

THE LIMFJORD CHALLENGE

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trans4num INSPIRE Hackathon

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AARHUS UNIVERSITY



The challenge: a future farming landscape

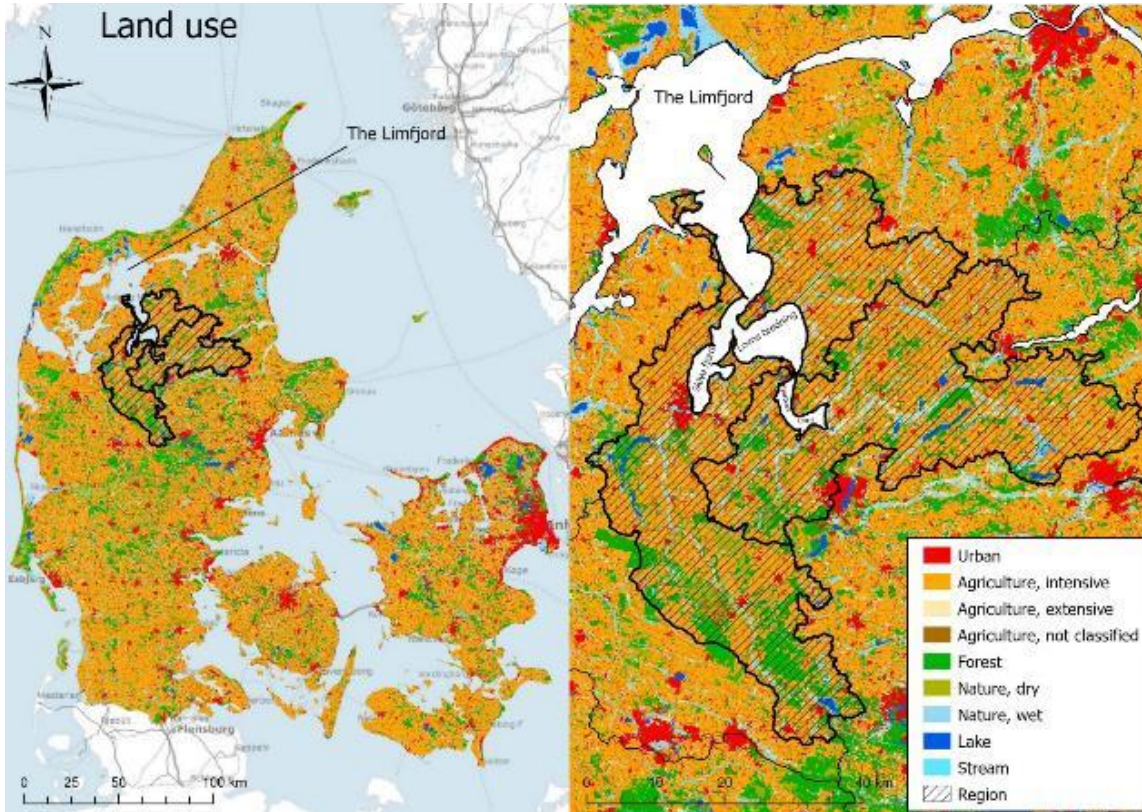
How can we reduce nitrogen losses
while keeping farming productive and viable?



Design a landscape that also works for climate, nature and local communities.



Agriculture and nitrogen losses around the Limfjord



Orange and yellow indicate agricultural land.

Agriculture dominates

Intensive crop and livestock farming is a major source of nitrogen entering the fjord.

Soils and drainage shape losses

Sandy soils can favour nitrate leaching. Drains can carry nitrate rapidly to streams.

Natural removal varies

Where less nitrate is removed on its way, more of the field loss reaches the fjord.

The same reduction in field losses can have different benefits for the fjord.

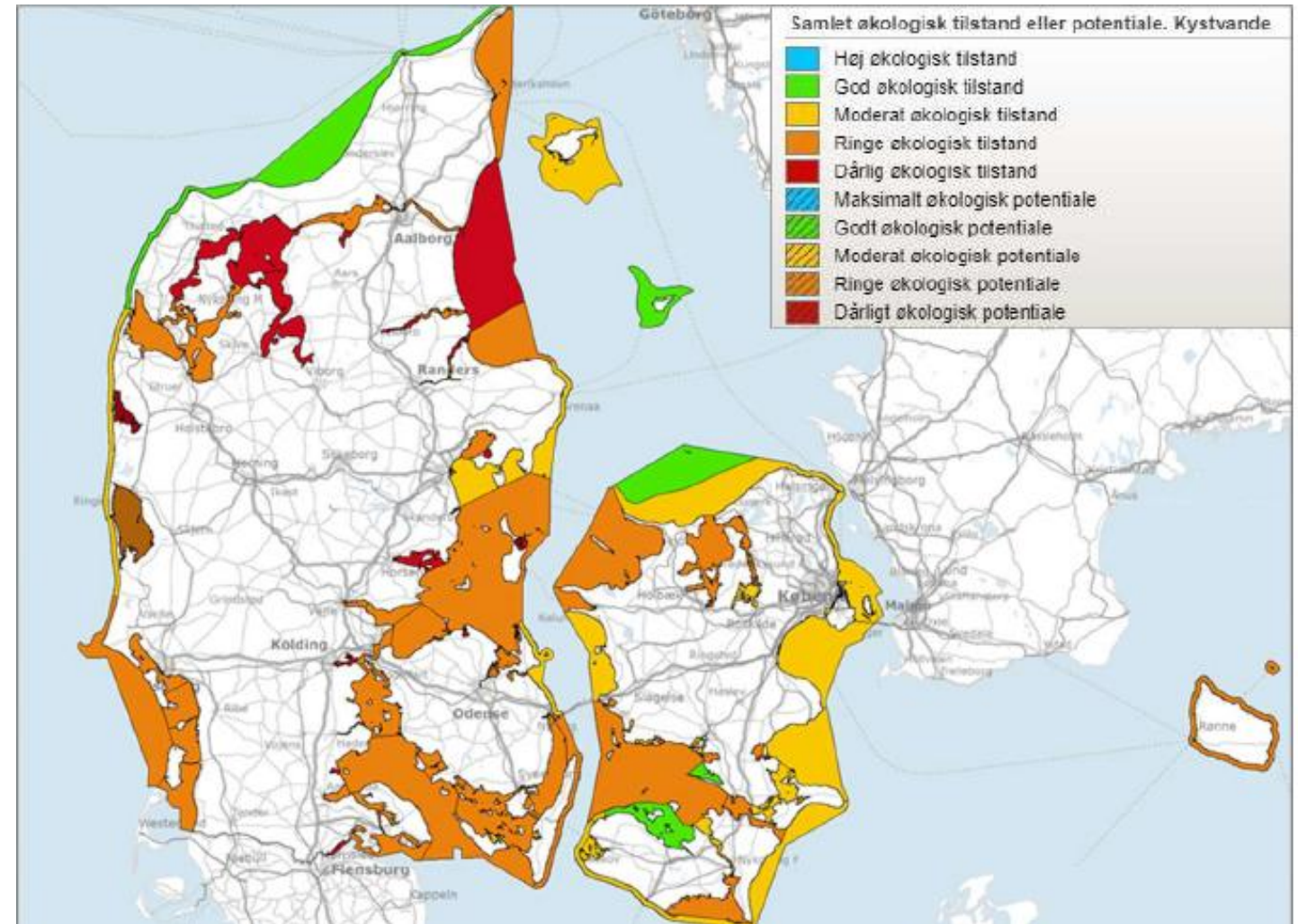
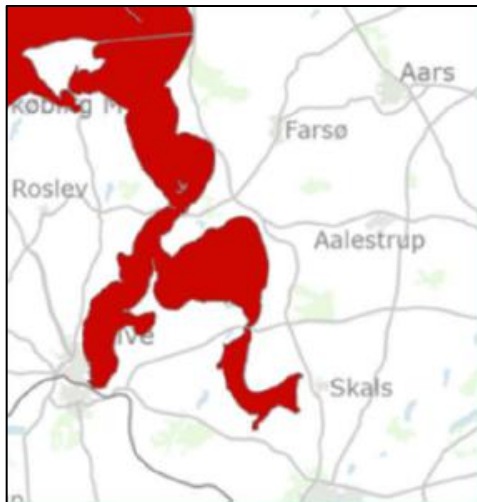
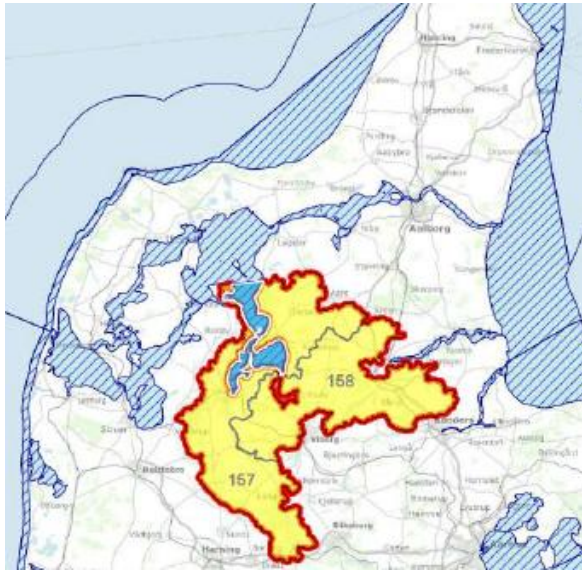
Land-use map: original slides. Sources: SGAV Limfjord guide; GEUS/AU (2025); USDA-NRCS. Details in notes.



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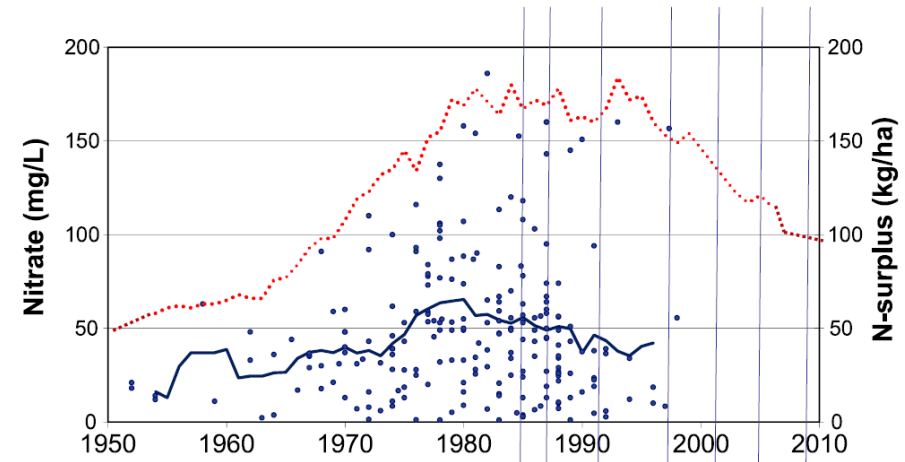
Conditions



Local challenges

Denmark: Reduced N surplus and leaching halved

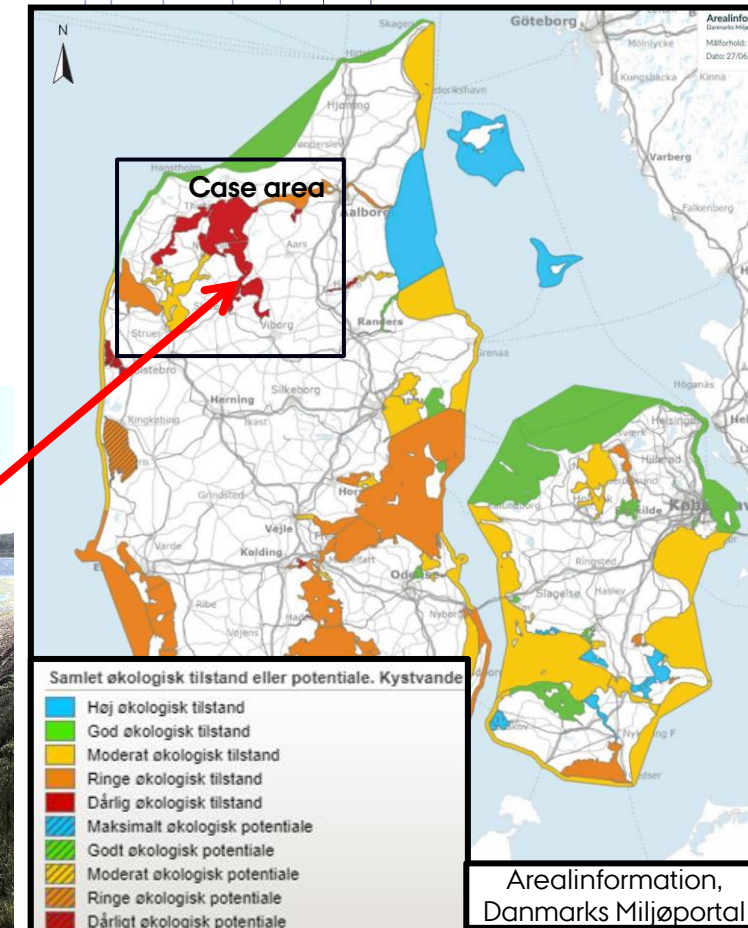
- Nitrogen losses from agriculture remain one of the greatest pressures on Danish coastal waters
→ primary reason for non-compliance with the WFD (Hermann et al., 2023, Ministeriet for Grøn Trepert, 2024)



• NO₃⁻ in oxic groundwater
— Average NO₃⁻ concentration
..... N-surplus from agriculture
(Dalgaard et al., 2014)



Virksund: May 20, 2025



Why the Limfjord is vulnerable



DCE (2025), oxygen depletion report, pp.12–14. Photograph: Virksund, 20 May 2025

Excess nutrients support more algae

Their decomposition consumes oxygen in the water.

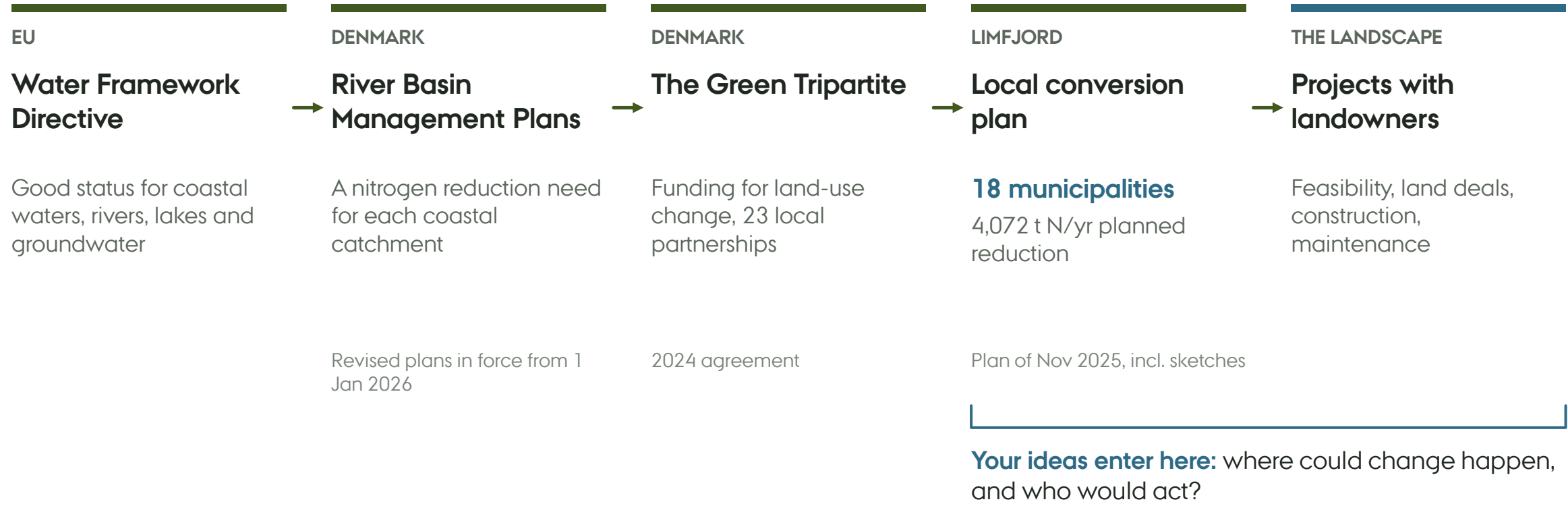
Oxygen can run out near the bottom

Salty water can form a thin bottom layer that mixes poorly with the water above.

Warm, calm conditions increase the risk.



Why change is possible now



National land-use ambitions

250,000 ha

New forest

by 2045

140,000 ha

**Carbon-rich lowland
and adjacent land**

out of cultivation by 2030

23

Local Green Tripartites

to plan the transition

National targets, not completed conversion or local hectare quotas.



Ministeriet for Grøn Trepert, factsheet on conversion plans, 13 December 2024.

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What the Green Tripartite has set in motion

2024

A national agreement

National funding and land-use ambitions.

2025

23 local partnerships

Local partners register conversion proposals in MARS.

2026

Project development

Feasibility studies, landowner dialogue and land consolidation.

2027

New field regulation

Emission-based rules for farming are due from 1 January.

**National ambitions: 250,000 ha new forest by 2045;
140,000 ha carbon-rich lowland and adjacent land out of cultivation by 2030.**

National agreements and SGAV guidance. Position as of 21 October 2026; 2027 regulation is forthcoming.



Collective measures and land conversion

The Green Tripartite supports voluntary projects through public funding.

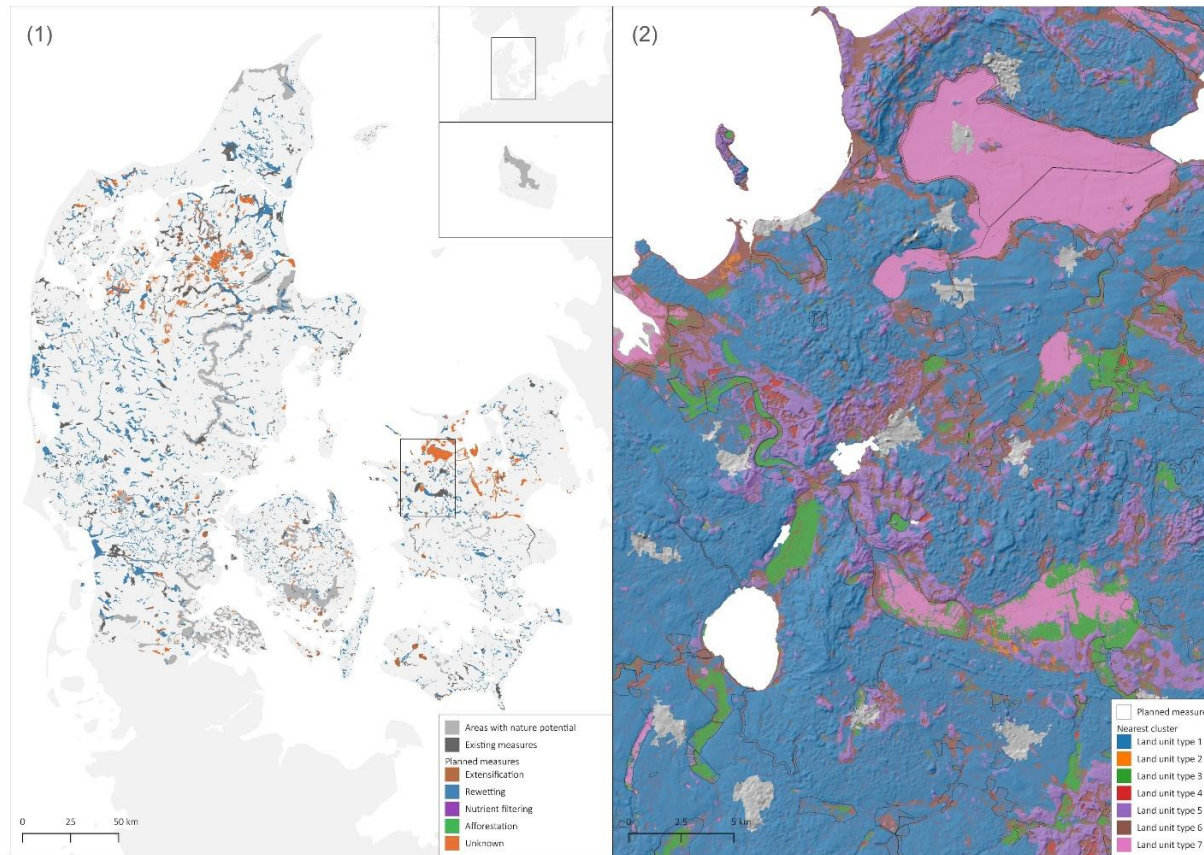
Measure in the conversion plans	What changes in the landscape?
Nitrogen wetlands	Remove nitrate from water passing through wet soils.
Constructed wetlands	Remove nitrate from agricultural drainage water.
Rewetting carbon-rich soils	Reduce CO ₂ emissions. Nitrogen effects vary by site.
Afforestation	Reduce nitrogen leaching by converting farmland to forest.
Permanent extensification	End fertilisation and tillage. Grazing or mowing can continue.

Land purchase, compensation and land consolidation support implementation.

Sources: SGAV, measures and grant schemes (2026); permanent extensification guidance (2026). Details in notes.



What the first plans reveal



Rewetting dominates

Agricultural lowlands are strongly represented in the proposed changes.

The land is heterogeneous

One measure category spans different soils, groundwater conditions and terrain.

National map (left): blue areas show proposed rewetting.

Christensen et al. (2026), working manuscript, version 24. Fig.4: Denmark and a central Zealand example.



Questions?



