



Agricultural Production and Water Quality in the Weser River Basin – Challenges for the implementation of the WFD



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Land Use and Water Quality, Vienna 2015

Vienna, 22 September 2015

Background

- **European Water Framework Directive:**
 - good chemical and ecological status of all surface water bodies and a good chemical and quantitative status of all groundwater bodies until 2015 (or 2027 at the latest) Article 1 and 4 of the WFD
 - implementation until 2015, auxiliary dates 2021, 2027



Application of integrative model network

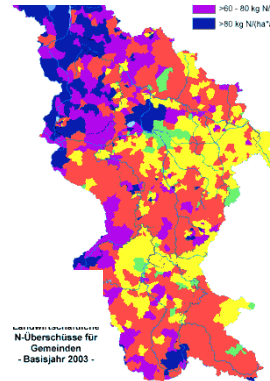
1st AGRUM Weser Project 2005-2008 (for period 2003 – 2015)

2nd AGRUM⁺ Weser Project 2011-2013 (for period 2007 – 2021)



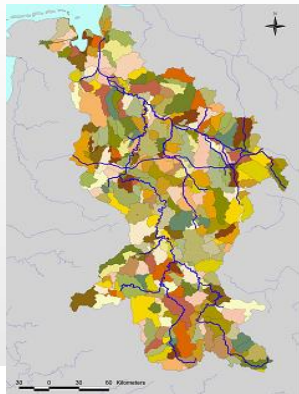
AGRUM modelling network

TI RAUMIS



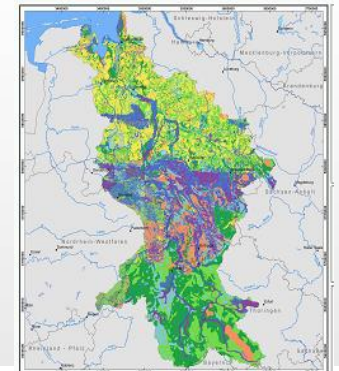
- Regional representation of agriculture consistent to EAA
- NUTS3 and LAU1
- Nutrient surpluses
- Scenario development

IGB MONERIS



- Framework of consistency for sub-catchments
- Point and diffuse sources in river basins
- Retention in the water system
- Venohr et al. 2011

FZJ GROWA / WEKU DENUZ/ MePhos



- Spatially differentiated analyses
- Diffuse and point source pollution
- Diffuse N-leaching via soil and ground water
- Wendland et al. 2010

AGRUM modelling network

Required reduction
to achieve management
targets for surface water
(2.8 mg N/l)

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Regional combination of measures

Required reduction
to achieve ground water
targets (50 mg NO₃/ l)

Nutrient surplus 2007
and 2021

FZJ

GROWA / WEKU
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N- and P- inputs for
MONERIS -AU

Focus:

- Retention Surface water
- Point sources
- Reduction amounts for surface water

Diffuse inputs:

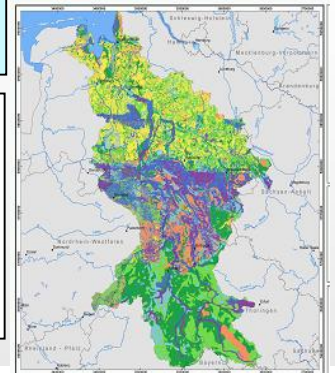
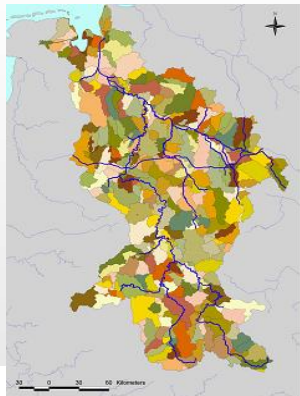
Interflow
Drainage
Groundwater
Erosion
Rainwash

N- and P- inputs for 100 x
100 m - grid

Focus

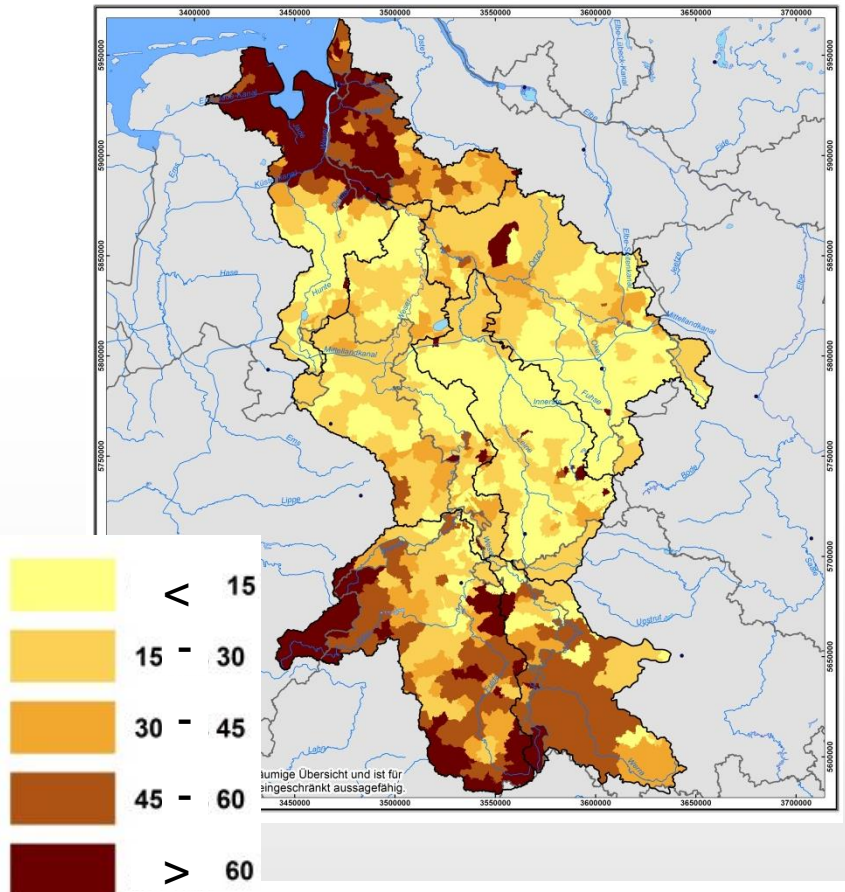
- Water balance
- Drainage
- Erosion
- Reduction amount Groundwater

Point source inputs
Urban areas

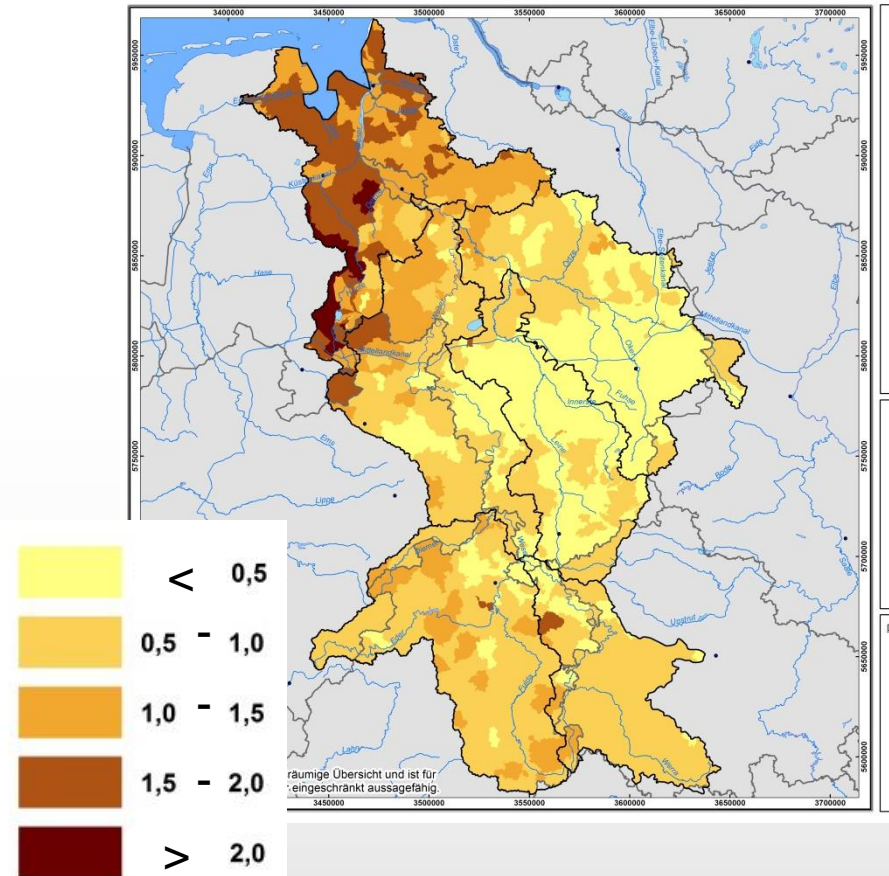


The Weser River Basin: ~ 49 000 km²

Grasland (% of UAA, 2007)

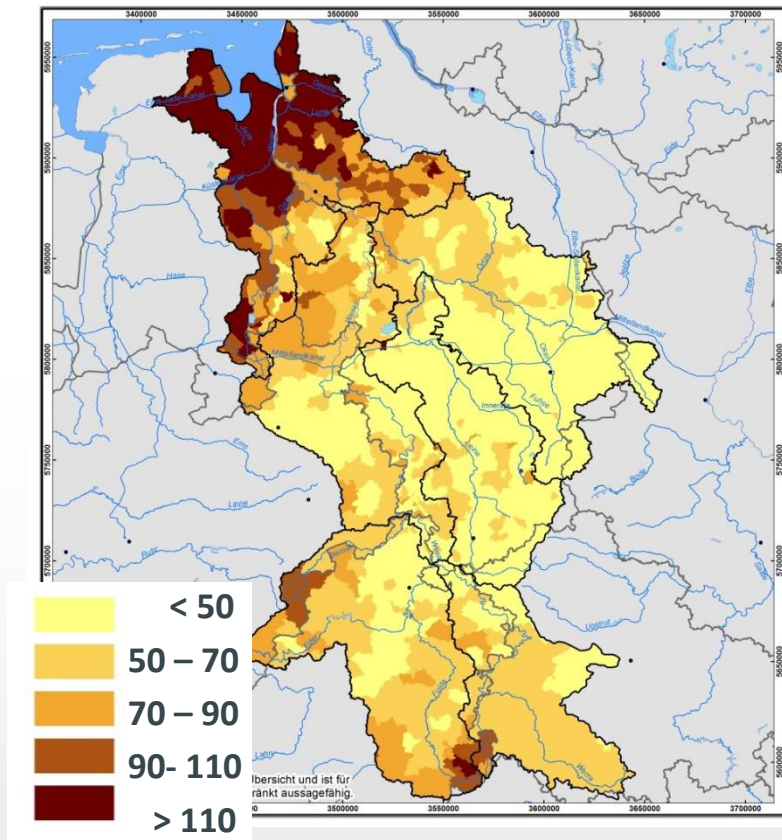


Livestock density (LU per hectare UAA, 2007)

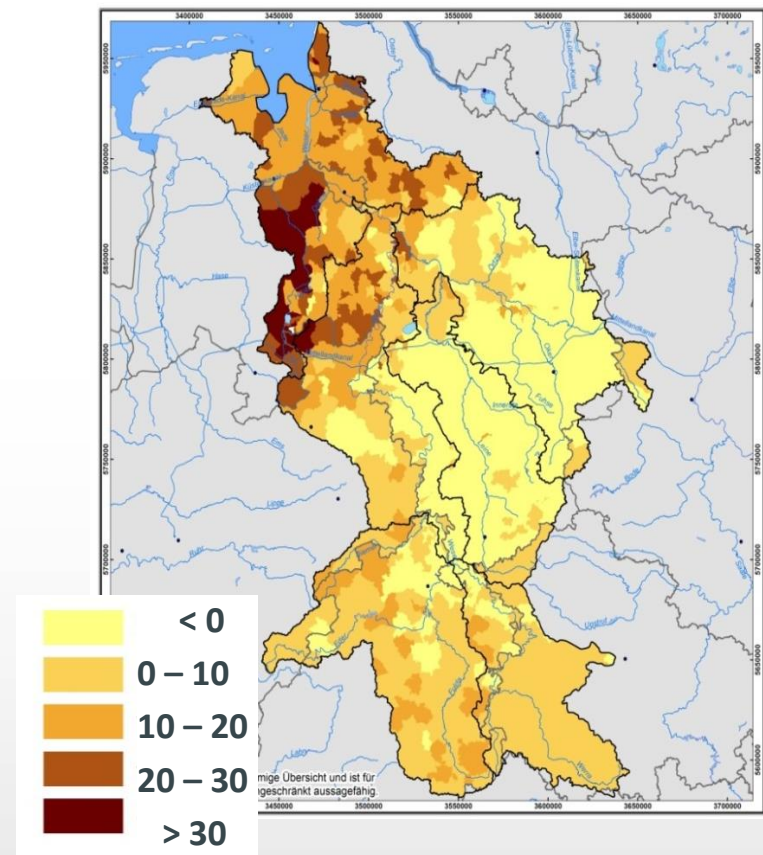


Nitrogen and Phosphorus surpluses, 2007

N-surplus (kg N / ha UAA) in 2007



P-surplus (kg P / ha UAA) in 2007



Central framework conditions for future nitrogen surpluses until the year 2021



- **General agricultural policy**
 - Reform of market regulations (e.g. milk, sugar)
 - Decoupling of animal and area premiums
 - Phasing out of obligatory set-aside
 - (Implementation of the fertilization ordinance)



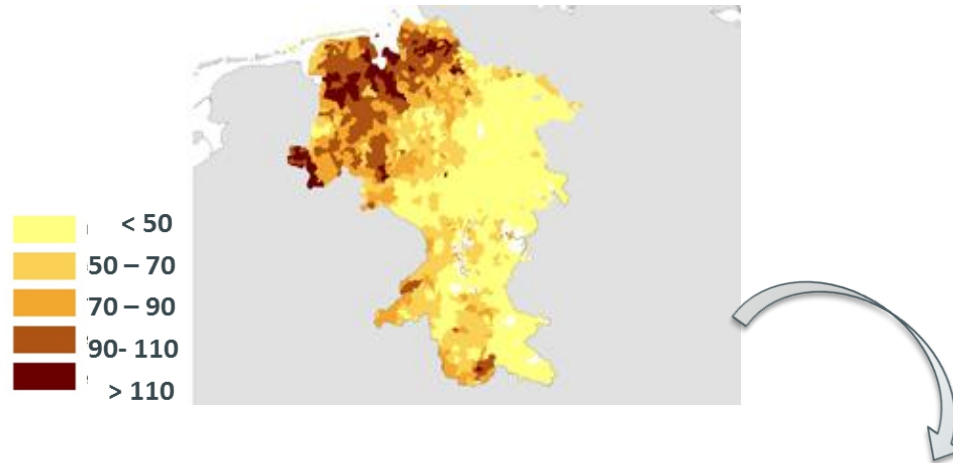
- **Additional measures**
 - Agro-environmental measures
 - Additional measures to achieve WFD targets



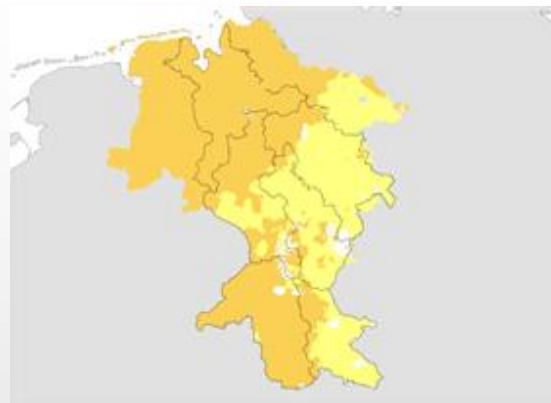
- **Other impacts**
 - Promotion of biomass production as renewable energy source
 - Rise of agricultural prices on world markets
 - Development of energy and fertilizer prices
 - Technical progress

N surplus in the Baseline 2021: implementation of the nitrate directive (fertilization ordinance in Germany)

Baseline without the fertilization ordinance (FO):



Baseline with FO allowing transportation < 40km



fertilization ordinance (FO):

DüV, 2006

Max. N surplus at 60 kg N/ha UAA

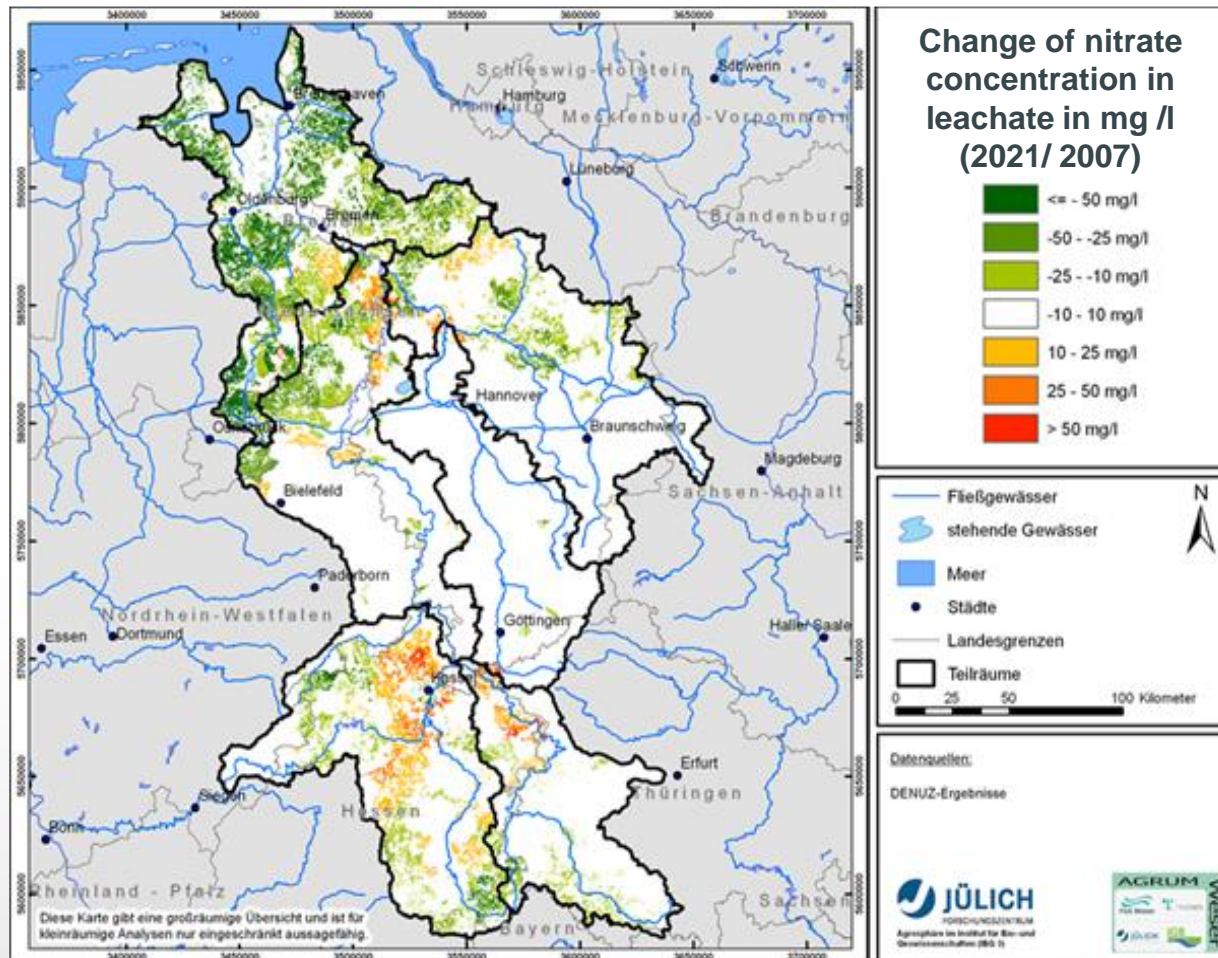
(since 2009)

141 000 t N in 2007

112 000 t N in 2021

Δ 13 kg N / ha UAA

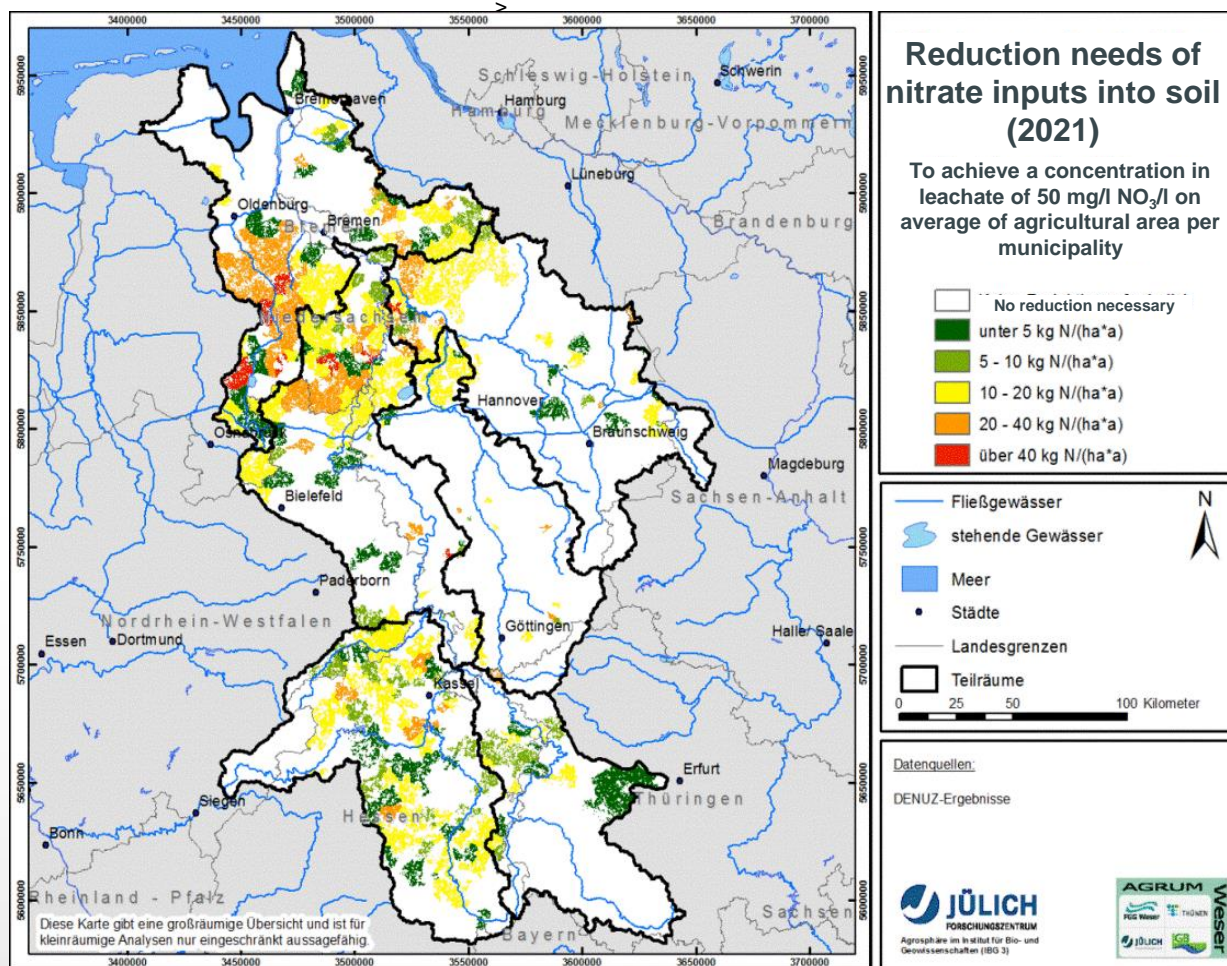
Change of nitrate concentration in leachate 2021 to 2007



32 mg NO₃ in 2007

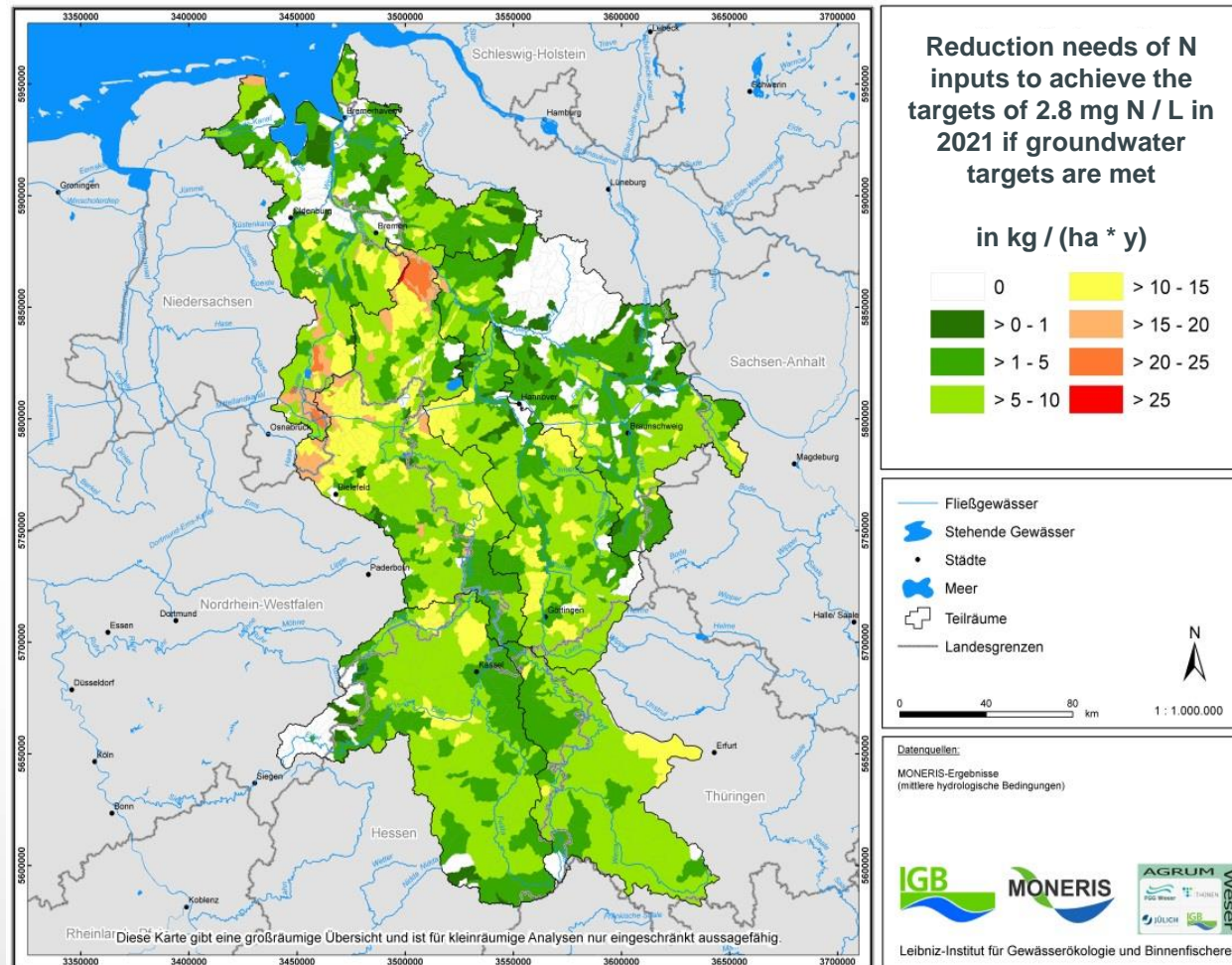
28 mg NO₃ in 2021

Regional need to reduce nitrogen surplus in the Weser basin to achieve a nitrate concentration of 50 mg NO₃/l in leachate



Reduction need of
N surpluses for:
14 000 t N / year

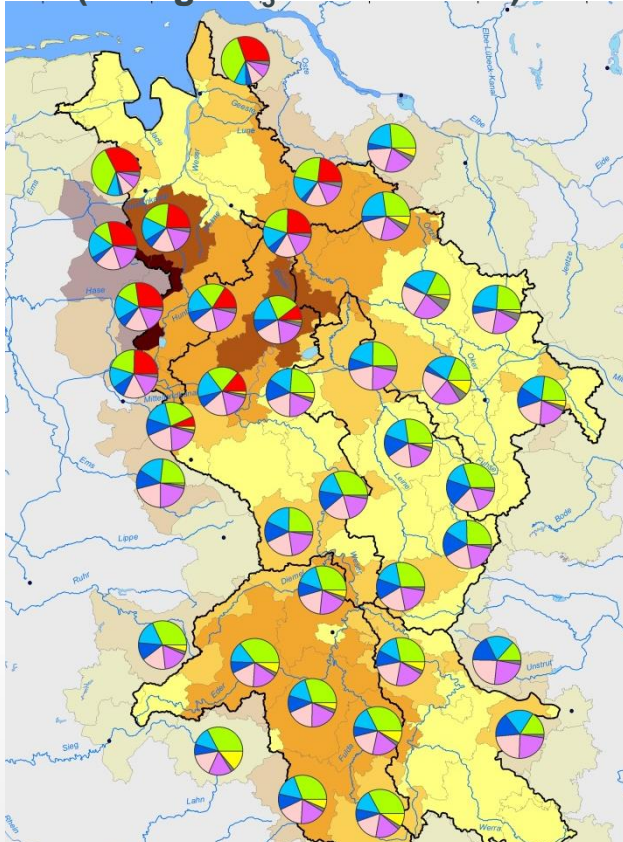
Reduction needs of N inputs to achieve the targets of 2.8 mg TN / l in 2021 if groundwater targets are met



Reduction need of
N surpluses:
39 000 t N / year

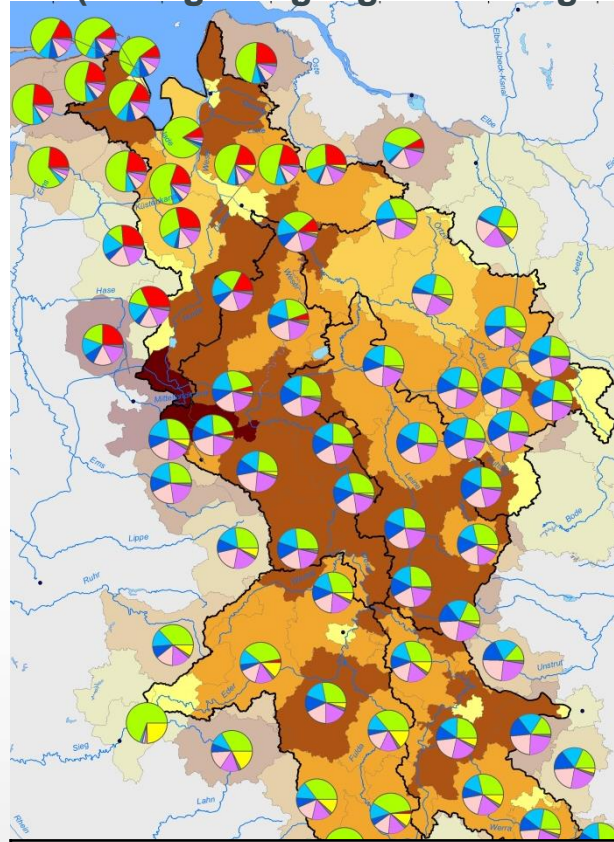
Additional agri-environmental measures (AEM)

Groundwater
(50 mg NO₃ / l in leachate)



Necessary N	Reduction	Estimated	Estimated
Reduction t N / y	with AEM	Area	costs
14 000	13 000	0.6m ha	36m €

Surface water
(2.8 mg / l at gauge Hemelingen)



Necessary N	Reduction	Estimated	Estimated
Reduction t N / y	with AEM	Area	costs
39 000	28 000	1.3m ha	80m €

% of promoted area

- no manure after harvest
- improved manure tech
- reduced fertilizer in cereals
- Promotion of extensive agric
- intertillage
- undersown crops
- fallow land
- extensive grassland cultiv

in % of UAA

- < 10
- 10 - 30
- 30 - 60
- 60 - 100
- >100*

* Some measures can be realized on the same area in parallel such that more than 100% are feasible.

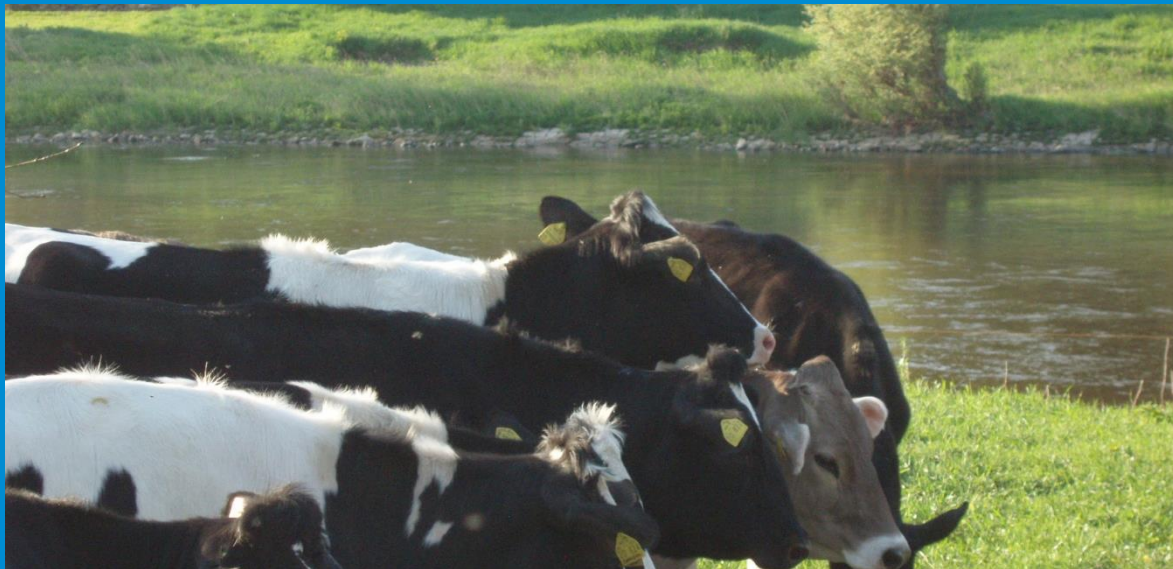
Conclusions

- According to model results a positive development of nutrient balances is expected until 2021
=> i.e. further reduction of nutrient leaching in ground water and surface water
- Assumption of the full implementation of the fertilization ordinance until 2021 -> pronounced positive influence on the reduction
- Nevertheless, targets for examined nutrients will not be achieved until 2021
~45% of nitrogen surpluses need to be additionally reduced
- Need for action is very heterogeneous, high in areas with intensive livestock
- Agri- environmental measures cannot solve the problem
- Further measures are necessary to achieve the targets of the WFD (revision of manure regulation, export and processing of manure, less mineral fertilizer use, reduction in livestock...?)

Thank you for your attention!

More information:

https://www.ti.bund.de/media/publikationen/thuenen-report/Thuenen-Report_21.pdf



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Survey of appropriate nitrogen reduction measures

Measure:	Impact on N-surplus (kg N/hectares)	(Min-Max)	Costs (€/hectares)	(Min-Max)
No application of organic fertilizer after harvest	30	20-40	20	10-30
Catch crops	20	0-40	80	40-110
Groundwater protective application of dung	25	10-40	25	15-35
Extensive grassland production	30	10-60	100	80-150
Promotion of extensive farming	40	20-60	70	50-150
Reduced mineral fertilizer application in cereal production	30	20-40	80	50-300
Cultivation of turnip rape	10	0-20	60	-
Obligatory set aside	60		110-150	
<i>Transformation of crop land to grassland</i>	<i>50</i>		<i>400</i>	
<i>Organic farming</i>	<i>60</i>	<i>30-120</i>	<i>170</i>	<i>80-200</i>

Data of measures by Osterburg and Runge, 2007