Federal Agricultural Research Centre

Institute of Rural Studies

Integrated Agricultural and Hydrological Modelling within an Intensive Livestock Region Taking Supra-regional Manure Transports into Account

Diffuse Inputs into the Groundwater
Monitoring – Modelling - Management
Graz, 29. January 2007

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Structure of the Presentation

- Introduction and objectives
- Description of the agricultural economic and hydrological model network
- Model results on impacts of nutrient reductions measures taking supra-regional manure transports into account
- Conclusions and outlook

Objectives and scope of the RAUMIS, GROWA / WEKU model-network

Area differentiated status quo and impact analyses of policies aiming at reducing diffuse pollution of ground- and surface waters

- **Comprehensive consideration of meso- to macroscale catchments**
  - Catchments 1.000 - 100.000 km^2
  - Consistent link-up of well established, operational agricultural economics and hydro(geo)logical models
  - Quantification of nutrient inputs (N and P) via all relevant diffuse input pathways
- **Uniform and transferable assessment approach**
  - Uniform methods arranged in tiers according to data availability
  - Uniform data base (e.g. EU wide data = minimum standard on macro scale, …)
  - Indication of data gaps and recommendations (e.g. monitoring programs)
- **Support of policy decision-making**
  - Impacts of nutrient reduction measures on nutrient load in rivers and on the agricultural sector (area differentiated)
  - Consideration of the downstream/upstream problematic
  - Consensual agricultural and environmental policies beyond state borders (e.g. achievement of HELCOM / PARCOM agreements)
  - Support the establishment of management plans as required by WFD

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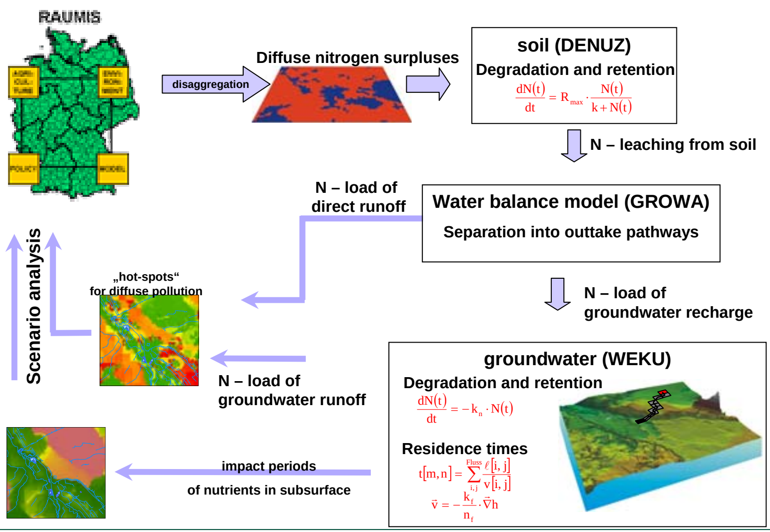
Integrated agroeconomic / hydro(geo)logic model system (RAUMIS and GROWA/WEKU)



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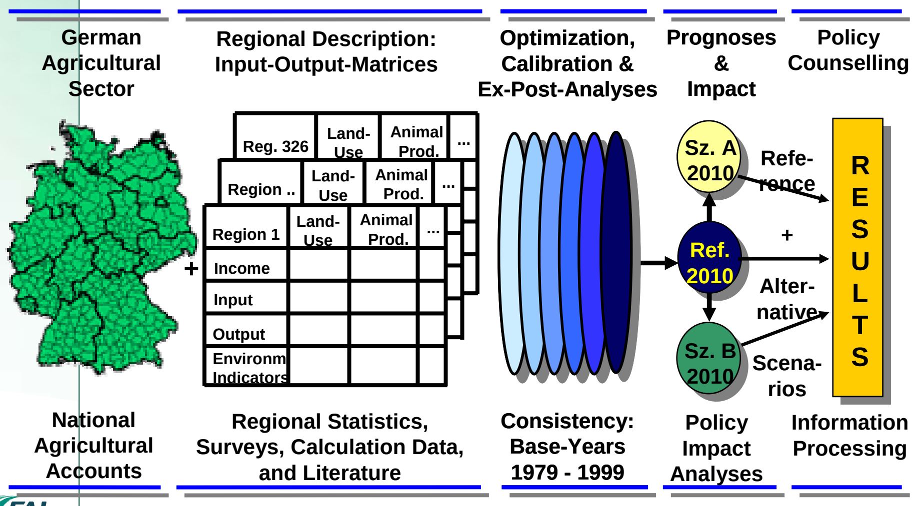
General model structure: RAUMIS



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Fields of application

- **Common Agricultural Policy**
  - decoupling of premiums
  - sugar market reform
  - milk market reform
- **Environmental Policy**
  - reduction of diffuse water pollution by agriculture
  - reduction of greenhouse gas emissions
  - impacts of cross compliance
- **Other**
  - impacts of global/climate change on agriculture
  - impacts of energy production from biomass on agriculture

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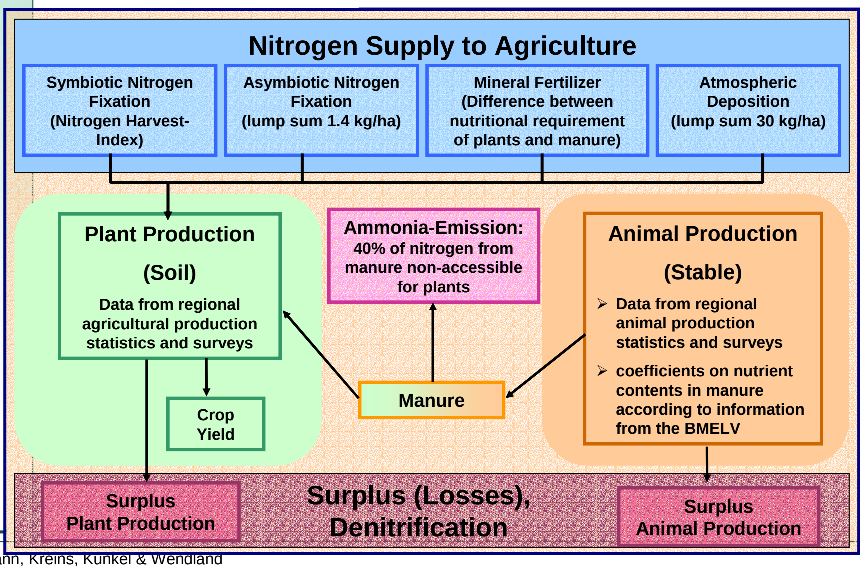
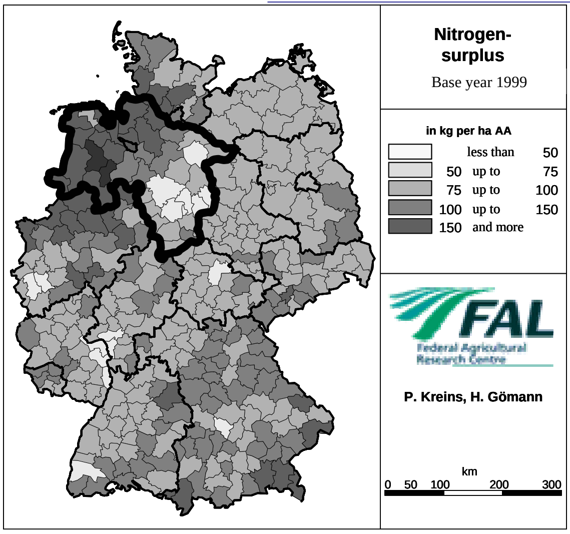
Solution / endogenous variables / Indicators

- Agricultural land use
- Intensity of arable land and grassland use
- Marginal use / profits of agricultural area
- Agricultural income
- Livestock-/Manure-Unit density
- Nutrient balances
- Agricultural greenhouse gases
- Plant protection expenditures
- …

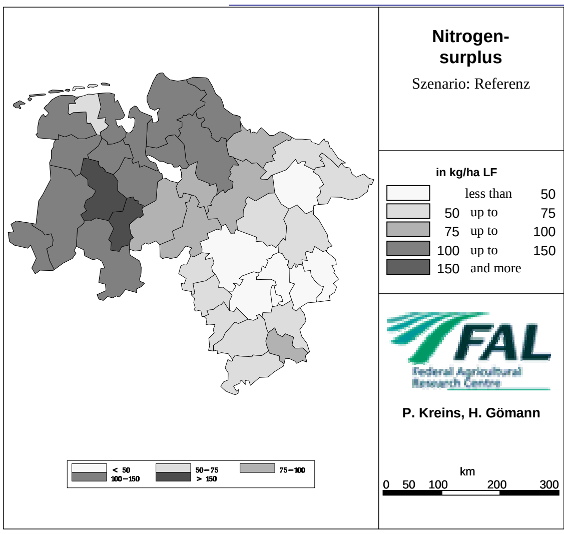
Nitrogen Bilancing



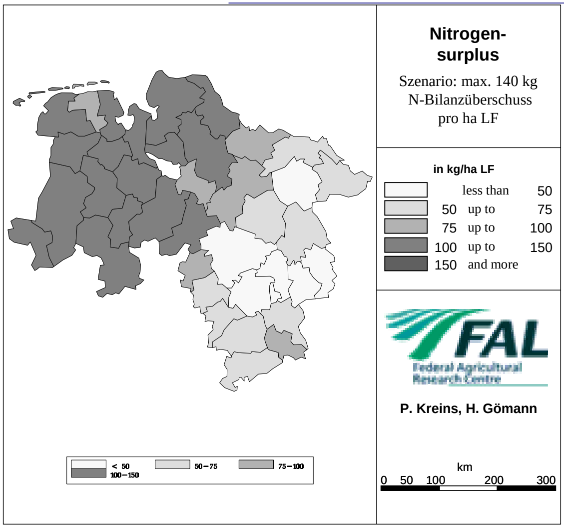
Regional Nitrogen Balances



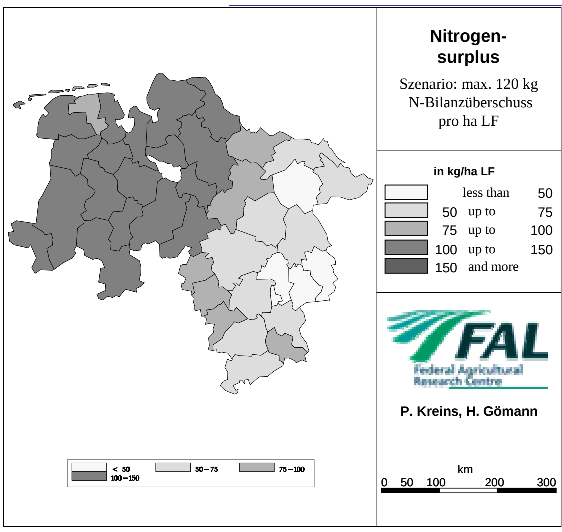
Nitrogen Balance (reference scenario) without supra-regional manure transports



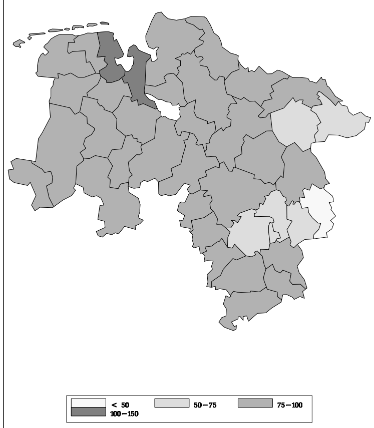
Nitrogen Balance (max. 140 kg N per ha)



Nitrogen Balance (max 120 kg N per ha)



Nitrogen Balance (max. 100 kg N per ha)



Nitrogen-surplus

Szenario: max. 100 kg N-Bilanzüberschuss pro ha LF

in kg/ha LF

	less than	50
50	up to	75
75	up to	100
100	up to	150
150	and more	

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km
0 50 100 200 300

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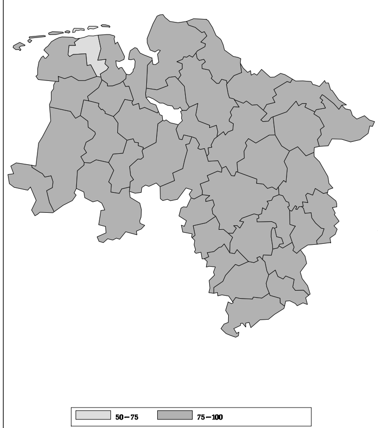
Nitrogen Balance (max. 80 kg N per ha)



Nitrogen-surplus

Szenario: max. 80 kg N-Bilanzüberschuss pro ha LF

in kg/ha LF

	less than	50
50	up to	75
75	up to	100
100	up to	150
150	and more	

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km
0 50 100 200 300

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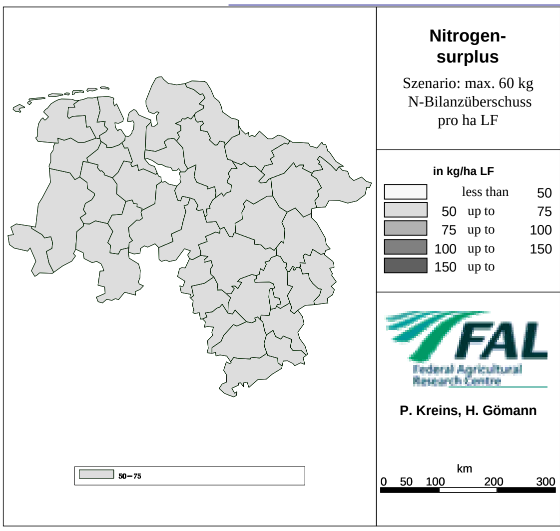
Nitrogen Balance (max. 60 kg N per ha)



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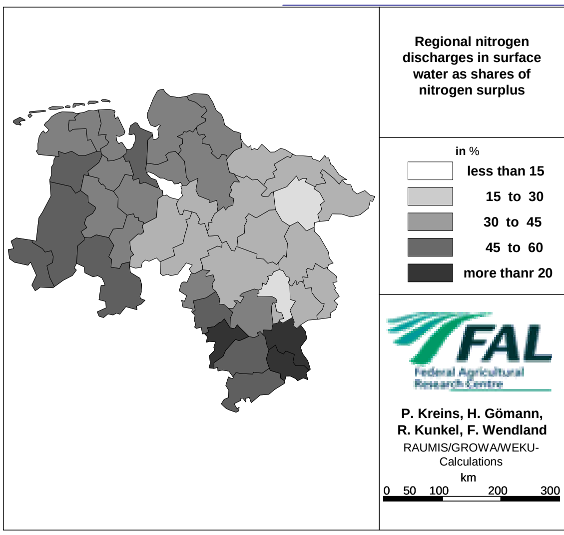
Share of N-surplus leaching into surface water



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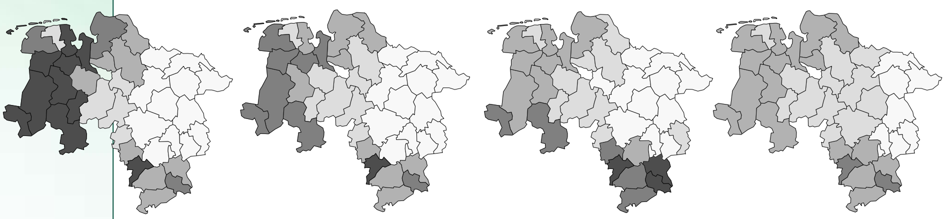
Nitrogen entry into surface water

Reference scenario	max. 100 kgN/ha UniNbalNoTrans	max. 80 kgN/ha UniNbalWithTrans	max. 80 kgN/ha DiffNbalWithTrans



in kg N per hectare

	less than		20
	20	up to	30
	30	up to	40
	40	up to	50
	50	and more	

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RAUMIS/GROWA/WEKU

0 50 100 km 200 300

Aggregate impacts

		Reference scenario	UniNbal-NoTrans 100 kg N/ha	UniNbal-WithTrans 80 kg N/ha	DiffNbal-WithTrans 80 kg N/ha
Nitrogen surplus	tons	241,155	201,760	210,951	222,320
	kg per ha AA	93	78	81	85
Nitrogen discharges in surface water	tons	89,045	73,262	74,152	73,871
	kg per ha AA	34	28	28	28
Agricultural labour force	1,000 LFU	73.6	65.7	68.4	70.6
Livestock density	LU per ha AA	1.4	1.1	1.2	1.3
Supra-regional manure transport	million m^3			10.3	14.3
Average transport costs	Euro per m^3			-10.5	-9.8
Total transport costs	million Euro			-109	-141
Net agricultural value added	million Euro	2,606	2,393	2,463	2,469
Cost of N discharge reduction in surface water	Euro per kg N		13.5	9.6	9.0

Conclusion and Outlook

- **Comprehensive consideration of agricultural and hydro(geo)logical conditions in large catchments**
  - Limited correlation between risk indicator “nitrogen surpluses from agriculture” and actual depositions of nitrogen into water bodies
  - Consideration of main diffuse input pathways and natural degradation in soil and groundwater
  - Consideration of agricultural adjustments (e. g. with supra-regional impacts)
- **Further development of the model network RAUMIS, GROWA, WEKU and …**
  - Stronger regionalization to describe the units under the county level (i.e., with the help of community statistics, ICAS, GIS – Daten (remote sensing, soil)
  - Integration of further models in the model-network (e.g. MONERIS)
  - Implementation of further environmental processes
  - Validation of the model network based on measured values
  - Application of the methodology to other German or European river catchments is possible
- **Impact assessment of various agricultural and environmental policies social and economic consequences for agriculture (according to Art. 9 WFD)**

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Thanks !
Any questions ?

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