



# GREENHOOD

Nutrient management strategies for regional ecosystems across Europe

## **Nutrient balance and Resource Optimization in Regional Ecosystems through holistic, sustainable, and zero-pollution solutions**

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PA Nutri Talks – Nutrient recycling in the Baltic Sea Region

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the European Union

## General project information

- Nutrient balance and resource optimisation in regional ecosystems through holistic, sustainable and zero-pollution solution – GREENHOOD
  - Call topic: HORIZON-CL6-2024-ZEROPOLLUTION-01-1
  - Project Budget: 9.6 M€ (EU Contribution: 9 M€)
  - Project duration: 01/01/2025 – 31/12/2028
  - Total of 30 partners from 10 countries (Austria, Belgium, Croatia, Czech Republic, Finland, Greece, Italy, Netherlands, Norway, Spain)



## Four demo regions

- Each demo regions demonstrate approaches, considering local challenges, to re-balance nutrient flows and reduce N/P emissions.
- Through targeted efforts in regional hotspots, guided by robust nutrient budgeting methodologies, and collaborative testing of diverse innovation with regional stakeholders
- GREENHOOD aims to pave the way for societies to operate within safe ecological boundaries while satisfying socioeconomic needs

## GREENHOOD demo-regions

GREENHOOD's demo regions — **Ebro River Basin (Spain)**, **Rhine/Meuse/Scheldt Basins (Belgium/the Netherlands)**, **Archipelago Sea Basin (Finland)**, and **Trondheim Fjord Basin (Norway)** — represent varied ecosystems and challenges. By analysing and testing in these areas, we ensure solutions are as diverse as the environments they serve.

A map of Europe with four circular callouts highlighting the demo regions: Ebro River Basin (Spain), Rhine/Meuse/Scheldt Basins (Belgium/the Netherlands), Archipelago Sea Basin (Finland), and Trondheim Fjord Basin (Norway). Each callout shows a different landscape: a river, a coastal area, a sea basin, and a fjord.

*Each basin tells a different story, but all share a common goal: balancing ecosystems for a sustainable future.*

## Ebro River Basin in Spain

- Intensive livestock production
  - Following mitigation measures for reducing N and P losses are being tested
    - Nutrient recovery from manures (liquid and solid fraction), including phosphorus and ammonia recovery from liquid fraction, followed by microalgae cultivation. Solid fraction for high-quality soil improvers, containing also N and P
    - Bioremediation of nitrate-contaminated groundwater and producing drinking water for livestock
    - Nature based reactor (duckweed, *Lemna gibba*) for treating urban wastewater for upgrading the quality of the pond effluent (pathogens, BOD, N and P)
    - Fertinagro (fertilizer company) will produce bio-based fertilizers/tailor made fertilizers from recovered nutrients. Fertilizers will be tested in a field scale
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## Rhine, Meuse and Scheldt river basins in Netherlands-Belgium

- Demo region extends to both Netherlands and Belgium
  - Mitigation measures are nature-based solutions
    - Woodchip bioreactor for enhancing denitrification of subsurface drainage effluents
    - Sedimentation ponds for reducing N, P and C discharge
    - Buffer strips
    - Integrated, constructed wetlands, connected to dense artificial drainage networks
  - Optimizing the use of BBFs by utilizing novel sensor technology to achieve higher precision in fertilization, and by producing BBFs from side streams originating from the above-mentioned nature-based solutions
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## Trondheim Fjord basin, Norway

- Fish sludge and livestock manure produce large nutrient (N and P) surpluses in Norway, causing eutrophication
  - Aim is to process these side-streams into a BBFs
  - Both N and P will be recovered from the digested manures/sludges
  - Produced BBFs will be tested in field conditions across Norway
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## Archipelago Sea Basin, Finland

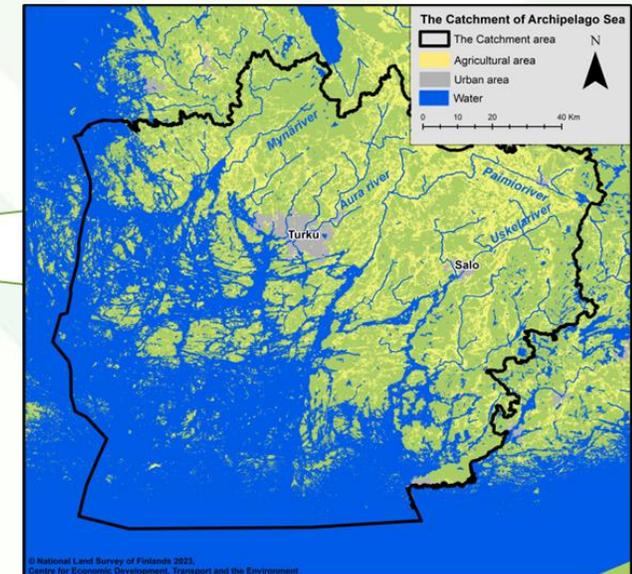
Partner involved	Role and main tasks in the Demo
	Leader of Demo#3, quantification and modelling of nutrient flows and balances, assessment of policy measures, experimental work related to soil improvers and BBFs, communication & dissemination
 <p>Centre for Economic Development, Transport and the Environment</p> <p>ELY Center Varsinais-Suomi</p>	Direct link to the measures in the national Archipelago Sea Programme, P status clinic with farmers, support for nutrient recycling solutions and policy measures, communication & dissemination
 <p>MTK Varsinais-Suomi</p>	Support for promoting nutrient recycling solutions and policy measures in agriculture and forestry of the demo region, communication & dissemination
 <p>Finnish Biocycle and Biogas Association</p>	Support for BBF production and nutrient recycling measures, communication & dissemination
	Development of pelletized BBF from poultry manure, experimental work
<p>Subcontracted by Luke Gasum, Kiertoravinne</p>	Participation to BBF production (esp. N fertilizers) from sewage sludge, experimental work

## Archipelago Sea Basin, Finland

 Solutions towards mitigation of N and P emissions in key sectors (agriculture, forestry, WWTP)

 Nutrient containing flows assessed in the demo:

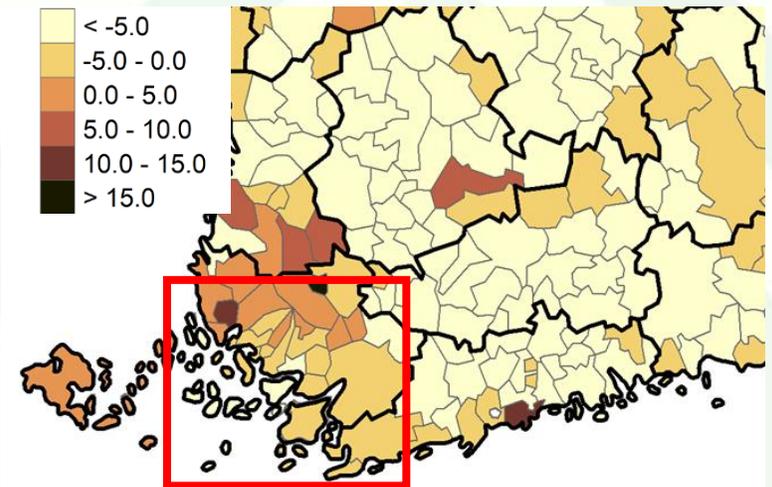
- Agricultural nutrient loading, incl. manure
- Sewage sludge
- Nutrient loading from forestry



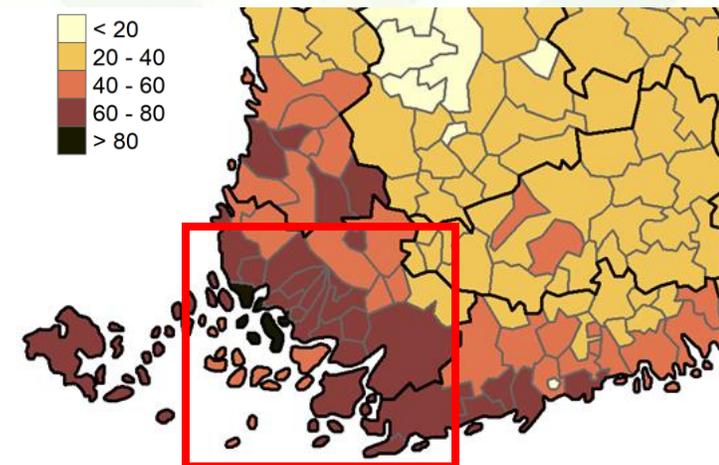
The Archipelago Sea is a shallow sea basin with over 40,000 islands and a high retention of waters collected from several river catchments. The basin is vulnerable to nutrient loading and is the only hotspot identified by the Baltic Marine Environment Protection Commission (HELCOM) in Finland. Its ecological status is mostly moderate, with the main issues being eutrophication and diffuse nutrient loading.

- *Intense agriculture* (240 000 ha, 28% of land area)
  - 80% of farms producing crops and other plants
  - Livestock production focused on pigs and poultry and heavily regionally concentrated to Western part of the region
  - High risk for erosion (clay soils); high P status common with no yield response to P fertilization
  - Manure P could cover the region's P fertilization need, if reallocated; still, little processing in use
- *Main land use: forestry* with a need to reduce nutrient loading
- Most of the *sewage sludge* anaerobically digested with a need to improve especially N recycling (liquid fraction) via processing

Surplus and deficit of manure P if it were used on all fields according to the crop need (kg/ha)



Share of field soils with no yield response to P fertilization (%)



## Mitigation measures tested for reducing emissions from agriculture, WWTP and forestry

- Soil amendments to reduce nutrient losses caused by erosion
  - Gypsum, fibers from forest industry, structure liming: close collaboration with on-going national AIN3 project, where soil improvers spread over 800 ha to retain nutrients in soils
  - Water quality will be monitored
- Processing the liquid fraction of digested sewage sludge to enhance its nitrogen fertilization efficiency
  - Aim is to increase the share of soluble N content in the liquid fraction
  - Tested in field scale and potential N losses monitored (both runoff and gaseous losses)



## Mitigation measures tested for reducing emissions from agriculture, WWTP and forestry

- Producing tailor made fertilizers (TMF) from poultry manure (FERTILEX)
    - Improving N/P ratio to better meet crop requirement and to avoid P accumulation in soil and thus minimizing P losses to surface waters
    - BBFs/TMFs will be tested in field conditions
    - An earlier study showed that BBFs induced lower P mobilization than conventional mineral P fertilizer
    - BBFs produced in Demo regions will be tested in rainfall simulation under different soil types
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## Mitigation measures tested for reducing emissions from agriculture, WWTP and forestry

- Nutrient recycling subsidy for the regional redistribution of phosphorus
    - Promotes processing and reallocation of manure-based digestates
    - The effectiveness of this subsidy, as well as its extension to other processing technologies, will be evaluated
  - Monitoring methods for assessing the progress of mitigation measures
    - Nutrient calculator tool for evaluating fertilization requirements and the suitability of various nutrient-rich side streams to meet these needs
    - Biomass Atlas provides the spatial distribution of biomasses
    - Models including nutrient flows in forestry improve knowledge about nutrient flows beyond agriculture
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THANK YOU

