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FarmAC model

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European Project n° 266018

INRA, ILRI, WUR,
EMBPRAR, FAO and others

TATION

Role of farm-scale N budgets (1)

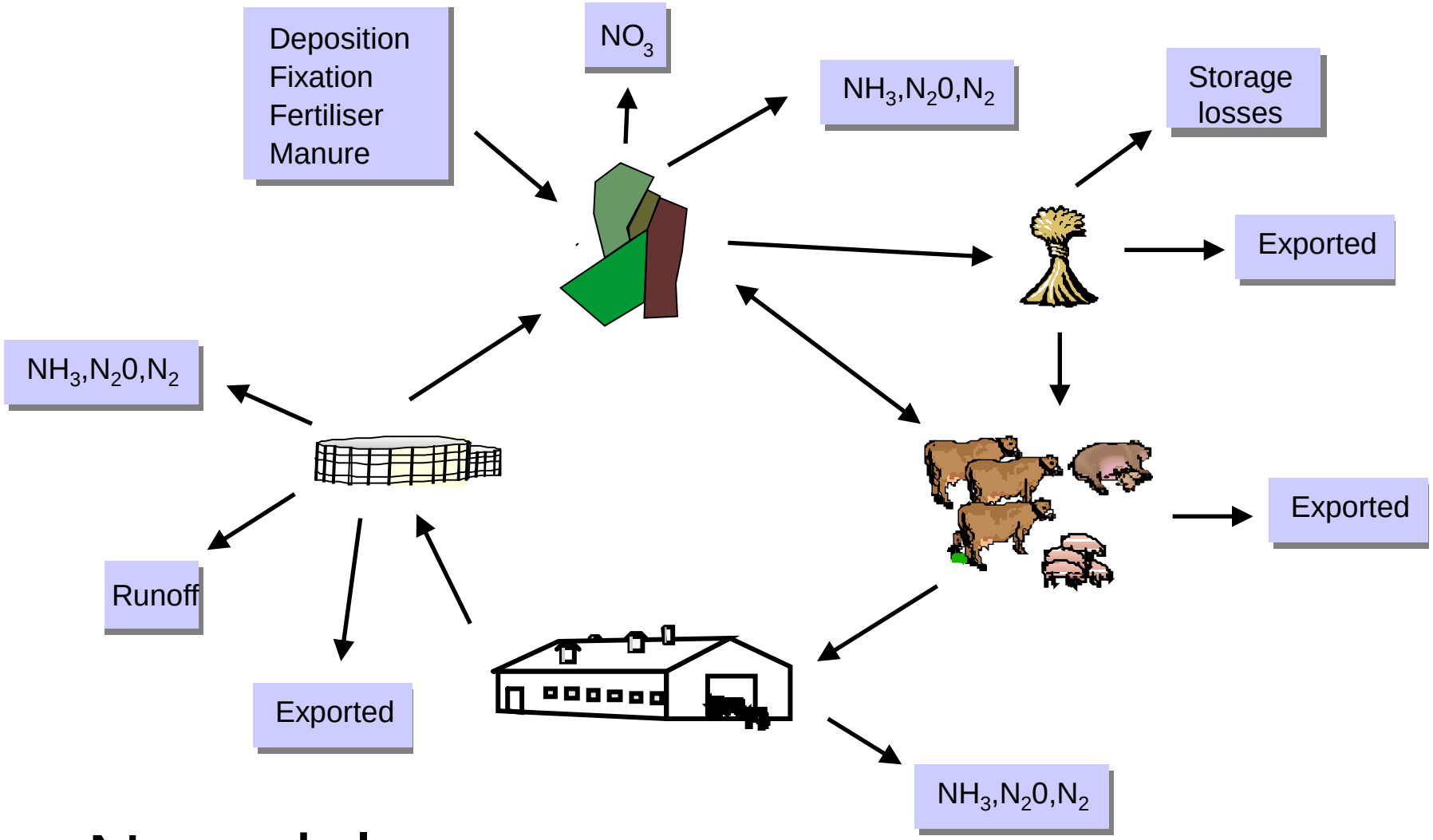
- Is there a problem?
  - Farm N balance (output of products – input of fertiliser etc)
  - Compare with standard or best-practice farms of same type
- Where is the problem?
  - Farm N budget, using measured data (e.g. milk production, crop production)
  - Compare N use efficiencies for livestock & crops with standard or best-practice farms of same type

Role of farm-scale N budgets (2)

- What to do about the problem?
  - What measures can be applied?
  - How effective are they likely to be?
- Requires a quantitative understanding of the mechanisms driving N use and loss
  - Modelling
- Requires data and parameterisation

FarmAC model

- Developed as part of EU AnimalChange project
  - www.AnimalChange.eu
- Intended to have wide applicability
  - W Europe, Senegal, S Africa, Brazil
- Simple enough – limited demand for inputs and parameters
- Complex enough - describe consequences of abatement/mitigation measures
- C and N mass flows
- Web-based user interface


Deposition
Fixation
Fertiliser
Manure
NO3
NH3,N20,N2
Storage losses
Exported
NH3,N20,N2
Runoff
Exported
Exported
NH3,N20,N2

N model

Livestock

- User defines:
  - Number of each livestock type
  - Composition of feed ration
- Energy and protein budget to predict:
  - Maintenance
  - Growth
  - Milk production

Manure management

- EEA/EMEP Guidebook Tier 2
  - Emission factors
- NH_3 emission from animal housing
- NH_3, N_2 and N_2O emission from manure storage
- Includes runoff from storage
- NH_3 emission from field-applied manures

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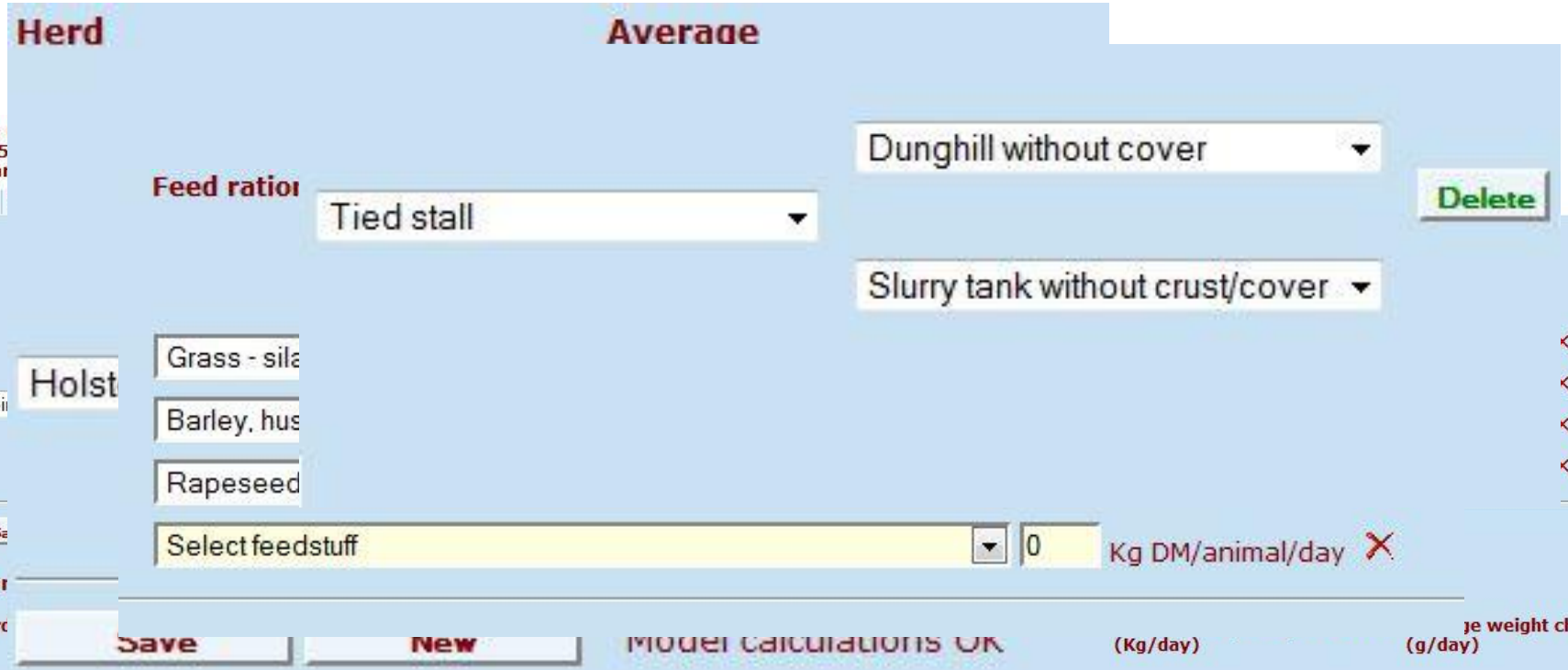
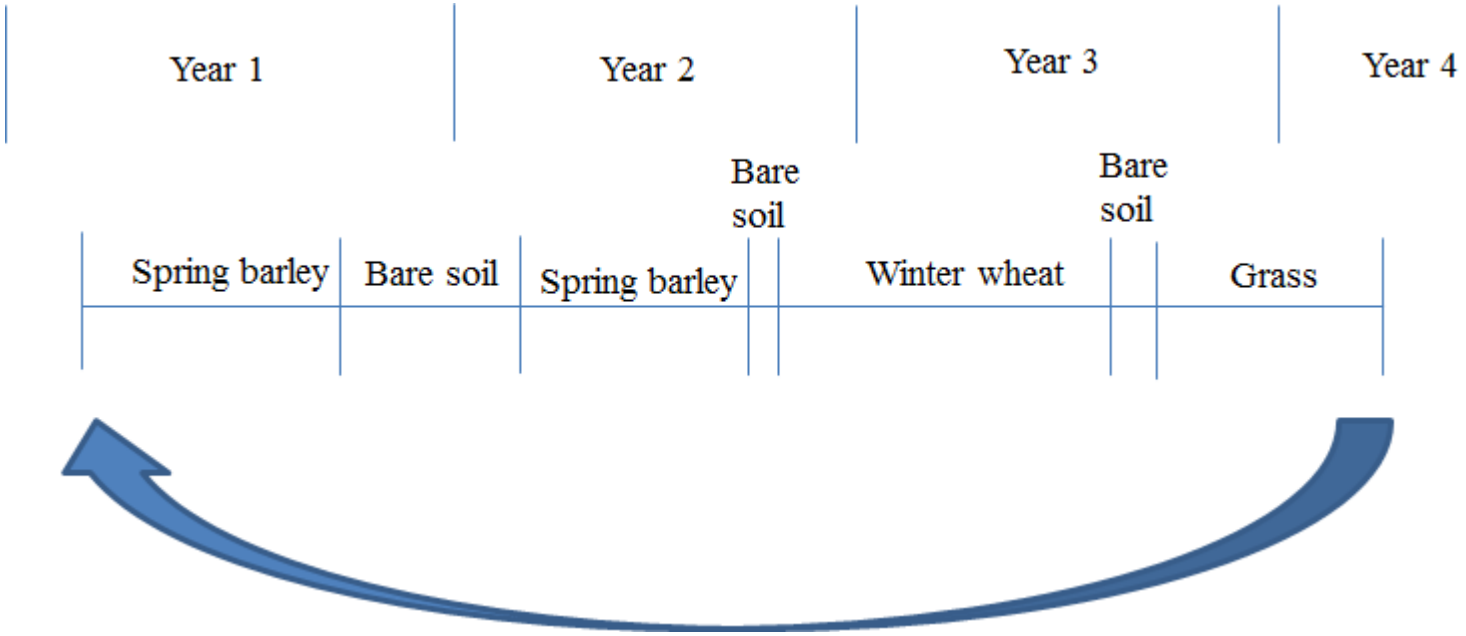
Cattle



Cropping

- None, one or many crop rotations



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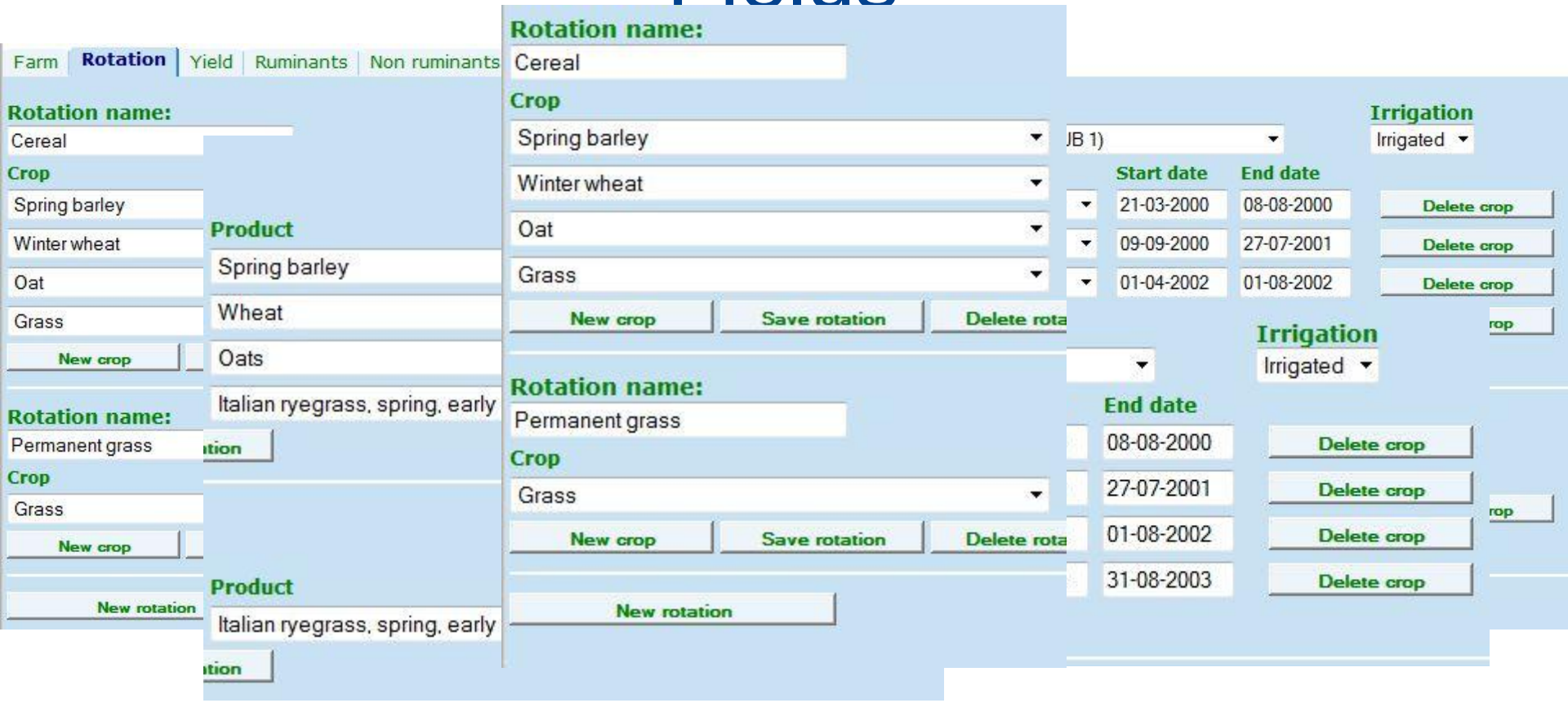
Fields



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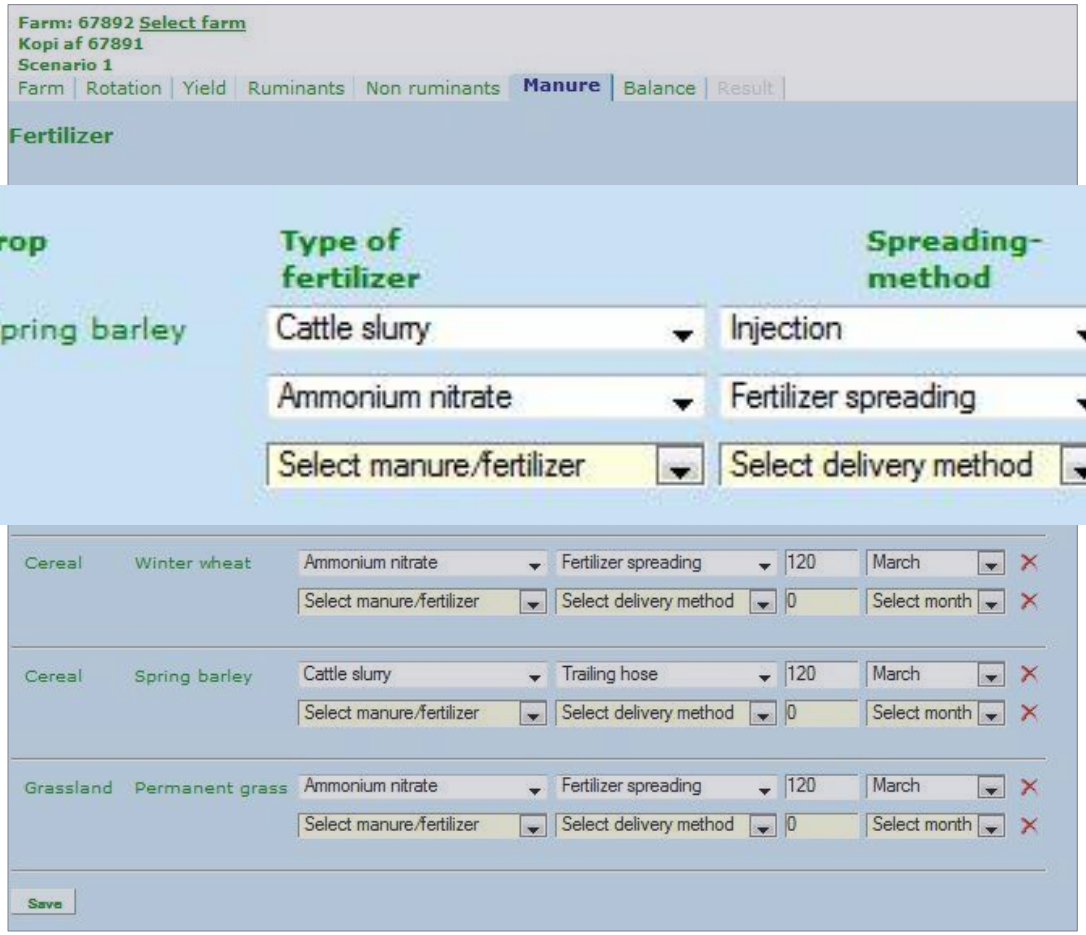
Fertilizer and manure applications



Mineral N supply

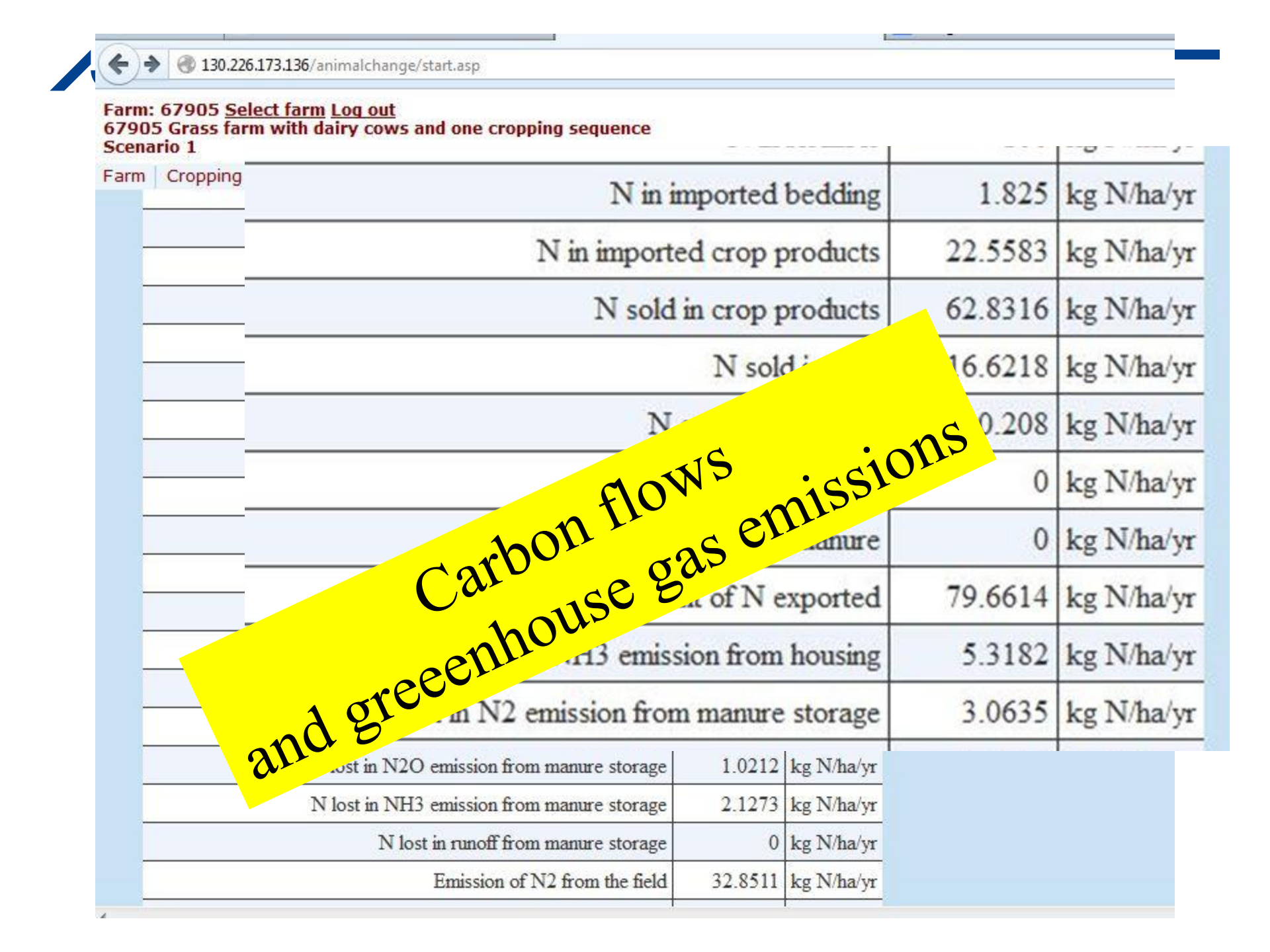
- Atmospheric deposition
- Fertilizer N input
- Manure ammonium N input
- Urine N input
- N fixation
- N mineralization/immobilization in soil
  - Crop residues, manure organic N, faeces
  - Simple dynamic soil N model
- Carry-over from previous crop

Mineral N losses & availability

- Ammonia emission from fertilizer
  - Depends on fertilizer type and spreading method
- N_2 and N_2O from manure, crop residues etc.
  - Source-specific emission factors
- N leaching
  - Simple index-based model for nitrate leaching
  - Organic N leaching – soil model
- Mineral N available to crop = supply - losses

Crop dry matter yield

- User inputs potential crop DM yield
  - Primary product (e.g. grain, grass)
  - Secondary product (e.g. straw), if relevant
- Actual yield is determined by:
  - Availability of water
  - Availability of mineral N in soil


130.226.173.136/animalchange/start.asp
Farm: 67905 Select farm Log out
67905 Grass farm with dairy cows and one cropping sequence
Scenario 1
Farm
Cropping
N in imported bedding 1.825 kg N/ha/yr
N in imported crop products 22.5583 kg N/ha/yr
N sold in crop products 62.8316 kg N/ha/yr
16.6218 kg N/ha/yr
0.208 kg N/ha/yr
0 kg N/ha/yr
0 kg N/ha/yr
of N exported 79.6614 kg N/ha/yr
3 emission from housing 5.3182 kg N/ha/yr
N2 emission from manure storage 3.0635 kg N/ha/yr
lost in N2O emission from manure storage 1.0212 kg N/ha/yr
N lost in NH3 emission from manure storage 2.1273 kg N/ha/yr
N lost in runoff from manure storage 0 kg N/ha/yr
Emission of N2 from the field 32.8511 kg N/ha/yr
Carbon flows
and greeenhouse gas emissions

Applications

- Use to estimate effect of farm-specific measures to improve N use efficiency and reduce N losses
  - Especially where local adaptability is important
- Farm N management data collection
  - Use the interface without using the model
  - Open access

Future

- Adding phosphorus, ash and water flows
  - Economics + LCA
- Improved modelling of nitrate leaching
- Tier 3 approach for gaseous emissions
  - e.g. temperature-dependent emissions factors
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