

Germany's new impact monitoring on the effectiveness of the Nitrates Directive Action Program

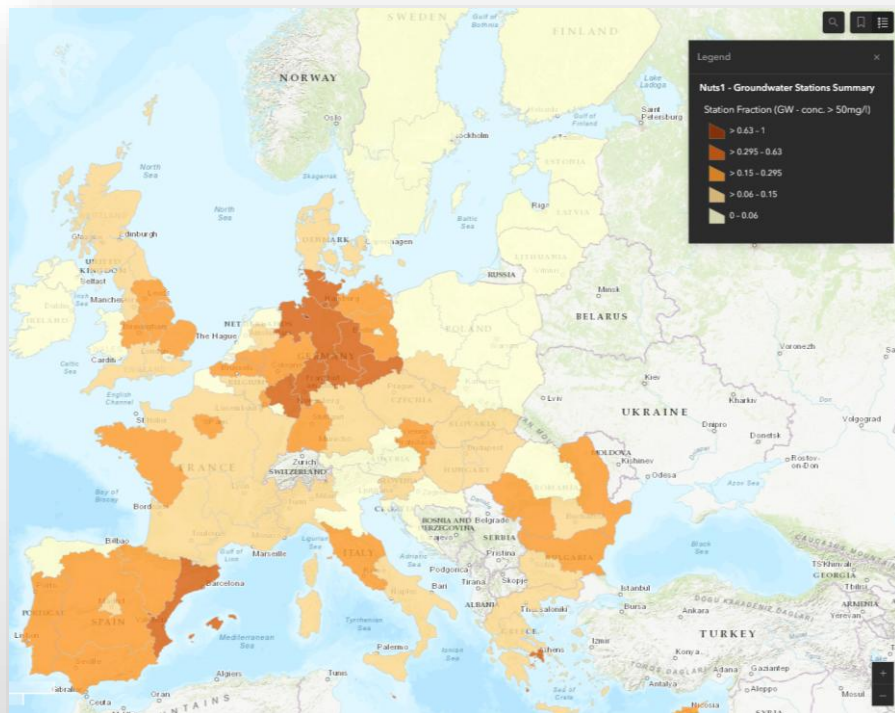
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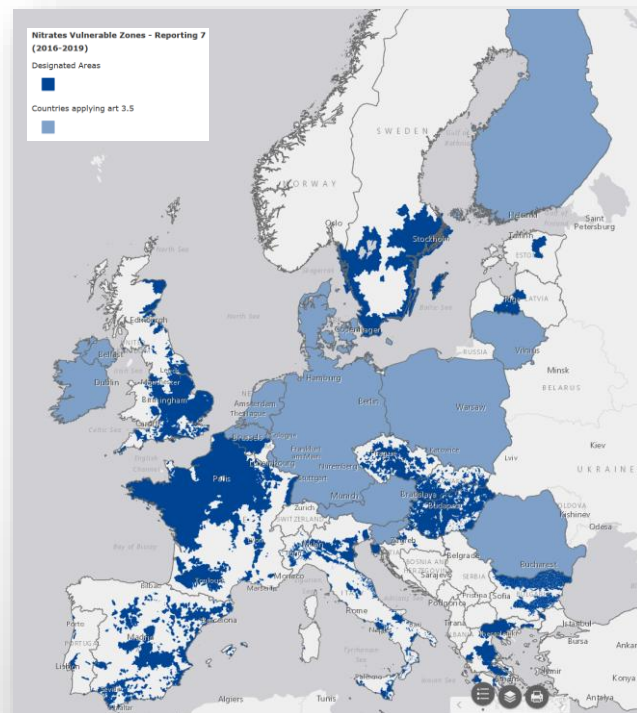
The German implementation of the Nitrates Directive – a never-ending story?

Share of GW-Stations with NO₃-concentrations > 50 mg / l



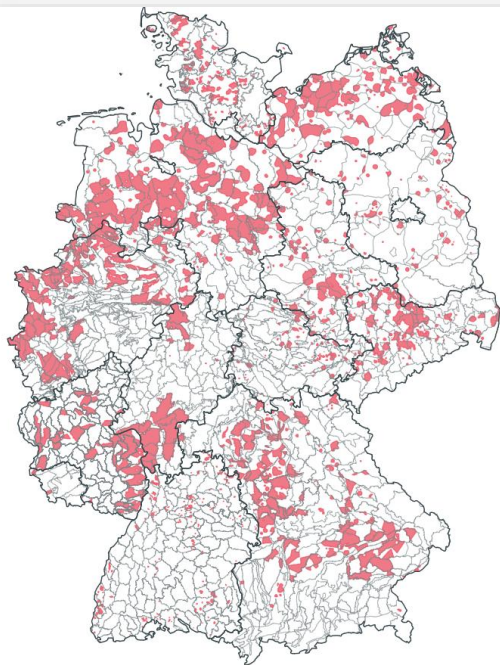
<https://water.jrc.ec.europa.eu/portal/apps/dashboards/cb6034c2a75e4df282f8a62f90c16caa%20> (2016-2019), 26.05.2025

Nitrate Vulnerable Zones



<https://water.jrc.ec.europa.eu/portal/apps/webappviewer/index.html?id=b33a220c1b284583851e93a245da02ef>, 26.05.2025

The German implementation of the Nitrates Directive – a never-ending story?



Nitrate Polluted Areas (Source: Data from German Environmental Agency, 2023)

FO = Fertilizer Application Ordinance

FO revision

Detailed fertilization planning, 170 kg N / ha for all organic fertilizers, etc.

Latest FO revision (EC's demand)

FO 2017 tightened, "Nitrate Polluted Areas" (NPA) with stricter measures, new impact monitoring.

2013

2017

2018

2020

2023

Infringement procedure

... against Germany due to insufficient Action Program

ECJ ruling against Germany

EC's complaint was upheld in all respects. Penalty payments of 800.000 €/d at stake.

Infringement proceedings closed

Template: PresentationGo.

Monitoring design



- **Goal:** evaluate effectiveness of FO and enable quick adjustments of regulations, especially in NPA
- **Challenge:** bridge the spatio-temporal gap between farm management and water quality
- **Idea:** Nationwide multi-level approach with 34 evaluation criteria

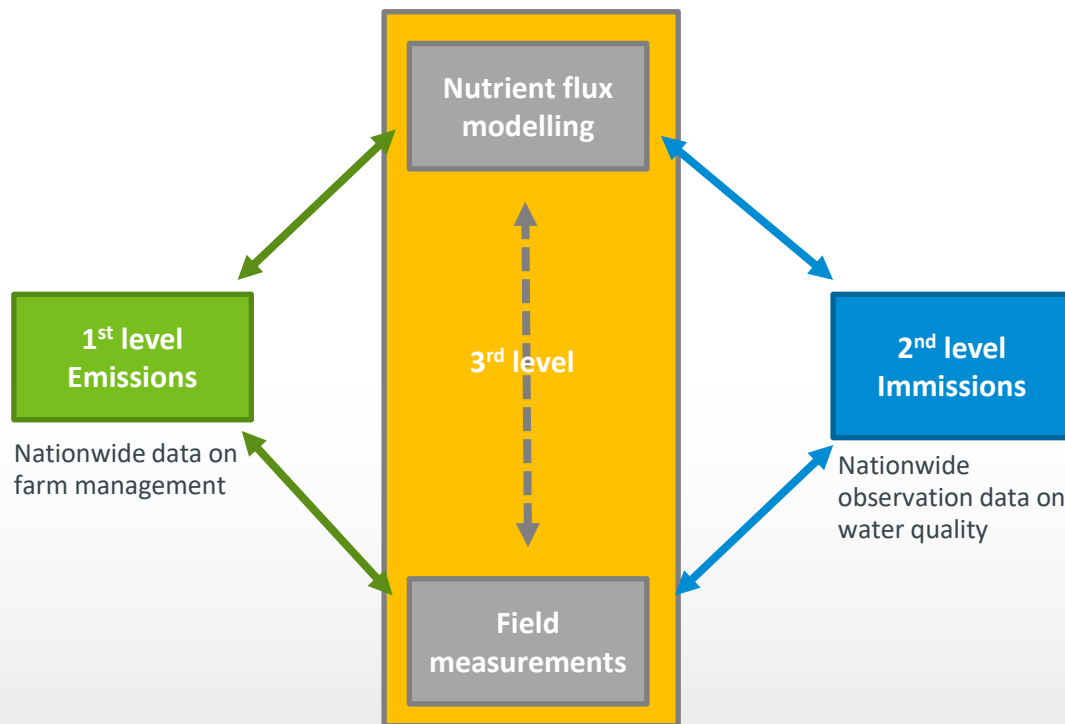
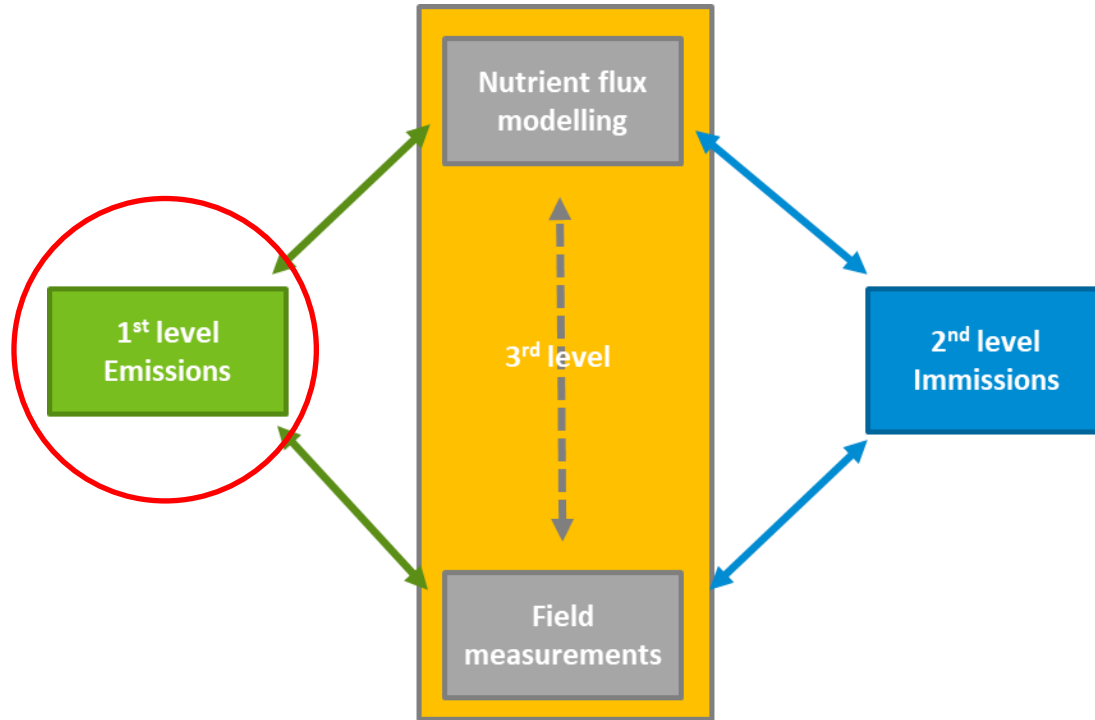
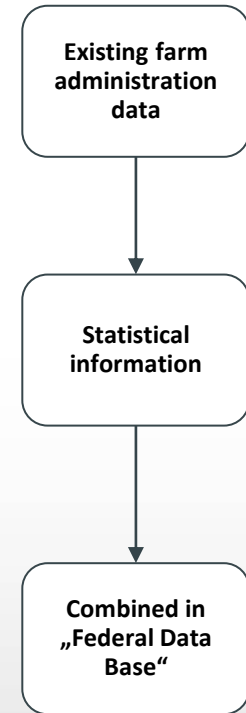
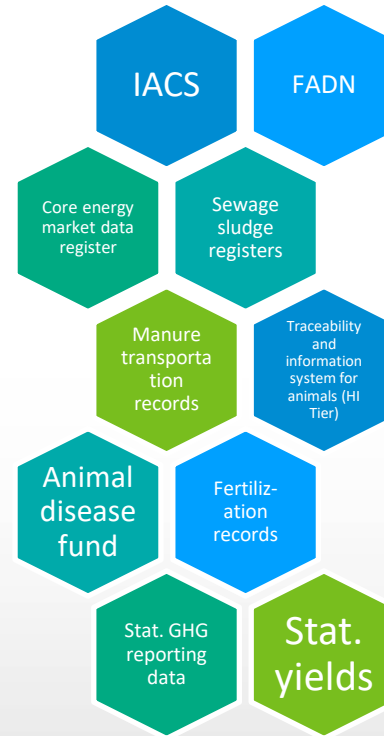


Image: Thünen-Institute.



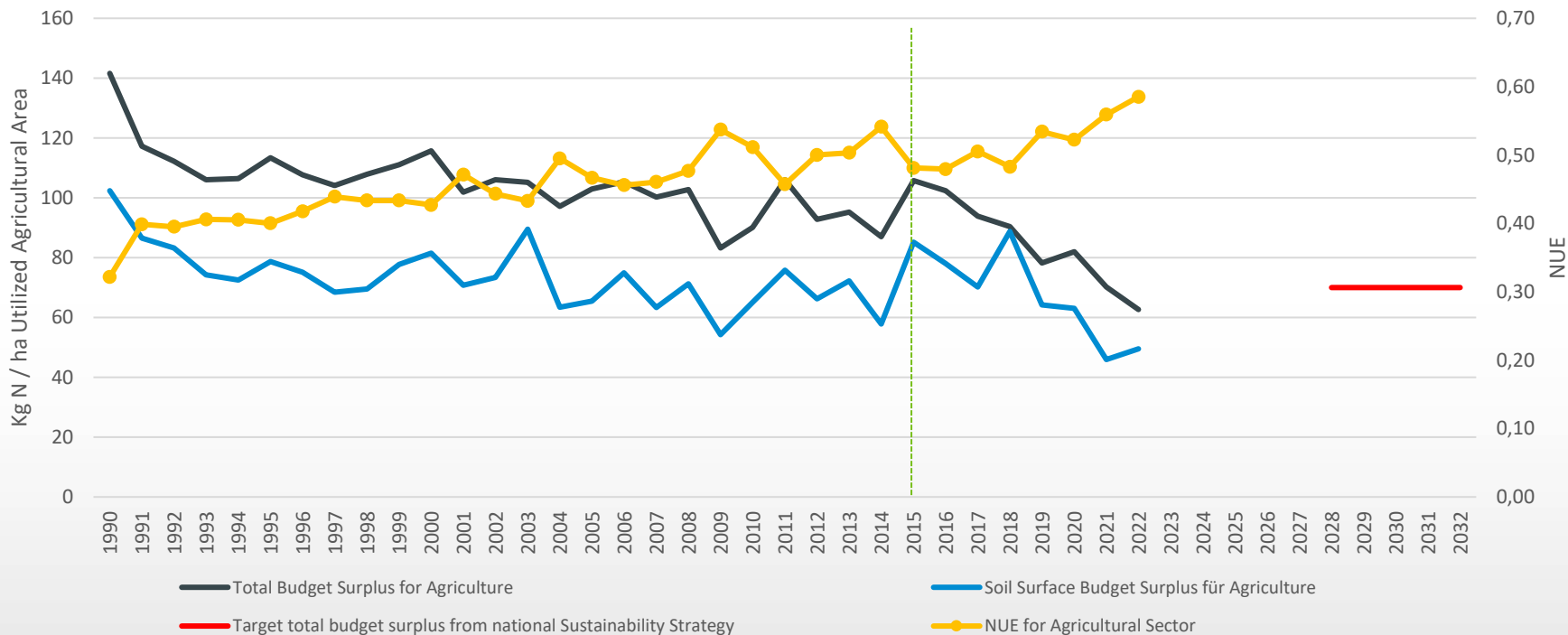
Identifying emission parameters with farm administration data

- Analysis of **existing** farm administration data, collected and provided by German Länder
- „Valorization of bureaucracy“
- detection of shifts and trends in nutrient emissions
 - policy impact assessment – already a the soil surface
 - „early warning“



Agricultural Nitrogen Surplus

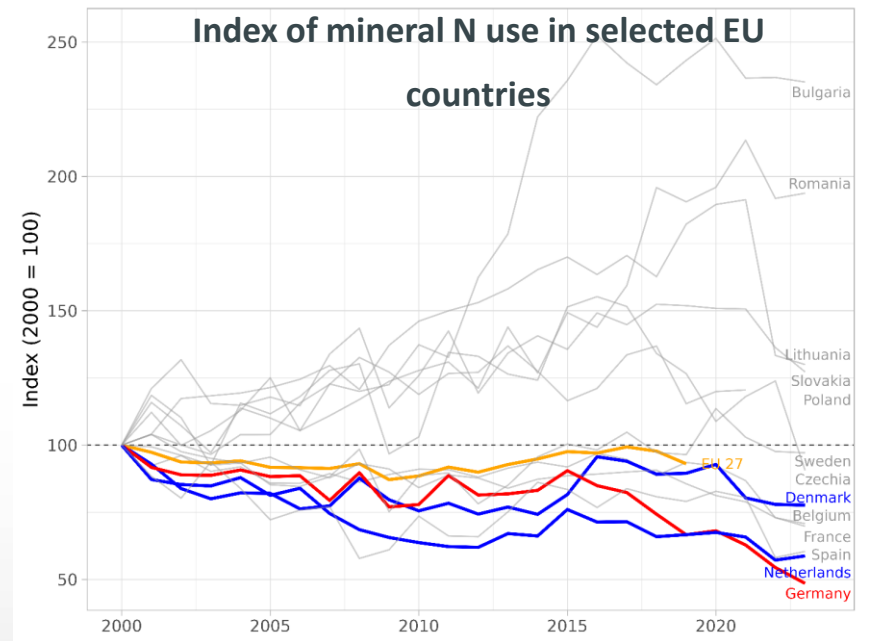
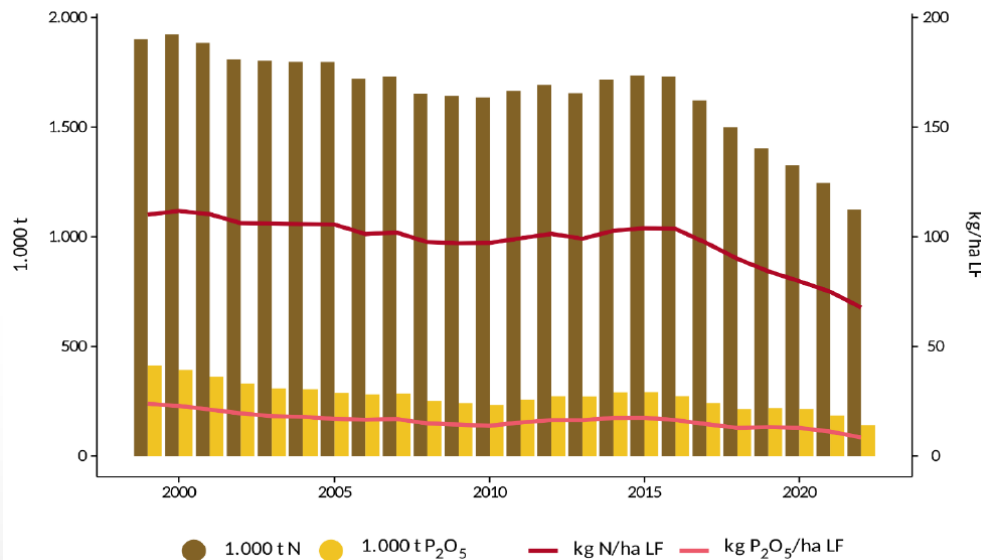
Nitrogen surplus and NUE of German agriculture



Source: German Ministry of Agriculture, <https://www.bmel-statistik.de/landwirtschaft/tabellen-zur-landwirtschaft>, 11.02.2025

National mineral fertilizer consumption

Mineral fertilizer consumption in Germany

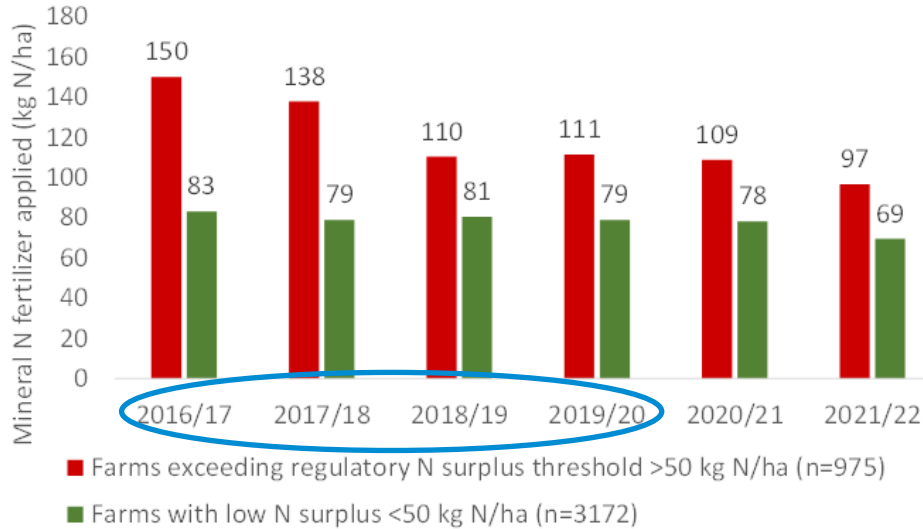


LF = Utilized Agricultural Area

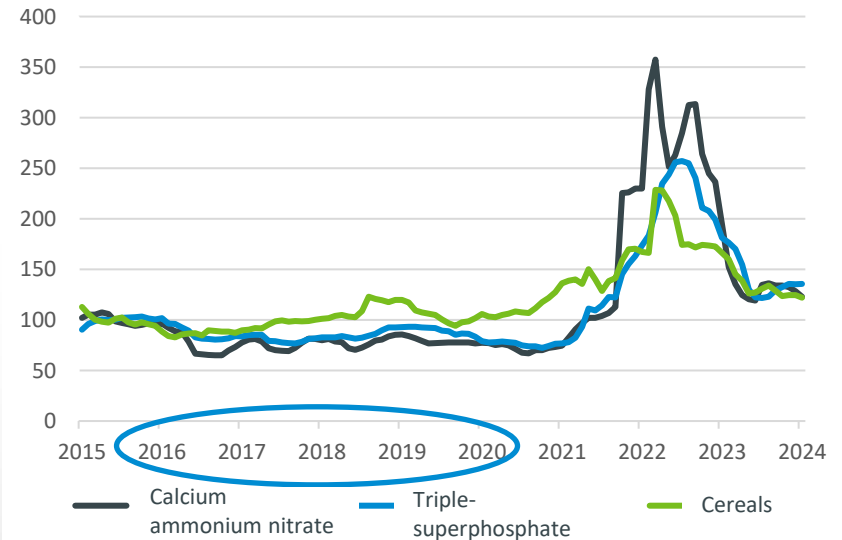
Source: left: German Ministry of Agriculture, <https://www.bmel-statistik.de/landwirtschaft/tabellen-zur-landwirtschaft>, 11.02.2025; right: EUROSTAT, 23.05.2025.

Mineral fertilizer consumption of FADN farms and price developments

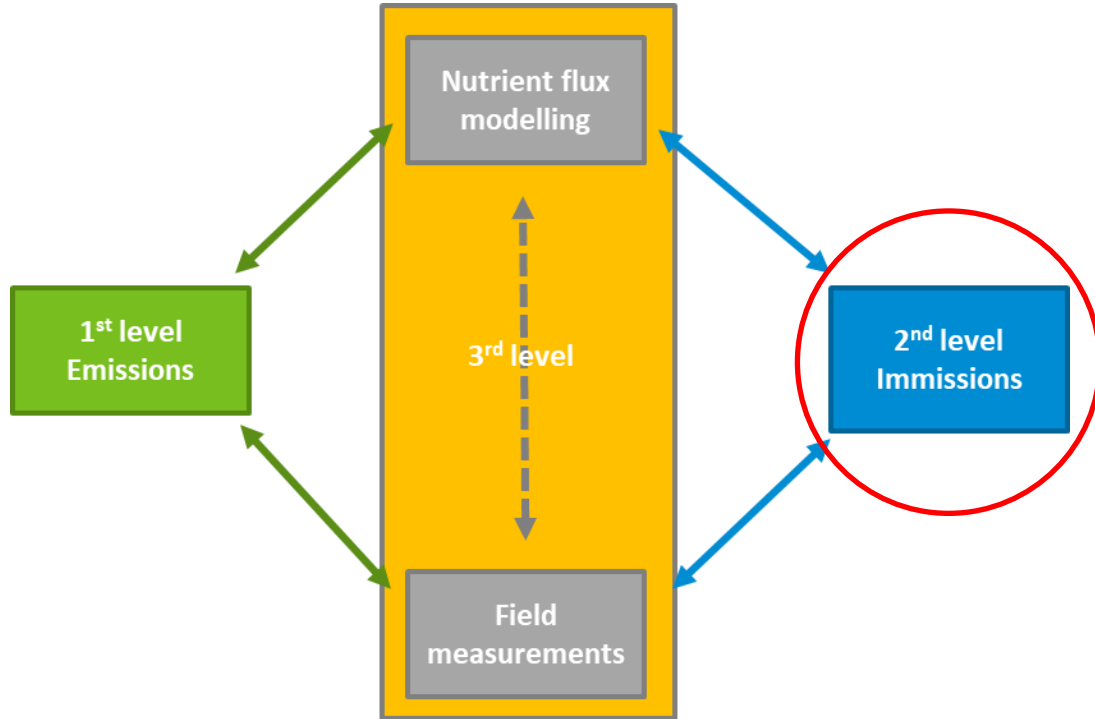
Mineral N fertiliser applied



Monthly Price Index (2015 = 100)



Source: Left: Löw, Söder, Osterburg (2024) Analysis of Mineral Nitrogen Fertiliser Use in Germany Between 2017 and 2022 – Implications for Policy Design. Beitrag zur DAFA-Konferenz 2024 Daten von 4.147 Betrieben. Right: LWK Niedersachsen, Sachgebiet Markt, FAO (Wholesale Germany, bread baking quality).



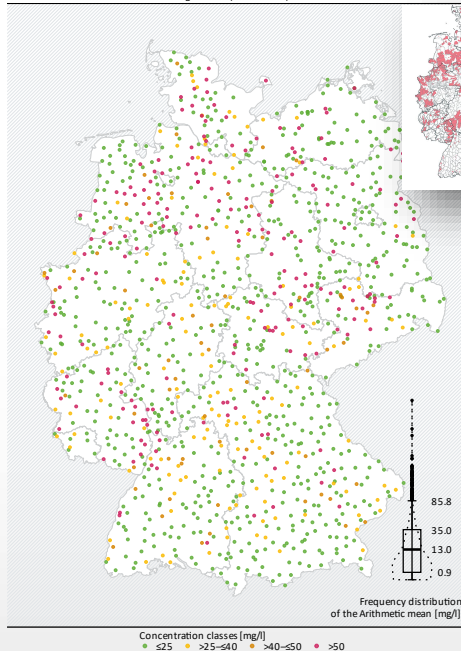
Immissions: extended nitrate monitoring network

- water quality monitoring (ground- and surface water)
- Existing EEA network: n = 1.233 (incl. 679 nitrate monitoring network stations)
 - 1 station / 290 km²
- New designation network used in impact monitoring: n = 7.795
 - 1 station / 45 km²

EEA monitoring network

Mean nitrate-concentration

At the 1213 sites of the EEA monitoring network (2020–2022)

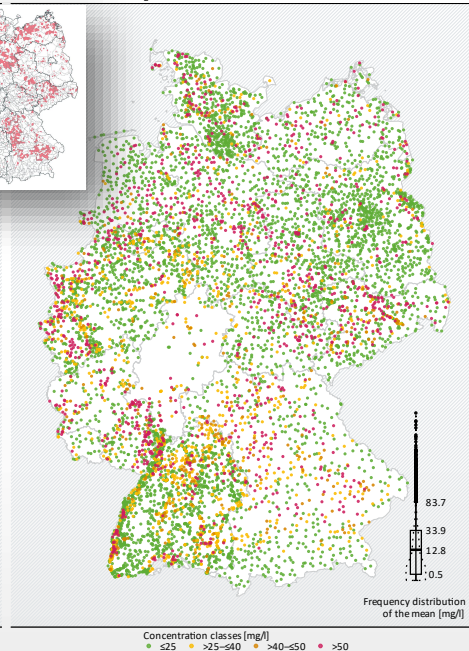


Source: Created by German Environment Agency, based on the data of the federal states (2023).

NPA designation network

Mean nitrate-concentration

At the 7795 sites of the designation network in 2023



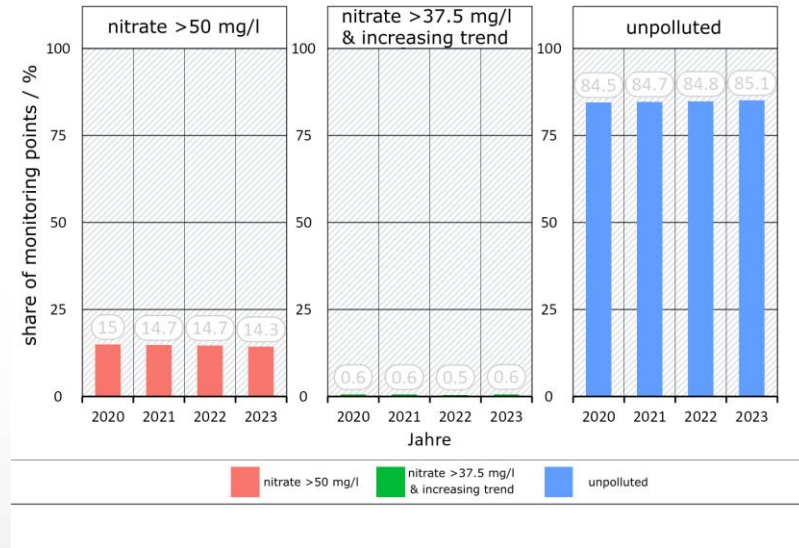
Source: Created by the German Environment Agency, based on the data of the federal states (2023).

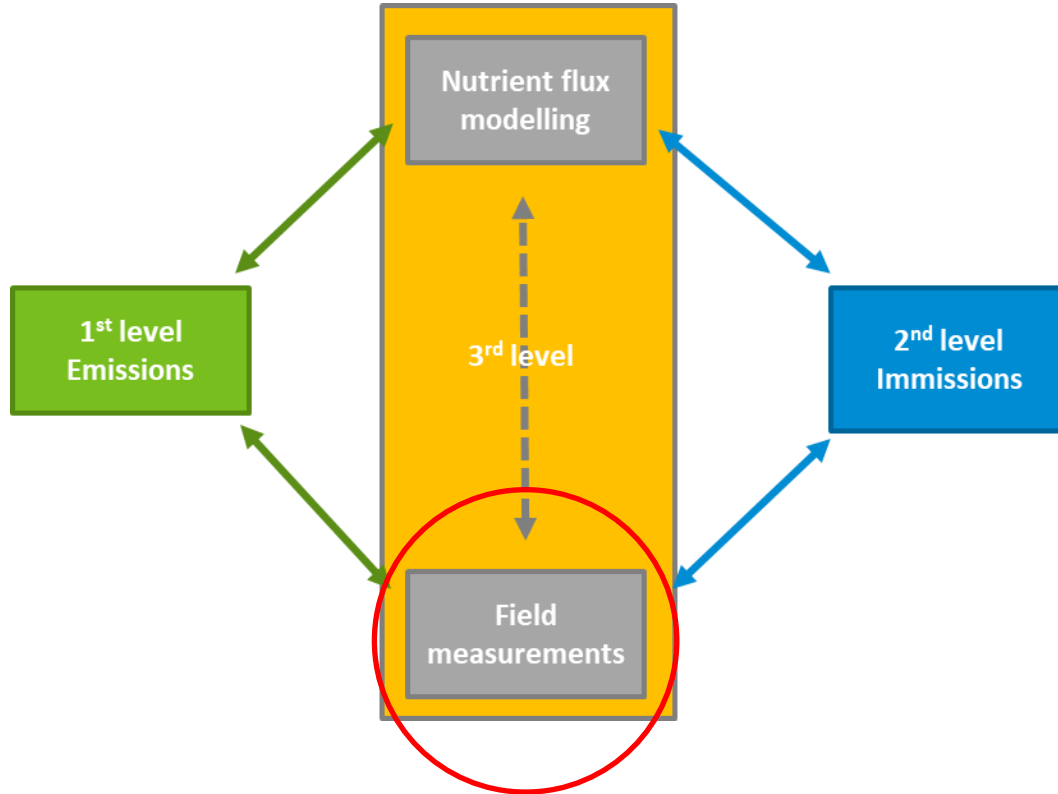
Immissions: extended nitrate monitoring network



- exceedances occurred more frequently in regions characterized by intensive agricultural use or where its recharge area is dominated by agriculture
- overall, about 15 % of monitoring stations show exceedances (average nitrate concentration: 90 mg/l)
- so far, no trend discernible (only 4 years of data available)

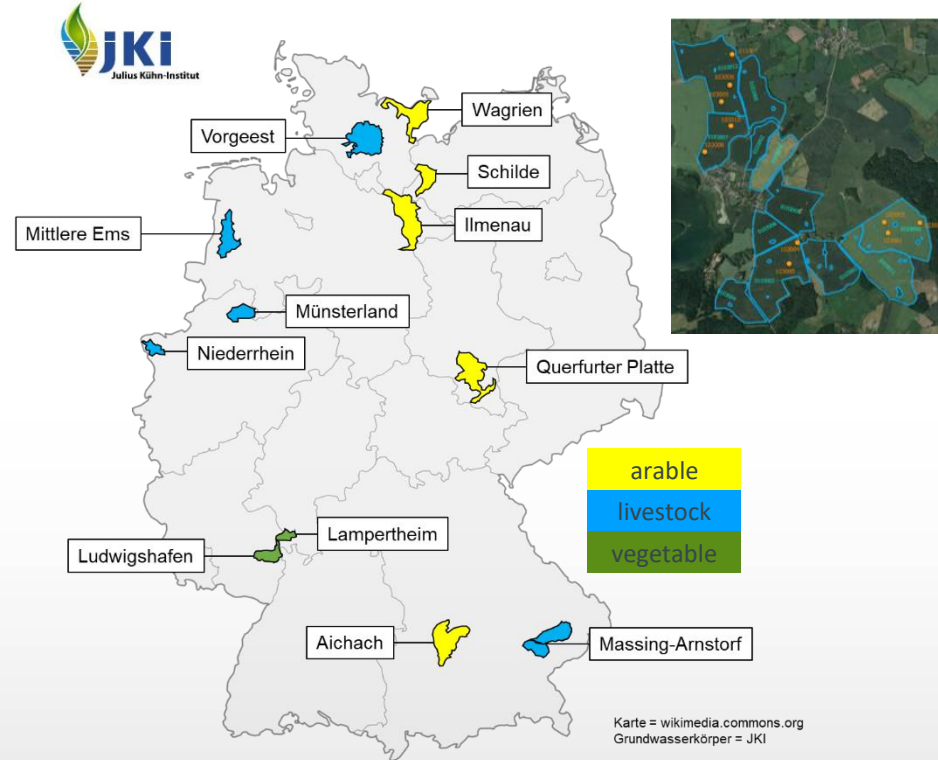
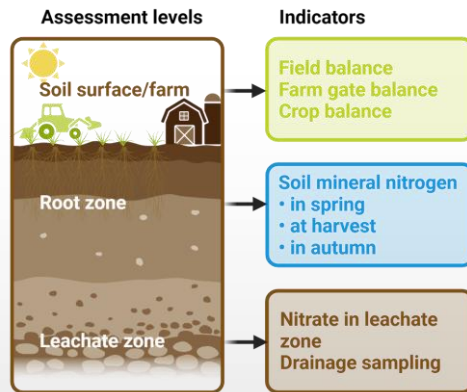
Nitrate concentrations in the NPA designation network



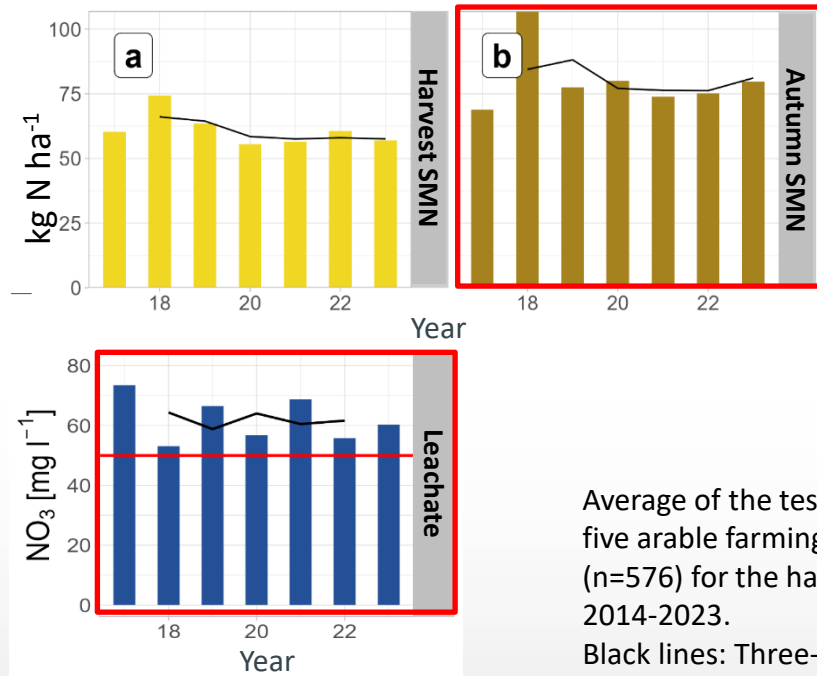
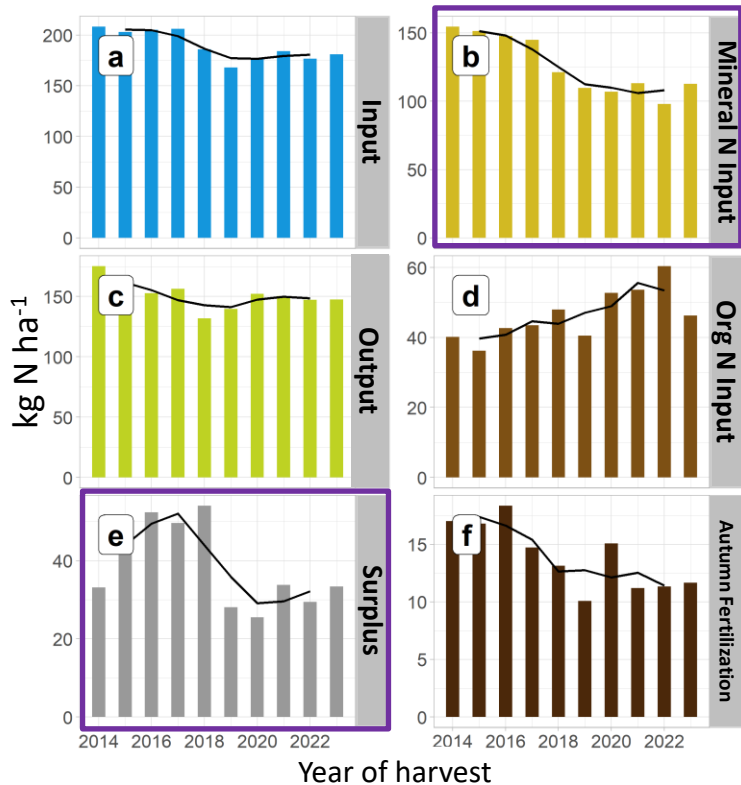


Field measurements in test regions

- 1116 test plots from 96 farms in 12 test regions
- capture adaption of farming practices to changes in regulations

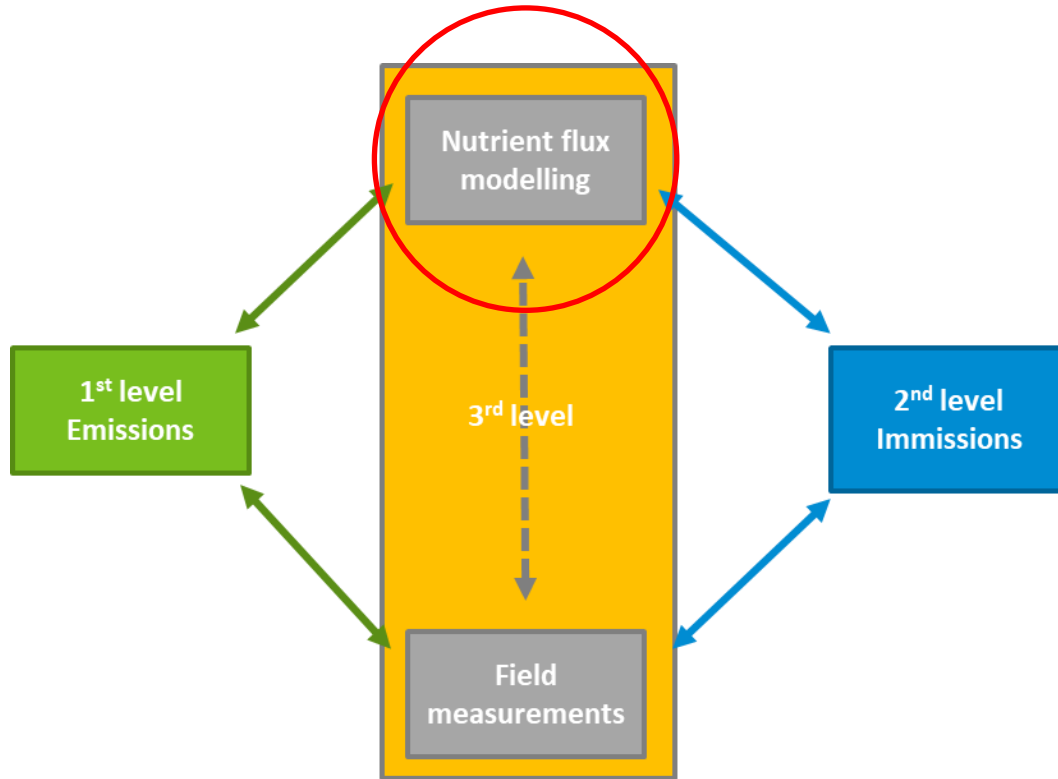


Field measurements in test regions – insights from arable regions



Average of the test plots in the five arable farming areas (n=576) for the harvest years 2014-2023.
 Black lines: Three-year mean value. SMN = Soil Mineral Nitrogen

Source: JKI



Nutrient flux modelling – model network AGRUM-DE



- Model network AGRUM-DE
 - Analyze nutrient sources, pathways, loads, concentrations, sinks
 - Capture time lag in the long run
- Linking NiD and WFD
- Scenario tool



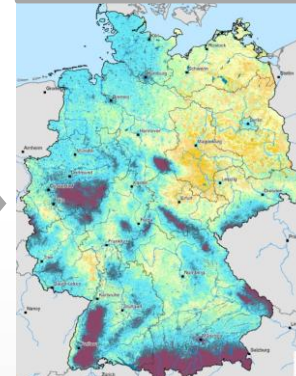
RAUMIS



Agricultural
nutrient surpluses,
agr. land use



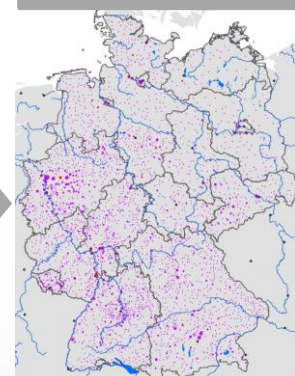
mGROWA-WEKU-
DENUZ-MEPHos



Water balance,
diffuse nutrient
inputs by input
pathways



MONERIS

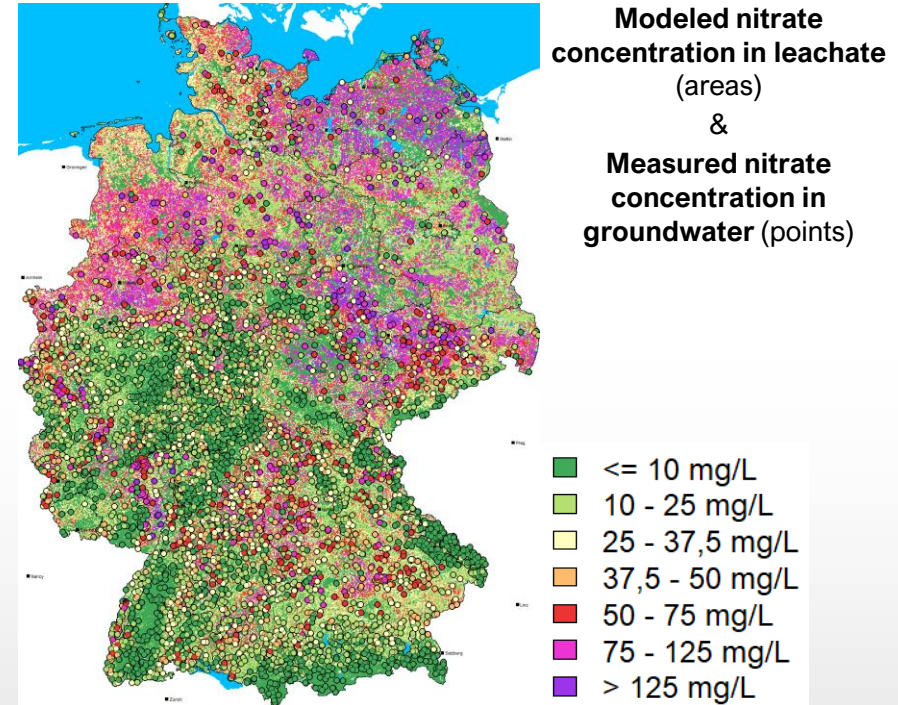
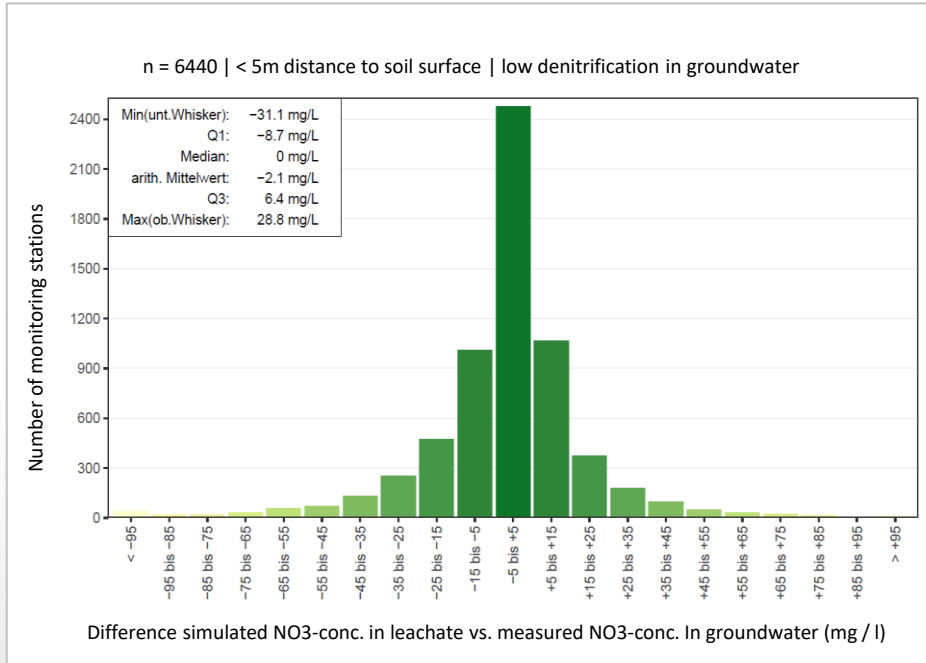


Point sources and
total nutrient loads

Nutrient flux modelling – model network AGRUM-DE

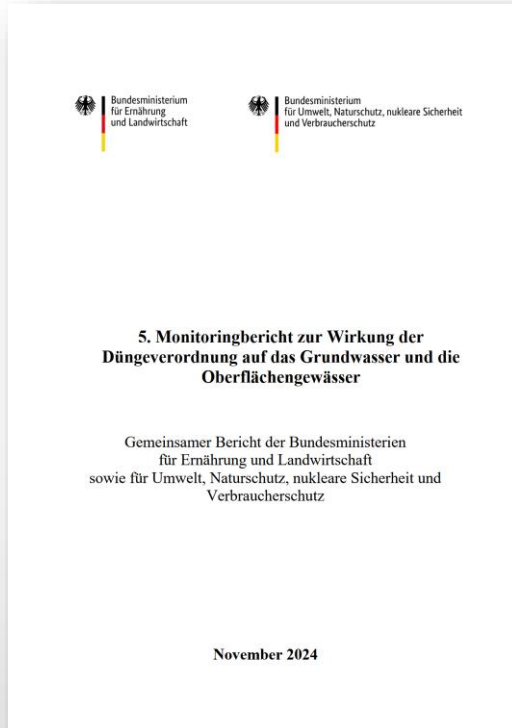


Validation – all land use types



Source: FZJ

Take home message



1. Germany implements an additional monitoring on the NiD Action Program. Implementation is still in progress, legal basis still missing.
2. Key idea: rapid policy assessment at the soil surface – not just in water – with a revolutionary database (for German conditions)
3. First results show decline in N emissions but not yet a response of monitoring network
4. Scientific and organizational challenges remain



Source: Michael Welling

Thank you for your attention!

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Bildquelle: Kym McLeod - stock.adobe.com



Bildquelle: jbpgraphylyt - stock.adobe.com



Further reading

Tetzlaff B, Kunkel R, Eysholdt M, Nguyen HH, Venohr M, Wolters T, Zinnbauer M, Wendland F (2024) Modelling current-state N- and P-fluxes into surface waters in Germany. *Water* 16(13):1872, [DOI:10.3390/w16131872](https://doi.org/10.3390/w16131872)

Löw P, Danne M, Offermann F, Osterburg B, Söder M, Zinnbauer M (2024) What drives recent trends of nitrogen use efficiency and mineral fertilizer consumption in Germany? Thünen Working Paper 251:106-107 https://literatur.thuenen.de/digbib_extern/dn069109.pdf

Zinnbauer M, Eysholdt M, Henseler M, Herrmann F, Kreins P, Kunkel R, Nguyen H, Tetzlaff B, Venohr M, Wolters T, Wendland F (2023) Quantifizierung aktueller und zukünftiger Nährstoffeinträge und Handlungsbedarfe für ein deutschlandweites Nährstoffmanagement - AGRUM-DE. Braunschweig: Johann Heinrich von Thünen-Institut, 454 p, Thünen Rep 108, [DOI:10.3220/REP1684153697000](https://doi.org/10.3220/REP1684153697000)

Wolters T, Cremer N, Eisele M, Herrmann F, Kreins P, Kunkel R, Wendland F (2021) Checking the plausibility of modelled nitrate concentrations in the leachate on federal state scale in Germany. *Water* 13(2):226, [DOI:10.3390/w13020226](https://doi.org/10.3390/w13020226)

Dieser, M., Zieseniß, S., Mielenz, H., Müller, K., Greef, J.-M., & Stever-Schoo, B. (2023). Nitrate leaching potential from arable land in Germany: Identifying most relevant factors. *Journal of Environmental Management*, 345(118664). <https://doi.org/10.1016/j.jenvman.2023.118664>

Löw P, Osterburg B (2024) Evaluation of nitrogen balances and nitrogen use efficiencies on farm level of the German agricultural sector. *Agric Syst* 213:103796, [DOI:10.1016/j.agsy.2023.103796](https://doi.org/10.1016/j.agsy.2023.103796)

Contributing projects

- <https://www.thuenen.de/en/cross-institutional-projects/mapping-regional-agricultural-nitrogen-fluxes-for-water-and-climate-protection-policy>
- <https://nitrat-boden.julius-kuehn.de/>
- <https://www.umweltbundesamt.de/themen/wasser/grundwasser/ueberwachung-bewertung/wirkungsmonitoring-zur-umsetzung-der#struktur-und-inhalt-des-monitorings>
- <https://www.thuenen.de/en/cross-institutional-projects/agrum-germany>