increase efficiency of roughage digestion
- Decrease N surplus ( $\text{NH}_3$  and  $\text{N}_2\text{O}$ )
  - Minimize input concentrates, fertilizers and manure
  - Maximize production (milk, meat and crops)
- Increase milk production per cow
  - Breed
  - Diet
  - Management
- Increase diet quality ( $\text{CH}_4$ )
  - Crop choice
  - Manure and fertilizer use
  - Maximize input concentrates
  - Maximize amount of starch in the diet



# The integrated whole system approach

- Definition (dairy) farm
  - Enterprise that transforms external and internal resources into milk and meat
- Conceptual model of five pools
  - Animal, manure, soil, crop and feed
  - In- and outputs are related to pools
  - Losses are returned to pools manure and soil
- Based on annual N and C flows
  - N- and C-cycle are integrated

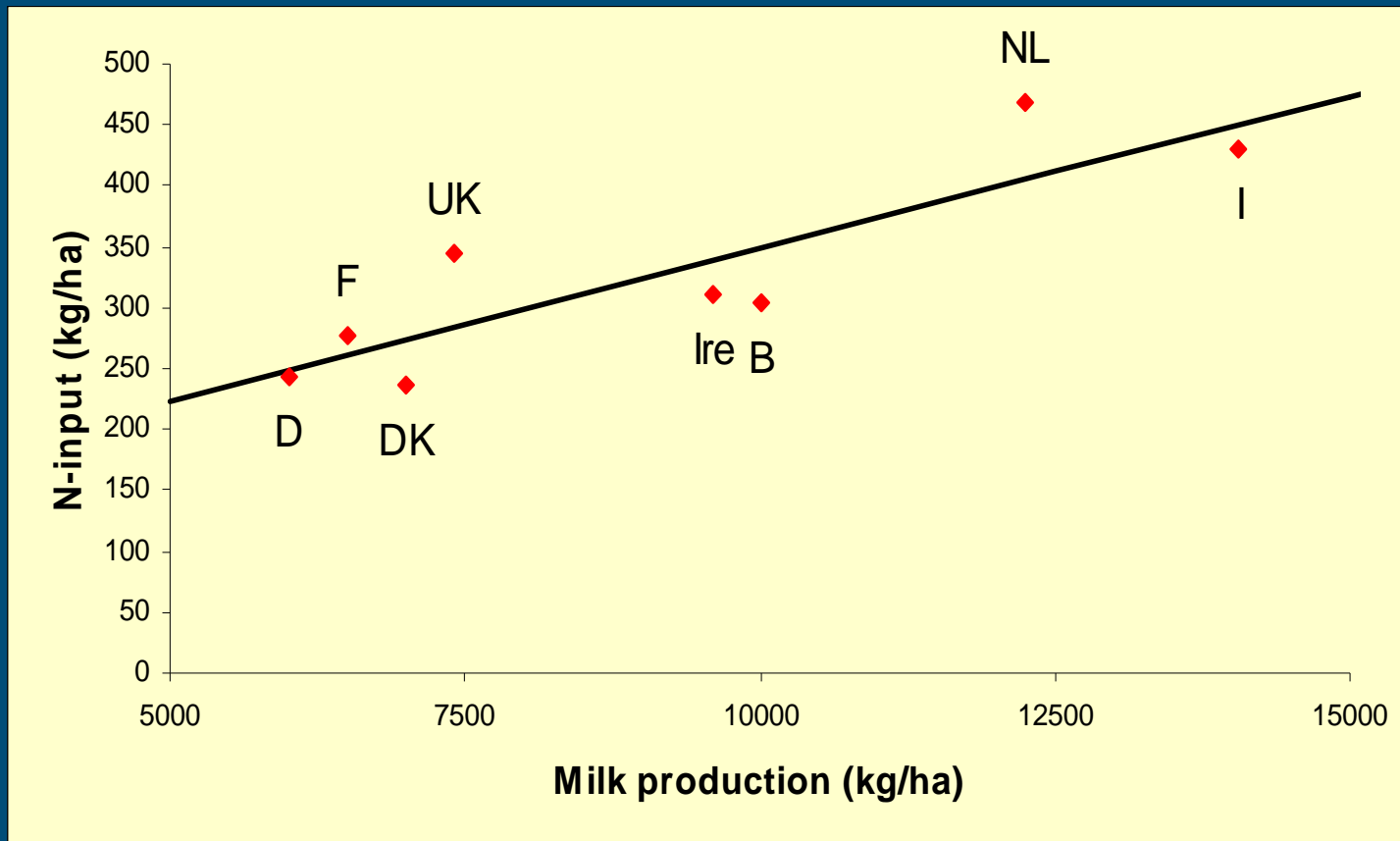


# Nutrition and environmental load

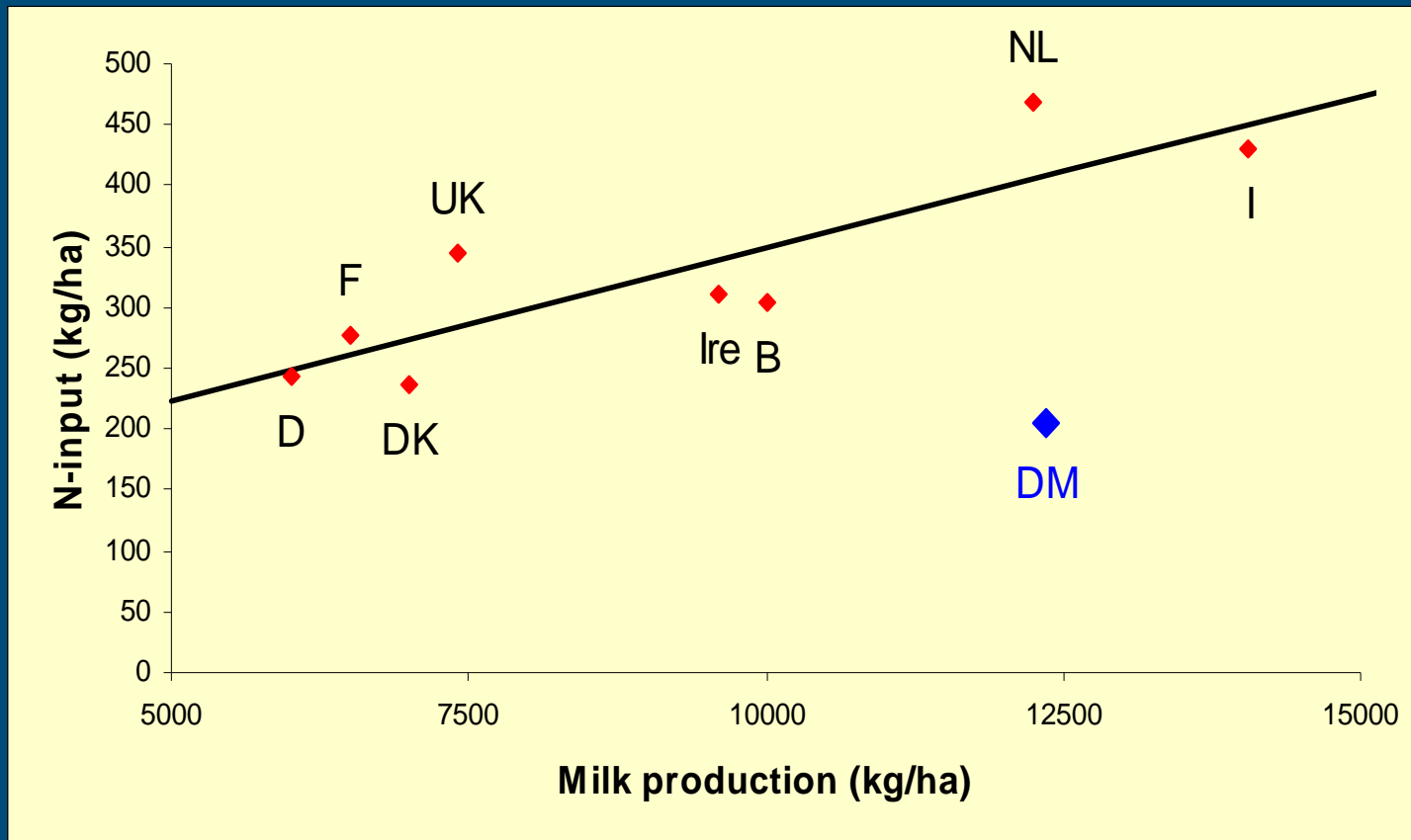
- Decrease N and P input
  - Animal and farm level
  - Maximum: home grown feeds without fertilizers
- Maintain or increase milk production
  - Increase system efficiencies (animal, soil, crop)
- Maintain or increase diet quality
- Challenge: Increase roughage quality



# Productivity and low input



# Productivity and low input



# Conclusions

- Low inputs decrease environmental load of dairy farms
- Risk for swapping between N- and C cycle
- Whole farm approach is useful
- Low inputs can be combined with high production

## Challenge

Improve roughage quality in low input systems



# Thank you for your attention!



ANIMAL SCIENCES GROUP  
WAGENINGENUR