State of play in the Baltic Sea Region

New data on what is the potential for nutrient recycling and Baltic Sea Regional Nutrient Recycling Strategy

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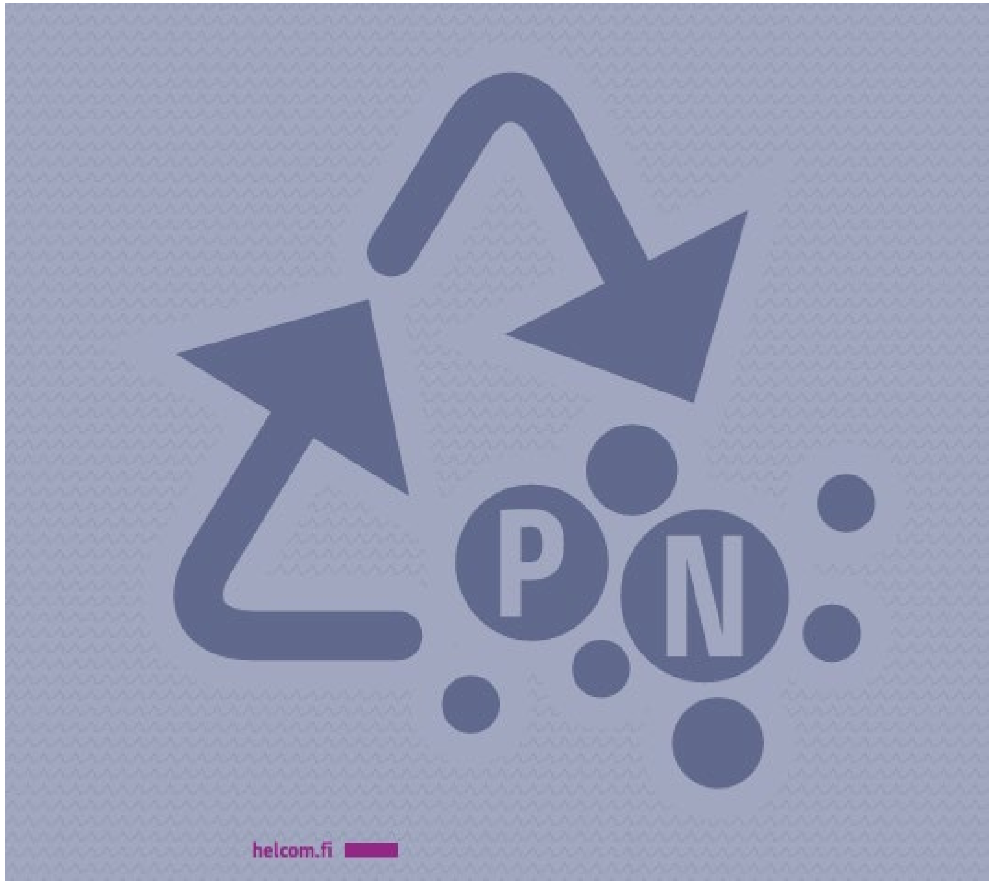
Why do we need nutrients in agriculture?

- Nutrients are essential for the yield capacity from agricultural fields, but they also require financial input and pose a risk for losses into the environment
- Fertilization needs to be optimized for the yield level targeted and according to the conditions
    - Excess fertilization increases the risk for losses, too low fertilization reduces the yield
- Nutrients behave differently in soil and while managing them
    - Phosphorus (P) binds into soil particles, forms a storage in soil and thus, depending on the soil P status, annual fertilization may not be needed
    - Nitrogen (N) can also be present in soil as organic N, but due to the biological activity of the soil, it is released according to the conditions, not only when the growing plant requires it
        - To ensure sufficient N availability for the plants, it must be added as fertilizer annually
        - Also, depending on the type of N fertilizer, gaseous emissions during handling and application need to be considered
- Nutrients can be added as mineral or recycled fertilizer products

Nutrient recycling – an integral part of circular economy

- Nutrient recycling means the recovery and reuse of different nutrient-rich side streams from human activities
- The aim is to reduce overall nutrient use via
  - Replacing (part of) mineral fertilizers with recycled products and thus reducing the need for mineral nutrient sources (esp. phosphorus) and for converting atmospheric nitrogen to ammonia, and
  - Reducing nutrient losses into the environment as emissions
- Main nutrients recycled are phosphorus and nitrogen
  - Potassium, micronutrients and organic matter also of interest



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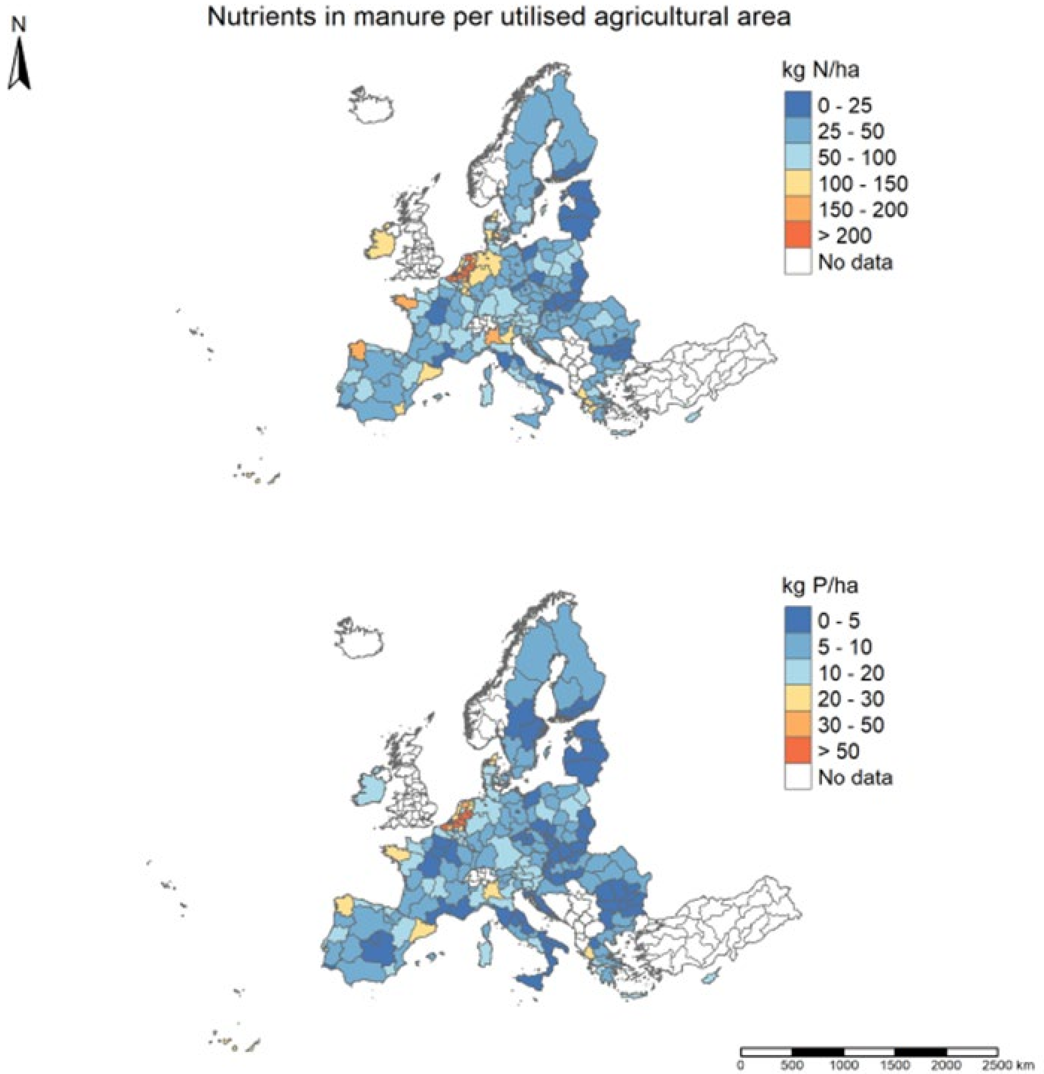
Nutrient-rich side streams for recycling

- Often of organic origin
  - May also be inorganic, e.g. from mining procedures

Agriculture	Municipalities	Industries
Livestock manure	Biowaste	Various side streams esp. from food processing
Side streams from plant production • Straw • Vegetable tops etc. • Excess silage • Biomasses from fallow lands	Sewage sludge from municipal wastewater treatment plants	
Energy crops via e.g. biogas production (use limited for sustainability reasons)		

Spatial variation in the availability of and the need for recyclable nutrients

- The nutrient-rich side streams are rarely located directly in the place where the nutrients are needed
  - Livestock and crop production are segregated and located in different regions in many countries
    - Livestock manure is regionally concentrated
  - Active industries are often close to larger human settlements with both of their nutrient-rich side streams also originating there
- Nutrient recycling requires transportation



EU Horizon project https://lex4bio.eu/

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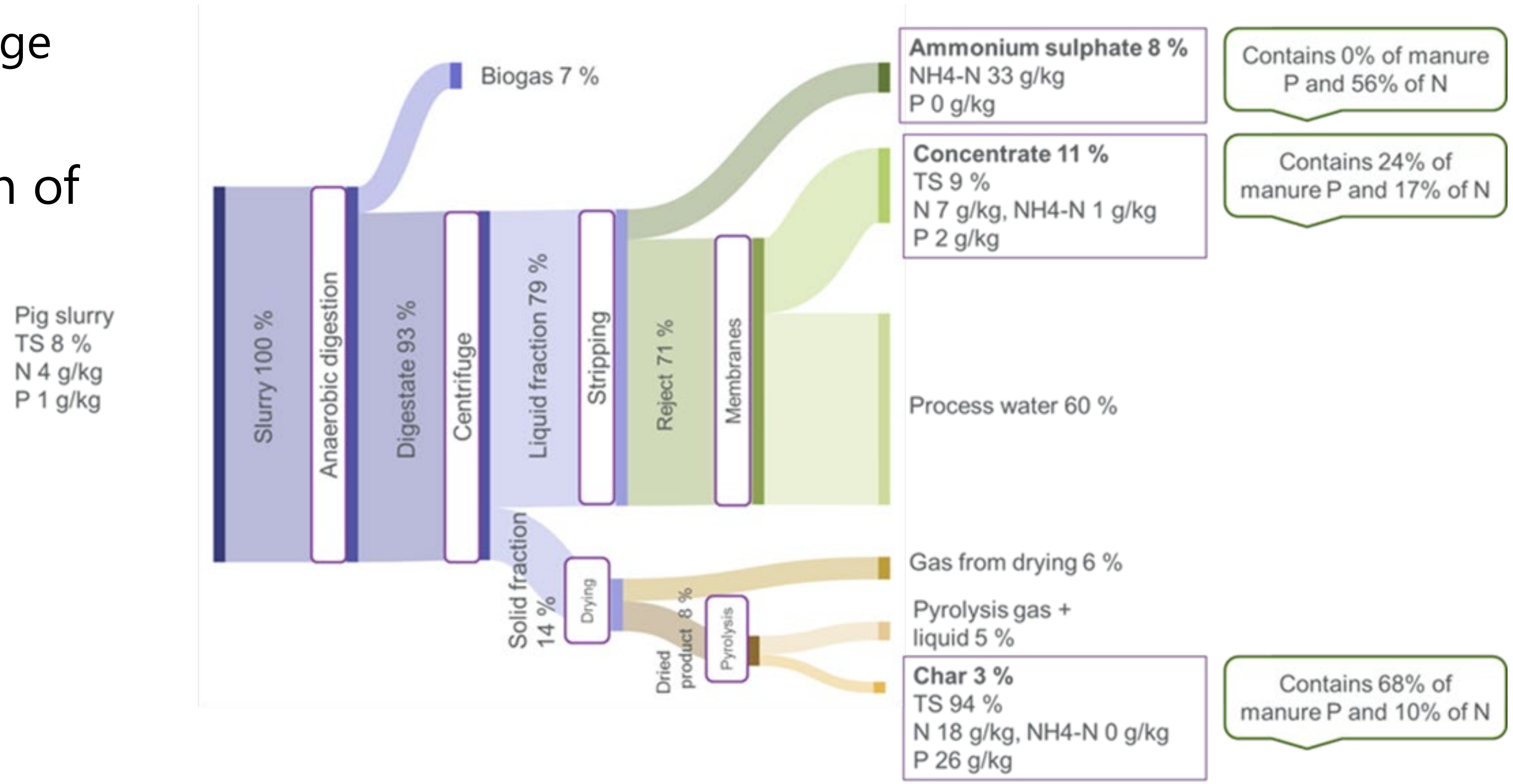
Processing technologies to enhance nutrient recycling

- Separation of nitrogen and phosphorus into different fractions to enhance their use
- Concentration of nutrients into smaller volumes to improve transportability
  - Also reduces requirement for storage capacity
- Potentially simultaneous production of renewable energy
- Ensuring safety of the products
- Recycling of organic matter



Very preliminary results from the data mapping of CiNURGi project

- National mapping still ongoing (more biomasses to be added, national coeffients and spatial data may improve precision)
- Indicative result for BSR: 2.7 million tons of N and 0.51 million tons of P available annually

	Livestock manure		Animal by-products		Sewage sludge		Municipal biowaste		Grape pomace	
t/a	N	P	N	P	N	P	N	P	N	P
Total BSR	***2 318 984***	***386 753***	***137121***	***30409***	***111 080***	***75 015***	***105 295***	***13 660***	***2641***	***113***
DK	238857	42176	13916	3120	5 429	3 666	9 922	1 287	0	0
DE	1136878	186539	59469	13338	65 785	44 426	78 032	10 123	2640	113
EE	21940	3448	474	109	838	566	162	21	0	0
LV	37436	5874	1100	245	785	530	320	42	0	0
LT	60454	9662	2286	510	1 863	1 258	740	96	0	0
PL	644748	110163	49427	10753	22 355	15 097	7 343	953	0	0
FI	70325	11504	4207	937	6 179	4 173	3 170	411	0	0
SE	108346	17387	6243	1397	7 846	5 299	5 606	727	1	0

Estimated based on a method developed in HE project LEX4BIO

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CIRCULAR ECONOMY CiNURGi
Interreg Baltic Sea Region
Co-funded by the European Union

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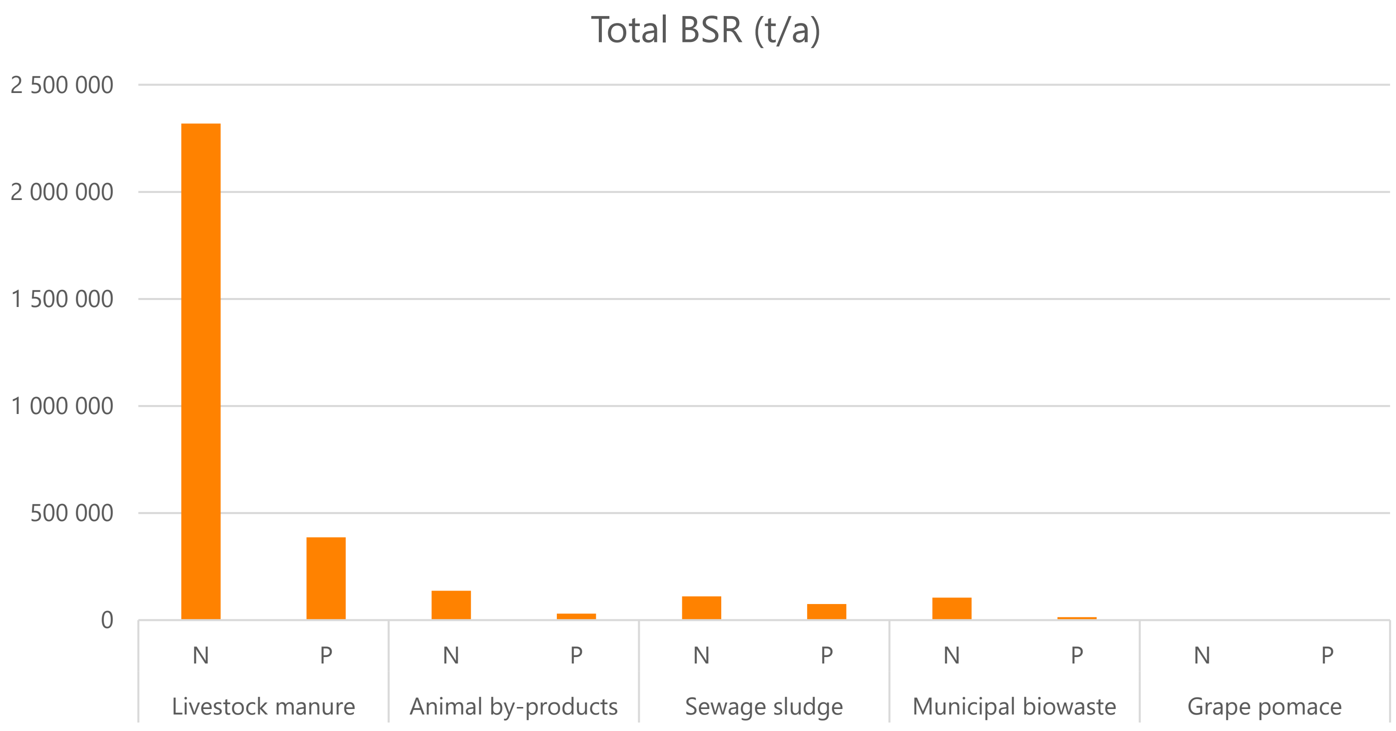

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CIRCULAR ECONOMY CiNURGi

Interreg Baltic Sea Region

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Better data needed to assess nutrient recycling potential in the BSR

- Data gaps especially with industrial side streams
- Sufficient spatial resolution a challenge
  - NUTS2-regions are too large to identify spatial variation in the amounts of recyclable nutrients available
  - Some data only available nationally without indication of its actual place of origin
- National coefficients for average N and P content in the side streams may differ
- Comparison to nutrient need in fertilization is difficult
  - Need for soil P data, statistics of crop produced in the fields, choice of fertilization limit
  - Comparison to utilized agricultural land (ha) simplifies too much

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Example: Finland (1)

- According to a recent estimate, 90% of phosphorus fertilization required in the Finnish plant production could be covered with the phosphorus in nutrient-rich side streams
  - 65% of this in livestock manure alone
- Still, approximately 11 500 tons of mineral phosphorus fertilizers are used annually
  - Improved nutrient recycling has a significant potential to replace mineral P

Phosphorus need/source	P (t)
Need for fertilization	*23 300*
Livestock manure	15 200
Sewage sludge	4 000
Food processing side streams	770
Municipal biowaste	540
Excess grass	560

http://urn.fi/URN:ISBN: 978-952-380-612-2

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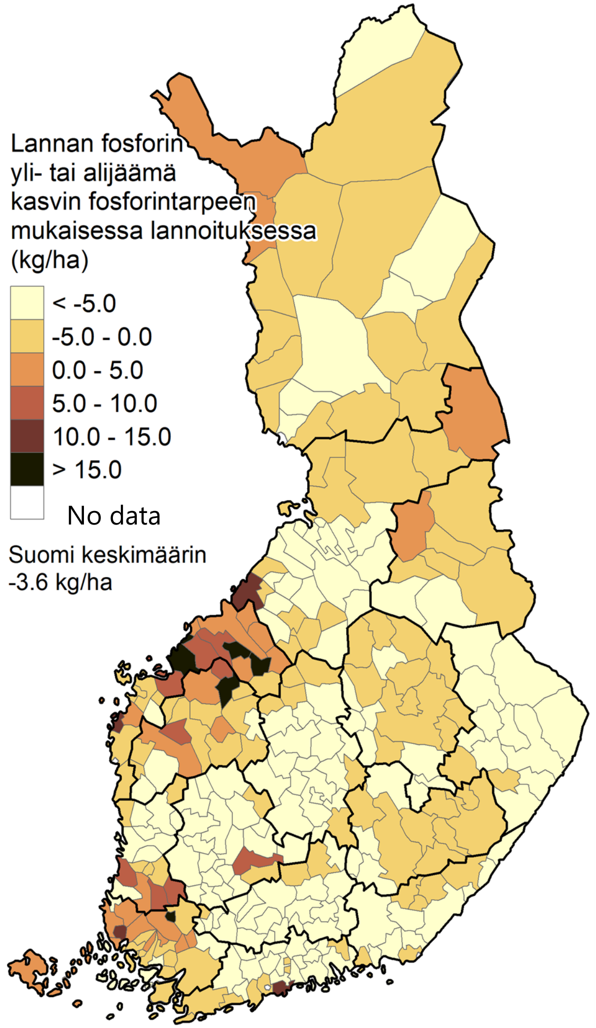
Example: Finland (2)

- Regions with dense livestock production also tend to have high soil P status and thus reduced need for P fertilization
- Need for nutrient recycling on several levels:
  - Farm-scale: more precise use of manure and solutions for allocating excess
  - Local: increased cooperation between farms to reallocate excess manure to crop farms
  - Regional: larger scale manure processing to convert manure into transportable recycled fertilizer products and reallocate the nutrients to regions in need of P fertilizers
    - Separation of N and P via processing enhances also N use
- Processing of other side streams to recycled fertilizer products also needs to be further developed

Excess or deficit in manure P vs. P fertilization required (kg/ha)

Average in Finland: -3.6 kg/ha



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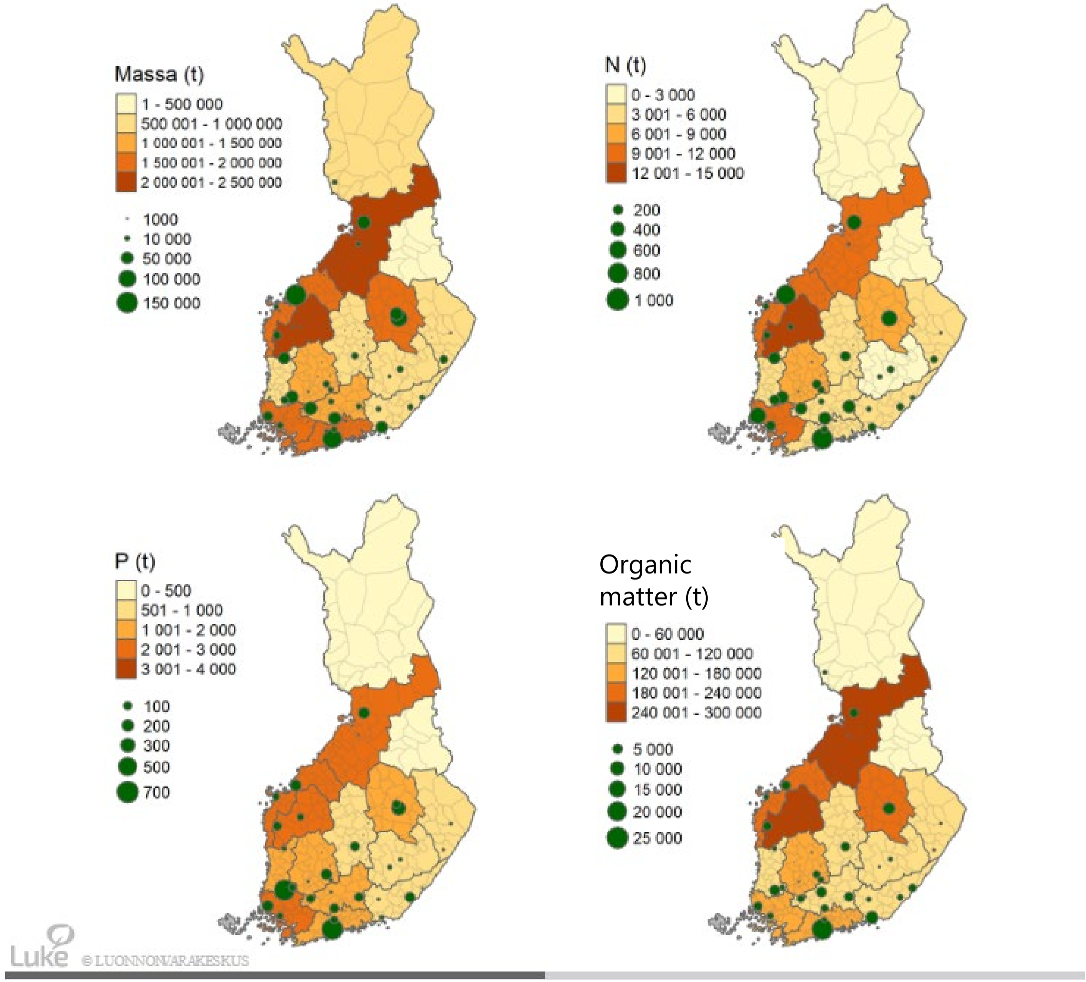
Example: Finland (3)

- For efficient nutrient recycling, most of the nutrient-rich side streams from industries and municipalities and part of the livestock manure need to be processed into more concentrated recycled fertilizer products
  - In the maps, the potential for recycling is depicted with the different colours of the regions, while the green dots show the amount currently recycled into recycled fertilizer products (type: soil improvers)
    - Clearly, there is plenty of recycling potential left for harnessing into use



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Indicator for nutrient recycling: https://www.luke.fi/fi/tilastot/indikaattorit/ravinteiden-kierratyksen-indikaattori

Data on nutrient recycling offers a basis to monitor both the availability of recyclable nutrients and the actual execution of nutrient recycling.

The data is indicative due to the complexity of data collection and quality. Data collection should be improved in all BSR countries.

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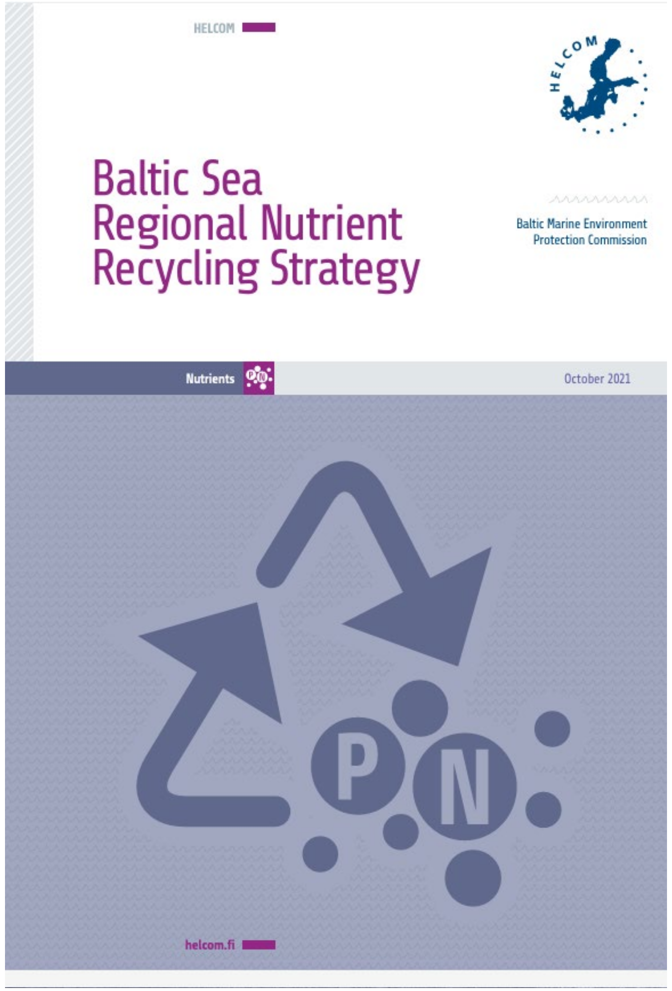
HELCOM BSAP and Regional Nutrient Recycling Strategy



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Measures for nutrient recycling in BSAP / Eutrophication

- Seven general measures to promote nutrient recycling
  - Some measures in themes Agriculture and Wastewater sector related to nutrient recycling
- The main aim is to improve fertilization precision and to increase i) production and use of safe recycled fertilizer products and ii) knowledge and cooperation between stakeholders on nutrient recycling

Theme: Nutrient recycling	
E30	Implement adequate measures, especially in agriculture and wastewater management, to achieve the objectives of the Baltic Sea Regional Nutrient Recycling Strategy by 2027.
E31	Create legal and institutional tools to advance towards introducing annual field-level fertilization planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) as a requirement for all farms in the Baltic Sea Region to reduce nutrient surplus on farmlands to the highest possible degree in a cost-effective way.
E32	Enhance the use of recycled nutrients in agriculture making use of best available technologies and fertilize according to crop needs.
E33	Develop by 2027 safety requirements for recycled fertilizer products and minimise the occurrence of harmful compounds in these products to comply with the requirements.
E34	Increase the knowledge and promote education and advisory services on nutrient recycling.
E35	Improve the conditions for the development of a market for recycled fertilizer products by setting incentives with the aim of making the use of such products equally attractive to farmers as the use of mineral fertilizers.
E36	Enhance cooperation and share experiences between sectors and actors to create a holistic view on sustainable food systems including nutrient recycling across sectors.

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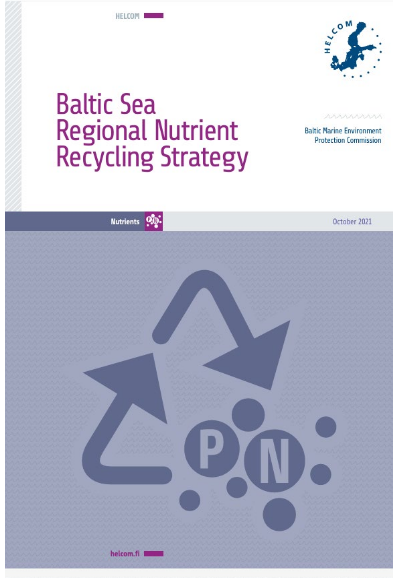
Regional Nutrient Recycling Strategy

Vision

Nutrients are managed sustainably in all HELCOM countries, securing the productivity of agriculture and minimizing nutrient loss to the Baltic Sea environment through efficient use of nutrients and cost-effective nutrient recycling.

- Six objectives with subobjectives listing the aims
- Examples of more precise measures with which the objectives can be executed
  - The list if not exhaustive: alternative measures and new ones can also be applied
  - National differences can be taken into account



Objectives 1 and 2

OBJECTIVE 1 — Baltic Sea region as a model area for nutrient recycling

SUB-OBJECTIVES

— *Increasing nutrient use efficiency*
— *Increasing the circulation of the available nutrient resources and reducing nutrient inflows to the region*
— *Utilizing nutrient rich organic residues originating from areas with high nutrient surplus for production of fertilizer products*

OBJECTIVE 2 — Reducing environmental impacts

SUB-OBJECTIVES

— *Reducing nutrient losses to the Baltic Sea area and closing nutrient cycles*
— *Reducing greenhouse gas emissions*
— *Reducing ammonia emissions*
— *Utilizing appropriate solutions to recycle nutrients for the specific conditions preventing contamination of the environment*
— *Improving soil quality and enhancing carbon sequestration by using organic fertilizers*
— *Promoting/advancing site specific optimized fertilization plans*

Objectives 3 and 4

OBJECTIVE 3 — Safe nutrient recycling

SUB-OBJECTIVES

— *Minimizing the risks for humans and environment posed by contamination*
— *Increasing research and knowledge sharing on risks and safe practices*

OBJECTIVE 4 — Knowledge exchange and awareness raising

SUB-OBJECTIVES

— *Promoting new research and technological development*
— *Facilitating knowledge transfer and information exchange on nutrient recycling*
— *Cooperating with other regions and global organizations to exchange information on the most up-to-date knowledge and techniques*
— *Raising awareness of the benefits of nutrient recycling*
— *Promoting a holistic view of food production*

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Objectives 5 and 6

OBJECTIVE 5 — Creating business opportunities

SUB-OBJECTIVES

- *Encouraging new business models with cross-sectoral cooperation*
- *Improving the economic viability of nutrient recycling*

OBJECTIVE 6 — Improving policy coherence

SUB-OBJECTIVES

- *Increasing cooperation of governmental agencies to improve policy coherence*
- *Updating the legal framework to facilitate nutrient recycling*

Thank you!

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