Farm Scale Nitrogen Budgets

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Environmental impact assessments

- **Obligatory when farms wish to expand or intensify**
- **Only medium & large farms**
  - > about 8500 kg N/ha/yr excretion
- **Includes N losses**
  - Ammonia (Habitats Directive + national limits)
  - Nitrate leaching (Nitrates and Water Framework Directives)
- **Wanted a tool for regulators**
  - Internet-based
  - Farm N balance

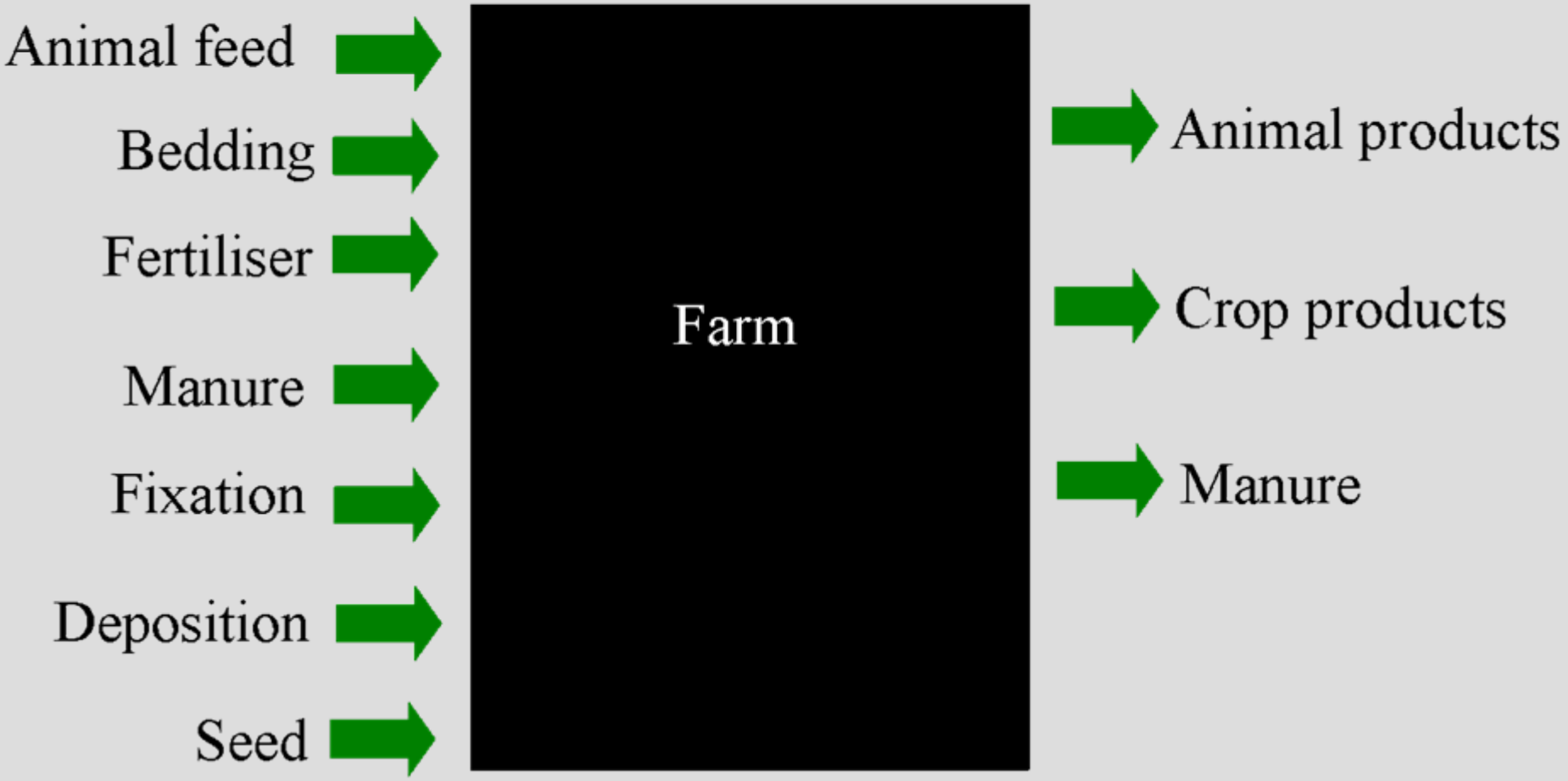
Philosophy

- Farm N balance is more reliable than animal, manure management or soil N balances
- Farm N balance acts as a constraint rather than an indicator
- Calculate N losses using independent models
- Adjust to be consistent with farm N balance

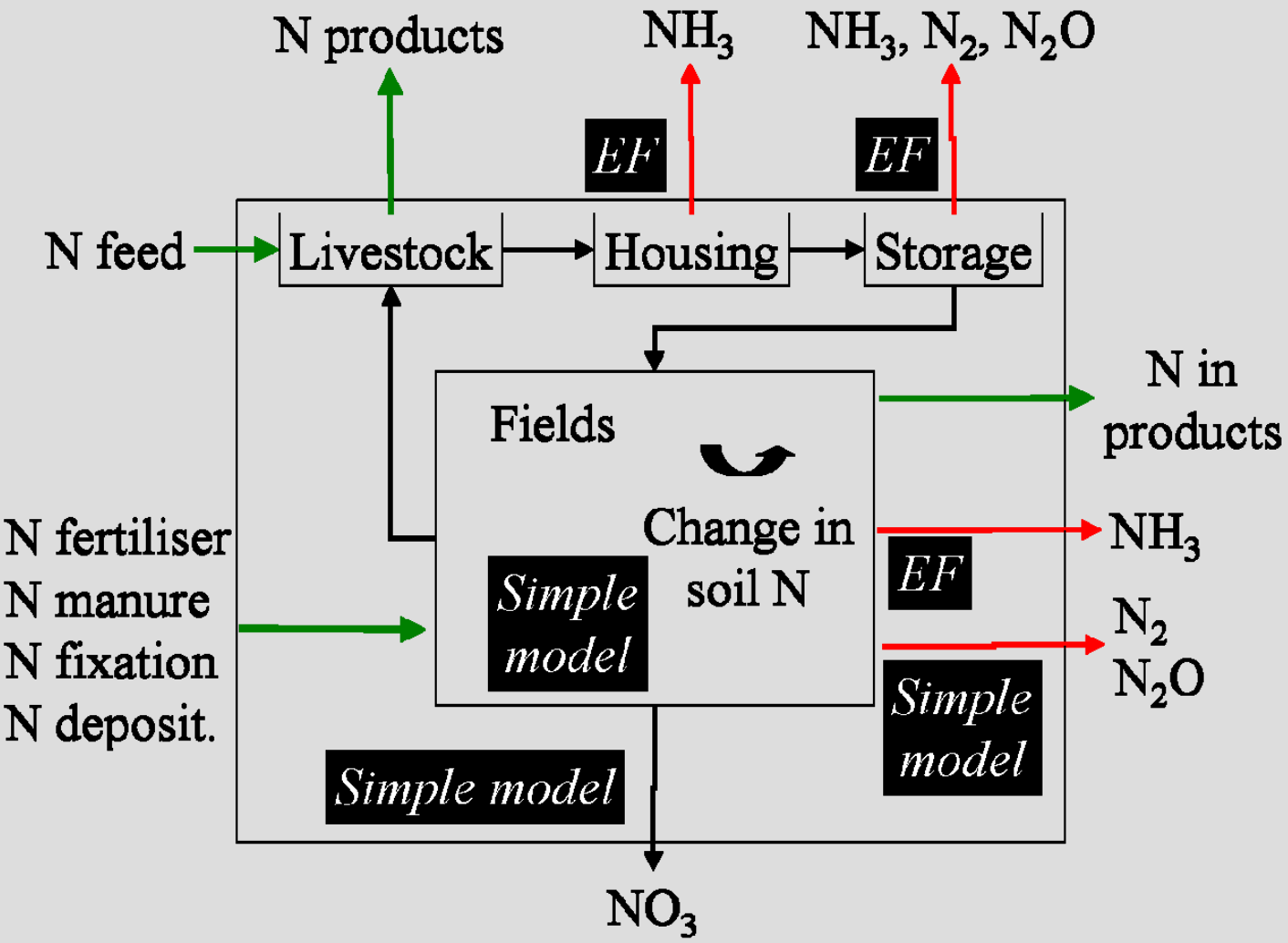
Calculations

- **Estimate farm N surplus**
  - Now
  - After farm expansion/intensification
- **Partition farm N surplus between**
  - N losses
  - Change in soil N storage
- **Does not assume soil N storage is in equilibrium with management**

Components of farm N surplus



Modelling of N losses



Note: NO and DON not included

Data sources

- **Linkage to national databases, e.g.**
  - Soil type
  - Current numbers of animals
- **Many inputs standard, e.g.**
  - Standard N excretion rates
  - Standard crop yields at maximum N application
  - Limited choice of crop mixtures
- **Regulation is more farm type specific than farm specific**

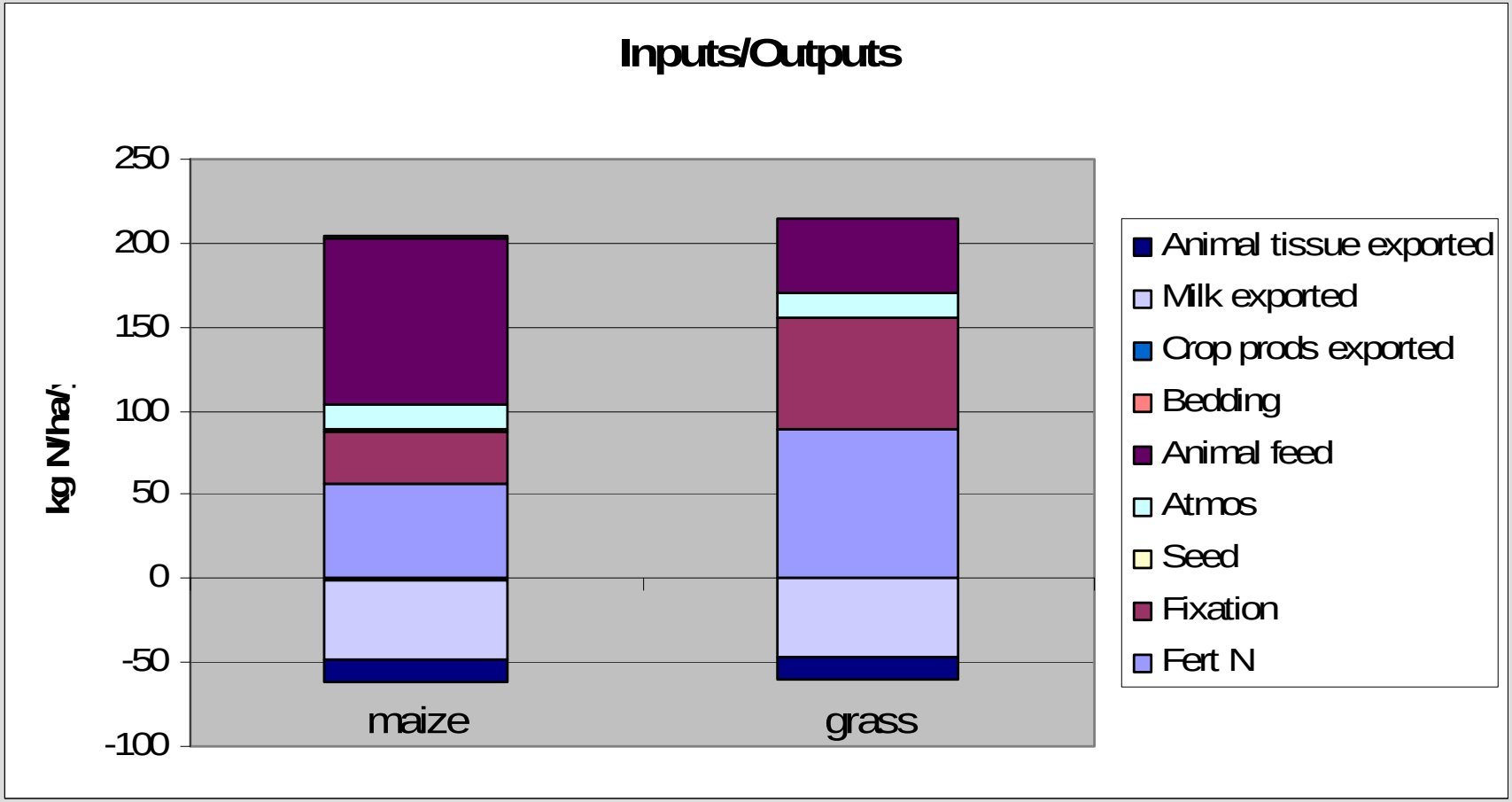
Example: dairy farm

- 118 mature dairy cows
- 130 heifers
- 26 bull calves
- Area = 100 ha, clayey sand

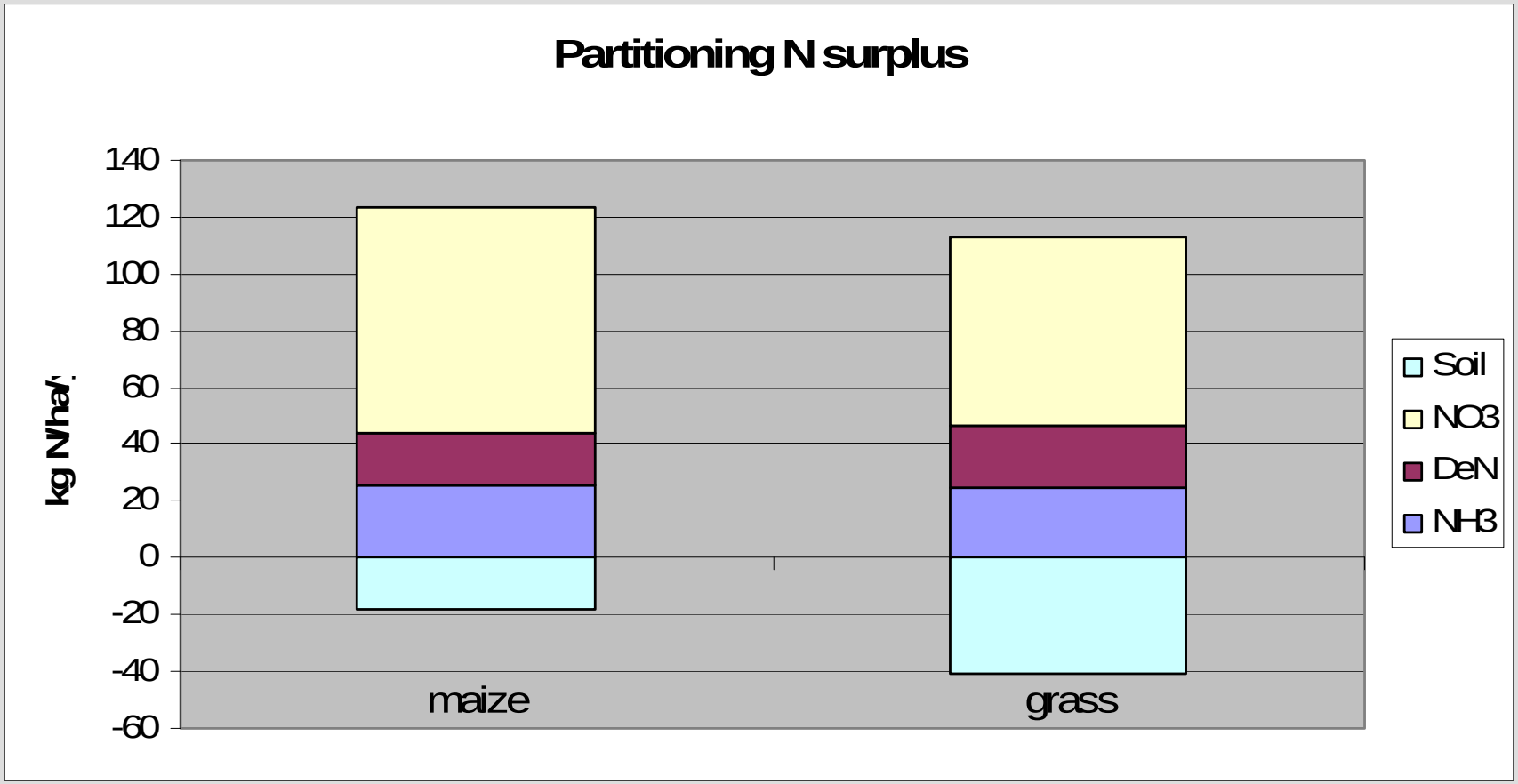
Table 2 Crop mixtures in dairy scenarios

Crop	Conventional dairy Dairy FYM	Dairy maize Dairy maize high	Dairy grass Dairy grass low
	ha		
Spring barley	7	8	11
Spring barley + grass catch-crop	7	7	3
Grass/clover	30	30	70
Whole-crop spring barley + grass catch-crop	26	20	16
Maize	30	35	0
Total	*100*	*100*	*100*

Standard animal N use efficiencies



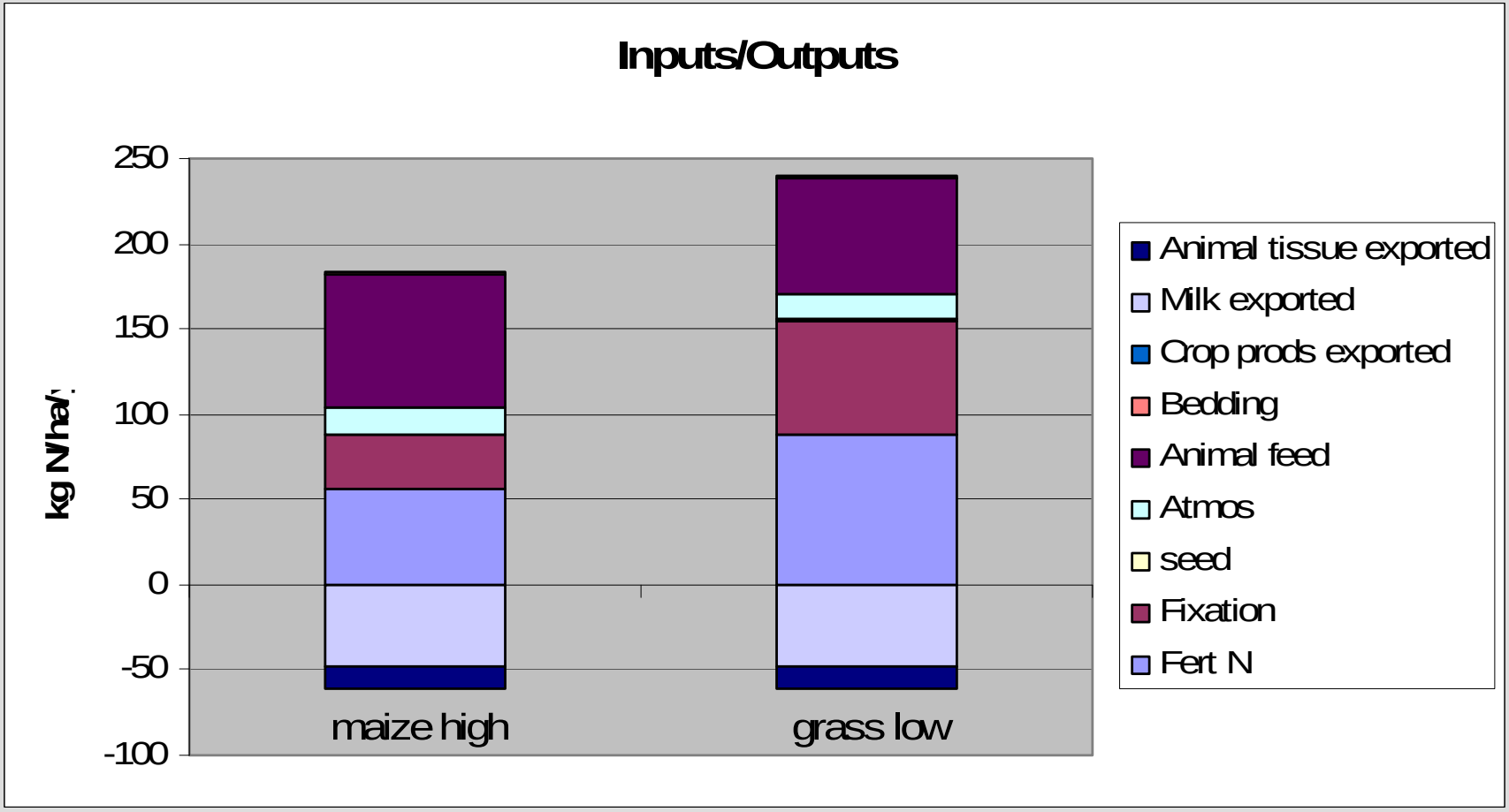
Standard animal N use efficiencies



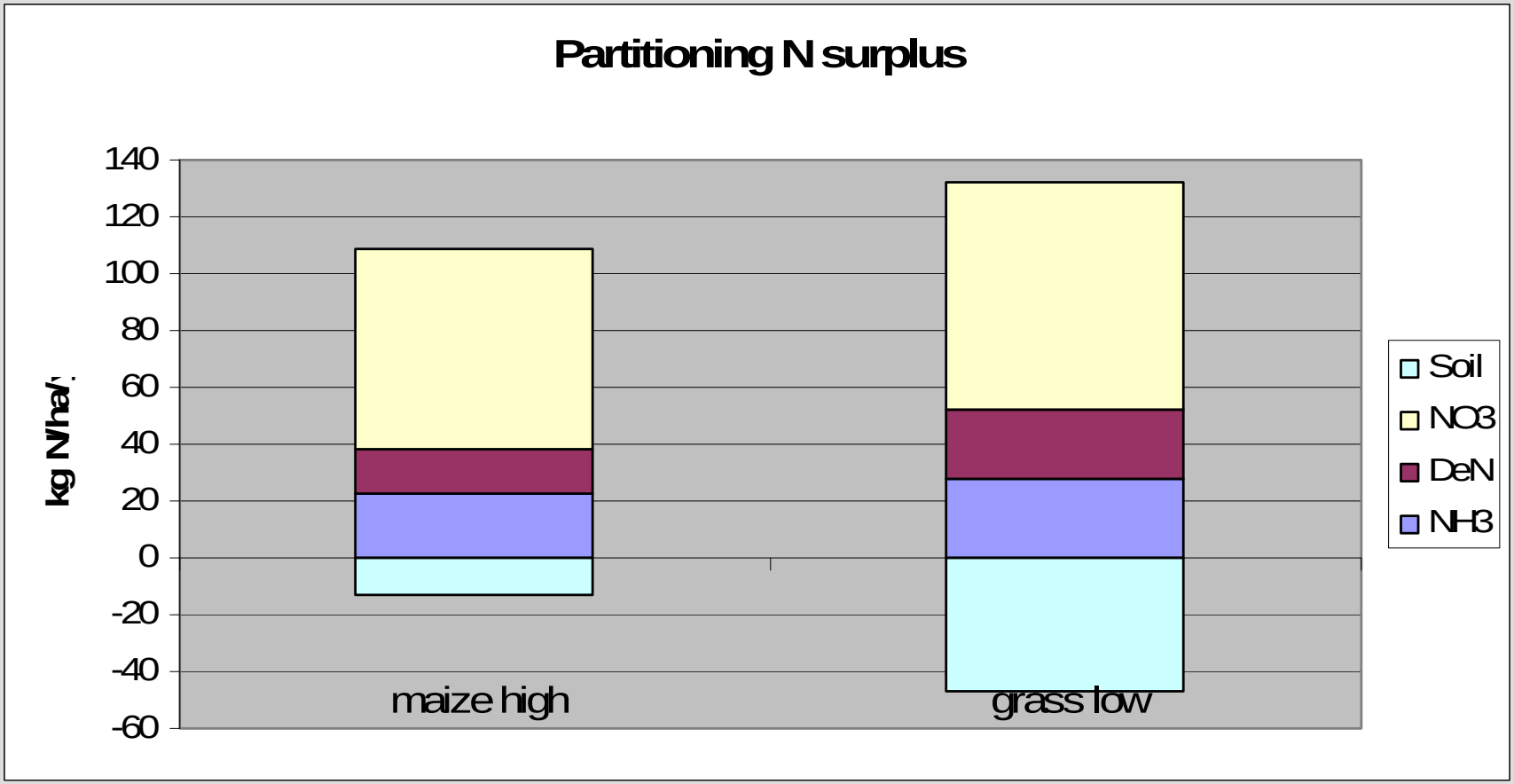
Change assumed efficiencies

- **Milk 25%, growth 12.5%**
- **Maize – increase animal N efficiency by 10%**
  - Better N:energy balance in feed
- **Grass – decrease animal N efficiency by 10%**
  - Poorer N:energy balance in feed

Variable animal N use efficiencies



Variable animal N use efficiencies

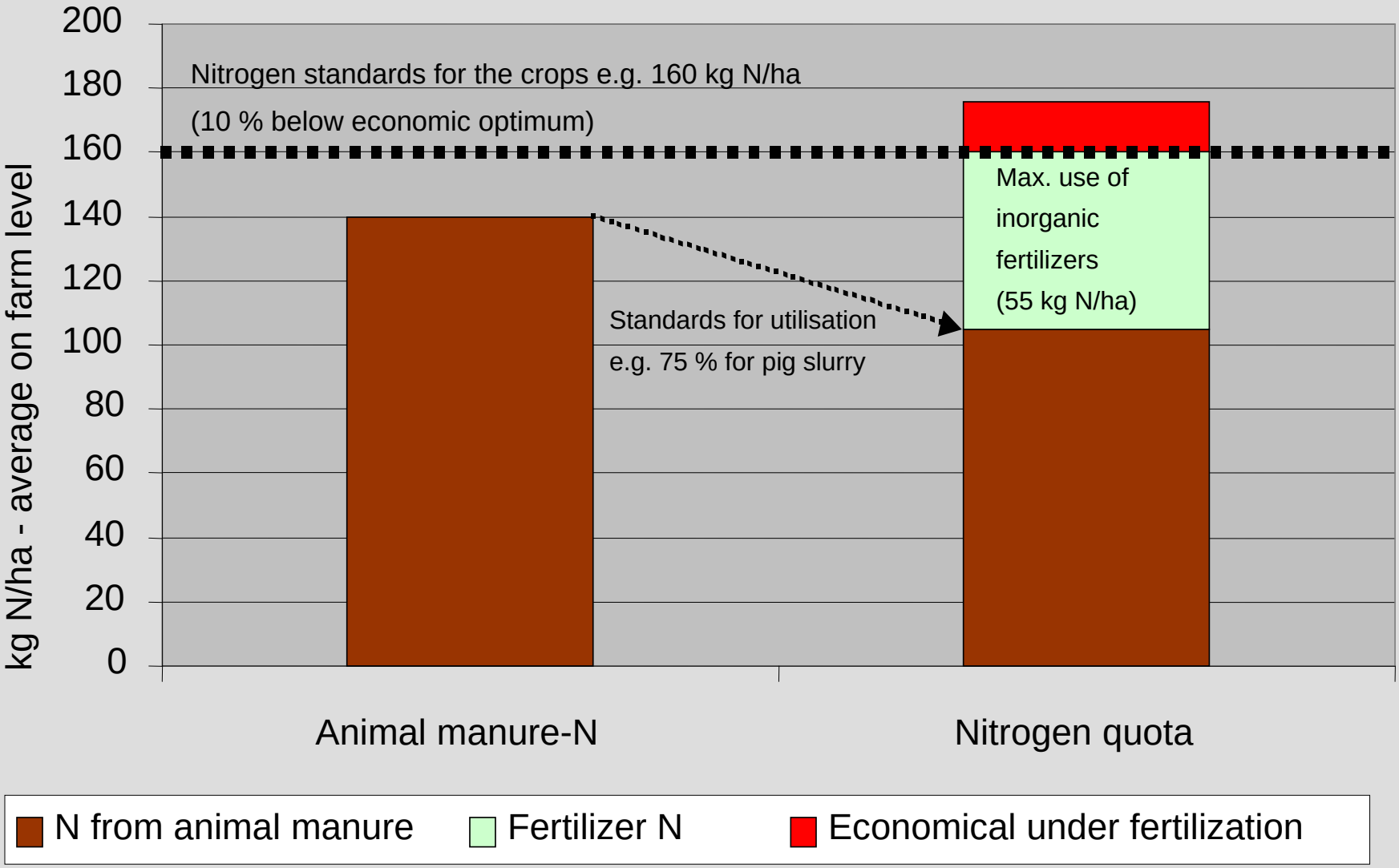


Conclusions

- **Method can be applied to a farm or a sector**
- **Use of farm N balances imposes discipline**
  - Identifies inconsistencies
- **Estimated losses very sensitive to N efficiencies used**

Danish N regulation

- **Farm-scale plant-available N quotas**
  - Depends on soil type and cropping
  - Maximum application rate for each crop
- **Plant-availability of N**
  - Mineral N = 100% available
  - Cattle slurry = 70% available
  - Cattle solid = 45% available
  - Pig slurry = 75% available
- **N quota = 90% of economic optimum**


200
180
160
140
120
100
80
60
40
20
0
kg N/ha - average on farm level
Nitrogen standards for the crops e.g. 160 kg N/ha
(10 % below economic optimum)
Standards for utilisation
e.g. 75 % for pig slurry
Max. use of
inorganic
fertilizers
(55 kg N/ha)
Animal manure-N
Nitrogen quota
N from animal manure
Fertilizer N
Economical under fertilization