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D2.3 Policy Recommendations for Recycled Nutrient Fertilisers in the Baltic Sea Region

Advancing Market Development, Policy Coherence, and Safe Use of Recycled Nutrients

April 2026

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Policy Recommendations for Recycled Nutrient Fertilizers in the Baltic Sea Region

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Foreword

CiNURGi (Circular Nutrients for a Sustainable Baltic Sea Region) is an Interreg Baltic Sea Region Core Project dedicated to advancing a circular economy for nutrients in the Baltic Sea Region. By strengthening knowledge, infrastructure, technology, stakeholder engagement, and policy dialogue, the project seeks to improve nutrient recovery from biomass and resource streams originating from agricultural, municipal, and industrial sources. In doing so, CiNURGi supports several regional and European policy frameworks, including the HELCOM Baltic Sea Regional Nutrient Recycling Strategy (HELCOM, 2021b), the HELCOM Baltic Sea Action Plan (HELCOM, 2021a), and the broader transition toward circular and sustainable nutrient management in Europe.

This report relates specifically to Activity A2.3, Increasing acceptance and use of recycled nutrients. A2.3 focuses on identifying the policy, regulatory, market, governance, and knowledge-related conditions needed to support wider uptake of recycled nutrient fertilizers (RNFs) across the Baltic Sea Region. The report brings together evidence from project activities, stakeholder dialogue, and broader policy and scientific sources to formulate policy recommendations that can help create clearer frameworks, stronger market conditions, and greater confidence in the safe and effective use of recycled nutrients.

The findings presented here contribute to CiNURGi's wider objectives by supporting the development of a more coherent and enabling environment for nutrient recycling. In particular, the report aims to strengthen the policy dimension of the project by translating project experience and stakeholder insights into practical recommendations for decision-makers at regional, national, and macro-regional levels.

We acknowledge the collaborative efforts of the CiNURGi consortium, which brings together partners and associated organisations from across the Baltic Sea Region. Their expertise and engagement have been essential in shaping the analyses and recommendations presented in this report.

For more information about CiNURGi and its activities, please visit the project homepage: https://interreg-baltic.eu/project/cinurgi/

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List of abbreviations

BBF	Bio-based fertilizers
BGK	Federal Compost Quality Association
BSAP	Baltic Sea Action Plan
BSR	Baltic Sea Region
BSRNRS	Baltic Sea Regional Nutrient Recycling Strategy
CAP	Common Agricultural Policy
CE	Conformité Européenne (EU conformity marking)
CiNURGi	Circular Nutrients for a Sustainable Baltic Sea Region project
DEI	Direct Emission Impact
DG AGRI	Directorate General for Agriculture and Rural Development
EIB	European Investment Bank
EU	European Union
EUSBSR	European Union Strategy for the Baltic Sea Region
FPR	Fertilizer Products Regulation
GHG	Greenhouse Gases
GSC	Guiding Social Cost
HELCOM	Helsinki Commission
N	Nitrogen
NRI	Nutrient Recycling Impact
P	Phosphorus
PA Nutri	Policy Area Nutri
PFAS	Per- and polyfluoroalkyl substances
PLC	Pollution Load Compilation
P_2O_5	Phosphorus(V) Oxide, Phosphorus pentoxide
QA	Quality Assurance
RNF	Recycled Nutrient Fertilizers
SME	Small and Medium Enterprise
SOUP	Single Operation Unit Process
SPCR	Swedish Product Certification
SuMaNu	Sustainable Manure and Nutrient Management project
VAT	Value Added Tax

Executive Summary

The Baltic Sea Region continues to face severe eutrophication despite decades of nutrient load reductions. Achieving the goal of a Baltic Sea unaffected by eutrophication under the 2021 HELCOM Baltic Sea Action Plan (BSAP) requires accelerating the transition from a linear to a circular nutrient economy, replacing imported mineral fertilizers with safely recovered, regionally produced recycled nutrient fertilizers (RNFs). The HELCOM Baltic Sea Regional Nutrient Recycling Strategy (BSRNRS) provides the overarching framework (HELCOM, 2021b), supported at the EU level by the EU Strategy for the Baltic Sea Region (EUSBSR) Policy Area Nutri, Action 3.

This report identifies six priority areas, aligned with the six BSRNRS objectives, where targeted policy action can unlock systemic change: (1) establishing the BSR as a model area for harmonised nutrient recycling monitoring and data governance; (2) reducing the environmental footprint of agriculture through RNF adoption; (3) ensuring safe nutrient recycling through robust standards and contaminant governance; (4) closing knowledge gaps and raising awareness across the RNF value chain; (5) creating viable business models and investment conditions for the RNF market; and (6) improving cross-sectoral policy coherence and institutional coordination.

Across these objectives, 27 concrete policy recommendations are presented, each directed at identified decision-making levels (EU, national, regional or local) with guidance on implementation priority: near-term (0 to 3 years) or medium-term (3 to 7 years). A critical cross-cutting finding is that all challenges in the BSR are compounded by a lack of regulatory clarity and coherence within and across countries, combined with inadequate economic incentives, infrastructure gaps, and limited stakeholder engagement.

CiNURGi's own research, including the environmental, climate and socio-economic assessment of 11 bio-based fertilizer (BBF) value chains (Foged et al., 2026a), the analysis of end-user acceptance, market potential and policy barriers (Foged et al., 2026b), the industry standards work (Sindhøj et al., 2025), and CiNURGi biomass mapping (Luostarinen, 2025), provides the empirical backbone for these recommendations. Stakeholder engagement through project events in Denmark, Finland (Turku, November 2024, 32 participants), and Sweden (Borgeby Field Days 2024) has further informed the analysis.

Keywords: recycled nutrient fertilizers (RNFs); bio-based fertilizers (BBFs); circular economy; nutrient recycling; Baltic Sea; HELCOM; policy recommendations; Baltic Sea Regional Nutrient Recycling Strategy (BSRNRS), Baltic Sea Action Plan (BSAP)

Definitions

In the field of nutrient recycling, numerous regulations, projects, initiatives, and associations introduce a wide range of definitions, which are also used in this report.

- **Fertilising product** means a substance, mixture, micro- organism or any other material, applied or intended to be applied on plants or their rhizosphere or on mushrooms or their mycosphere, or intended to constitute the rhizosphere or mycosphere, either on its own or mixed with another material, to provide the plants or mushrooms with nutrients or improve their nutritional efficiency. This definition comes from the EU Fertilising Products Regulation (Regulation (EU) 2019/1009; EUR-Lex, 2019).
- **Soil improver (SI)** is an organic material substrate that maintains, improves or protects chemical, physical, physicochemical, or biological parameters (e.g. condition, fertility, and structure) of the soil, as defined in the EU Fertilising Products Regulation (Regulation (EU) 2019/1009; EUR-Lex, 2019).
- **Circular Fertilising Products**: Fertilizers derived from recovered nutrients, contributing to the circular economy by reducing reliance on synthetic inputs and minimising environmental impacts.
- **Nutrient Recycling (NR)** refers to the process of reusing biomass or nutrient-rich matter for plant use, as described in the HELCOM Baltic Sea Regional Nutrient Recycling Strategy (HELCOM, 2021b).
- **Nutrient Recovery**: The process of extracting, purifying, or concentrating nutrients from waste streams, making them suitable for reuse.
- **Recycled Nutrient Fertilizers (RNFs)** are fertilizers derived from recycled materials such as manure, organic waste, sewage sludge, or industrial byproducts, as defined in the CiNURGi (INTEREG BSR) project. RNF is the overarching term used throughout the report, covering all recycled nutrient fertiliser products regardless of origin or processing route.
- **Bio-Based Fertilizers (BBFs)** come from organic waste of plant, animal, or microbial origin. If less than 80-90% of their nutrients are bio-based, they are classified as "Partly Bio-Based," a definition supported by EU HORIZON (e.g. LEX4BIO) projects and the European Sustainable Phosphorus Platform (ESPP). The term "BBF" is used in the report only where the text refers specifically to bio-based fertilisers as a subcategory assessed in CiNURGi's value chain work (Foged et al., 2026a; Foged et al., 2026b), and is retained there to remain consistent with the source documents.
- **Alternative Fertilizers (AFs)** are derived from secondary raw materials and are recognised in EU HORIZON CL6 ZEROPOLLUTION projects such as FERTITEC and FERTICOVERY.

1 Introduction and Policy Context

1.1 The Baltic Sea Challenge

Eutrophication remains the most serious environmental threat to the Baltic Sea. According to the updated Baltic Sea Action Plan (BSAP) (HELCOM, 2021a), achieving clear water requires reducing phosphorus inputs by approximately 42 percent and nitrogen inputs by 18 percent relative to reference levels. Despite significant progress since the 1980s, including a 40 percent reduction in nitrogen and phosphorus discharges from point sources, total nutrient inputs to some sub-basins remain above Maximum Allowable Inputs, most notably for the Baltic Proper and the Gulf of Finland. Diffuse nutrient loading from agricultural sources is the largest remaining contributor to this excess. Nutrients lost to the environment represent both an ecological cost and a wasted resource: the BSR annually imports large quantities of mineral fertilizers while simultaneously losing recoverable nutrients from biomass streams to water bodies and the atmosphere.

1.2 The Strategic Framework

The HELCOM Baltic Sea Regional Nutrient Recycling Strategy (BSRNRS), adopted at the Lübeck Ministerial Meeting in October 2021, articulates a vision in which nutrients are managed sustainably in all HELCOM countries, securing the productivity of agriculture and minimising nutrient loss to the Baltic Sea environment through efficient use of nutrients and cost-effective nutrient recycling (HELCOM, 2021b). The Strategy is organised around six objectives covering the full nutrient recycling cycle, from monitoring and safe use to market development and policy coherence.

The BSAP's eutrophication segment includes measures that directly mandate progress on nutrient recycling: E32 (evaluation of mineral fertilizer substitution), E33 (development of safety requirements for recycled fertilizers by 2027), E35 (improving market conditions and incentives), and E36 (boosting cooperation and advisory services) (HELCOM, 2021a). At the macro-regional level, the EU Strategy for the Baltic Sea Region (EUSBSR, 2021) assigns responsibility to cross-border and cross-sectoral collaboration "Policy Area Nutri" (PA Nutri), Action 3, to develop and promote safe and sustainable nutrient recycling, positioning it as the key vehicle for delivering BSAP eutrophication goals.

The EU Fertilising Products Regulation (EU) 2019/1009 (FPR), which entered into force in July 2022, established a harmonised EU-wide framework for the marketing of fertilising products, including those derived from recovered wastes (EUR-Lex, 2019). However, the FPR's relevance in relation to CiNURGi's objectives is limited: it does not provide any definition of recycled nutrient fertilizers, does not clearly distinguish these from soil improvers, and is not primarily concerned with supporting bioeconomy transitions or developing circular economies, but rather with regulating the marketing of fertilising products on the EU single market.

1.3 The CiNURGi Contribution

CiNURGi (Circular Nutrients for a Sustainable Baltic Sea Region, Interreg BSR #C049) is a cross-sectoral, transnational project that links bioeconomy and circular economy principles around

nutrient recycling. It develops and promotes standards for safe and sustainable recycling of nutrients from agricultural, municipal, and industrial biomass streams, directly supporting the HELCOM Baltic Sea Action Plan (BSAP) (HELCOM, 2021a), the HELCOM Baltic Sea Regional Nutrient Recycling Strategy (BSRNRS) (HELCOM, 2021b), EUSBSR PA Nutri Action 3, and the EU Green Deal's Farm to Fork programme.

This report constitutes Deliverable D2.3 of CiNURGi. It draws on:

- Quantitative assessments of nutrient recycling potential from national biomass mapping (Luostarinen, 2025)
- Environmental, climate, and socio-economic assessment of 11 BBF value chains across the BSR, using the Single Operation Unit Process (SOUP) method purpose-built for CiNURGi (Foged et al., 2026a)
- Analysis of end-user acceptance, market potential, and policy barriers and incentives for the 11 value chains, drawing on stakeholder surveys and CiNURGi events in Denmark, Finland, and Sweden (Foged et al., 2026b)
- Draft industry standards for RNF quality assurance and safety developed under CiNURGi Task A1.2 (Sindhöj et al., 2025)
- Stakeholder workshops including the CiNURGi/PA Nutri/HELCOM Workshop (October 2025) and the Turku Agri-Environmental Knowledge Exchange Workshop (November 2024, 32 participants)
- Scientific literature, EU legal instruments, and HELCOM official documentation

1.4 Structure of This Document

The following sections address each BSRNRS objective in turn. For each objective, the BSRNRS objective statement is presented, followed by a fact-based background with references, the key challenges structured around verifiable evidence, and then the paired policy recommendations, each with identified actors and a timeframe. Section 8 presents concluding remarks and cross-cutting priorities.

2 Objective 1: Baltic Sea Region as a Model Area for Nutrient Recycling

BSRNRS Objective 1: The Baltic Sea region should become a model area for nutrient recycling, with sub-objectives covering: increasing nutrient use efficiency; increasing circulation of available nutrient resources and reducing nutrient inflows to the region; and utilising nutrient-rich organic residues from areas with high nutrient surplus for production of fertiliser products.

2.1 Background

The BSR possesses exceptional assets for becoming a global NR model: extensive time-series data from HELCOM's Pollution Load Compilation project, advanced marine ecosystem models, and a tradition of transnational cooperation through projects such as BONUS RETURN, Manure Standards, SuMaNu, and CiNURGi (Savchuk, 2018; Kuka et al., 2025). Agriculture is a source of much nutrient loading, while simultaneously needing nutrient inputs. Nutrient imbalances characterise many areas with nutrient surpluses linked to intensive livestock production in some areas and heavy dependence on imported mineral fertilisers in others (Foged et al., 2026a).

Becoming a model area requires harmonising the data landscape. BSAP action E32 calls for the evaluation of mineral fertilizer substitution by recycled nutrients (HELCOM, 2021a). The BSRNRS underlines the need to quantify national and regional nutrient recycling potentials. CiNURGi's biomass mapping work (Luostarinen et al., 2025) provides an initial evidence base but reveals significant national data gaps and methodological inconsistencies that prevent meaningful regional comparison. CiNURGi's own assessment of 11 BBF value chains, using the purpose-built SOUP method, demonstrated substantial variability in nutrient retention efficiency (NRI, ranging from −9% to 100%, average 47%) and environmental performance across value chains (Foged et al., 2026a).

2.2 Key Challenges and Policy Recommendations

C1 Fragmented regional/cross-border data, definitions, and monitoring systems

National data on nutrient-rich biomass sources, processing volumes, product qualities, and end uses are scattered, inconsistent, and incomplete across BSR countries. Countries apply different definitions of nutrient recycling, different reporting methodologies, and different data collection systems, making regional comparison difficult. No designated regional monitoring framework integrates land-based nutrient management with marine nutrient responses. The absence of harmonised data is identified as a primary barrier to closing the phosphorus loop in the BSR (Rosemarin & Ek, 2019; Neset et al., 2021). The CiNURGi biomass mapping exercise confirmed these gaps at the national level (Luostarinen, 2025). Relevant across all BSR countries.

R1.1 Establish a harmonised regional monitoring system for nutrient recycling

Governments should appoint an authority to maintain national nutrient flow datasets using harmonised definitions, indicators, and HELCOM PLC-aligned reporting methods. Monitoring

must include inventories of nutrient-rich biomass, treatment pathways, product qualities and volumes, and regional surplus-deficit patterns. Datasets should align with EU reporting to support BSAP tracking, and HELCOM should coordinate regional data aggregation.

Priority and actors: Near-term (0–3 years). Actors: national environment and agriculture ministries, HELCOM, and statistics agencies.

C2 Regulatory divergence within and across countries

Despite shared EU legislation, countries in the BSR apply regulations on waste separation, collection, processing, and reuse of nutrient-rich biomasses differently. Regulatory gaps and a lack of clarity exist not only between countries but within individual countries, in waste classification, end-of-waste criteria, and permitting procedures. Obtaining end-of-waste status is in some BSR countries complicated, not standardised, and the procedure is not harmonised, complicating cross-border trade in recycled fertilizer products, particularly those based on municipal and industrial wastes (Foged et al., 2026b). Relevant across all BSR countries.

R1.2 Harmonise regulatory frameworks for the collection, processing, and use of nutrient-rich biomasses

National governments should work toward alignment of definitions, contaminant limits, end-of-waste criteria, and permitting pathways for nutrient-rich biomasses across the BSR. Harmonised quality assurance systems and joint labelling standards would reduce investor uncertainty and enable cross-border movement of RNFs consistent with the EU FPR (Regulation (EU) 2019/1009; EUR-Lex, 2019). A dedicated HELCOM working group should coordinate regulatory harmonisation efforts. Actions taken already at the stage of collecting and processing biomass rich in nutrients increase control over the quality of the fertilizer products and the safety of their use.

Priority and actors: Near-term to medium-term. Actors: the national environment and agriculture ministries, European Commission, HELCOM.

C3 Economic barriers and low competitiveness versus mineral fertilizers

High investment needs, logistical complexity, and persistent cost differentials between RNFs and mineral fertilizers undermine market viability. CiNURGi's assessment of 11 BBF value chains found that only one achieves cost parity with mineral fertilizers under current market conditions, and the price farmers are willing to pay for nutrients in BBFs is close to half the price of nutrients in mineral fertilisers. (Foged et al., 2026a; Foged et al., 2026b). Relevant across all BSR countries.

R1.3 Strengthen economic incentives and market conditions

Financial instruments should be designed to bridge the cost gap between RNFs and mineral fertilizers, reflecting verified societal benefits (reduced nutrient losses, avoided mineral fertilizer imports, GHG reductions). CiNURGi's value chain assessments confirm that the highest societal benefits are achieved by prioritising value chains with strong N and P retention and those replacing practices with high nutrient losses, particularly in municipal and industrial waste sectors (Foged et al., 2026a). Recommended instruments include:

performance-based payments per kg of N or P recovered; investment grants targeting low-energy processing technologies; logistics support for storage, transport, blending, and application; and public procurement mandates for certified RNFs in green area management.

Priority and actors: Near-term. Actors: national finance and agriculture ministries, municipalities, EU (CAP and cohesion funds).

C4 Unequal access to nutrient recycling technologies

The availability and readiness of nutrient recovery technologies vary widely across the BSR. Diluted nutrient streams and uneven spatial distribution of recyclable biomasses create regional surplus-deficit patterns requiring processing infrastructure that does not yet exist at scale in many parts of the region. Phosphorus surplus areas in Denmark, Sweden, and Germany coexist with deficit regions, highlighting logistical challenges for transporting untreated organic wastes and the need for concentrated, transportable RNF products (Foged et al., 2026b; Luostarinen, 2025). Relevant across all BSR countries.

R1.4 Support technology development and redistribution infrastructure

Investment should target technologies that convert dilute biomasses into concentrated, standardised, and transportable products. Regional nutrient hubs, strategically located at wastewater treatment plants and organic waste processing facilities, can achieve economies of scale and integrate N and P recovery. CiNURGi biomass mapping data (Luostarinen, 2025) should guide infrastructure investment toward areas with the greatest potential to address surplus-deficit imbalances. This recommendation emphasises early strategic planning to optimise nutrient distribution and maintain balanced national N and P levels.

Priority and actors: Medium-term. Actors: national governments, utilities, the EU, private sector.

C5 Insufficient stakeholder engagement and public awareness

Farmers, operators, regulators, and technology providers often lack a comprehensive understanding of RNF benefits, risks, and practical requirements. CiNURGi stakeholder events, including Borgeby Field Days 2024 (Sweden) and the Turku Agri-Environmental Knowledge Exchange Workshop (Finland, November 2024), confirmed that public perception of recycled fertilizers, including concerns about safety and odour, limits societal support and slows market uptake (Foged et al., 2026b). Relevant across all BSR countries.

R1.5 Strengthen cross-sector advisory services and knowledge exchange

National advisory services should integrate RNF options into fertilisation planning tools and provide crop-specific guidance. Communication strategies should directly address the waste stigma barrier by emphasising independently verified agronomic performance, environmental safety, and economic benefits. Cross-sector platforms linking farmers, utilities, industry, researchers, and regulators should be supported to accelerate learning and align implementation practices.

Priority and actors: Near-term. Actors: national agriculture extension services, research institutes, HELCOM, and project networks.

C6 Absence of a coordinated long-term monitoring national-level system

No regional system currently exists to collect, update, and publish data on nutrient recycling potential and actual recycling rates, nor to facilitate cross-country comparisons. Without such a system, it is impossible to target interventions effectively, evaluate and measure effectiveness, or steer investment and policy toward national and BSAP targets. HELCOM's State of the Baltic Sea 2023 (HOLAS 3) highlights that the BSR's eutrophication status has shown no substantial improvement since the previous assessment period, underscoring the urgency of improved nutrient monitoring linked to recycling policy (HELCOM, 2023). Relevant across all BSR countries.

R1.6 Establish clear governance and financing mechanisms at the national level

Each BSR country should establish or update a coordination mechanism linking agriculture, environment, water, waste, and bioeconomy authorities, with clear mandates for nutrient recycling policy. A national nutrient recycling observatory function, whether a dedicated body or a designated ministerial unit, should maintain data, publish indicators, and propose adaptive policy adjustments. Financing frameworks should combine grants, blended finance, and results-based payments.

Priority and actors: Near-term to medium-term. Actors: national governments, inter-ministerial coordination bodies.

3 Objective 2: Reducing Environmental Impacts

BSRNRS Objective 2: Reduce environmental impacts, with sub-objectives covering: reducing nutrient losses to the Baltic Sea and closing nutrient cycles; reducing greenhouse gas emissions; reducing ammonia emissions; utilising appropriate solutions preventing environmental contamination; improving soil quality and carbon sequestration through organic fertilisers; and promoting site-specific optimised fertilisation plans.

3.1 Background

RNFs produced from organic side-streams, such as animal manure, sewage sludge, food waste, and biogas digestate, can partially substitute mineral fertilizers, thereby reducing the extraction of non-renewable phosphate rock and limiting energy-intensive mineral nitrogen synthesis. The environmental case for RNFs is strong but conditional: it depends critically on the baseline practice being replaced, the nutrient retention efficiency of the recovery process, and the energy demand of processing.

CiNURGi's value chain assessments (Foged et al., 2026a) demonstrate this clearly: value chains replacing incineration or landfilling of municipal waste streams, such as urine recovery, sewage sludge to biochar, and meat and bone meal pelletisation, consistently achieved the highest nutrient recycling impacts (NRI up to 100%) and the greatest socio-economic benefit. In contrast, value chains based on farming wastes such as digestate and manure, where the baseline is already direct field application, generally showed limited additional nutrient recycling benefit and, in some cases, negative NRI, because processing steps introduce losses without improving on what was already a nutrient-retaining practice. BBF production cannot be assumed to be environmentally beneficial by default; value chain selection and technology choice play a decisive role (Foged et al., 2026a).

HELCOM's Palette of Solutions (HELCOM, 2021c) highlights that while strict wastewater treatment effluent limits have reduced direct discharges, approximately 90 to 95 percent of influent phosphorus is typically shifted into sewage sludge, making safe phosphorus recovery from sludge a high-priority measure for both environmental and circular economy goals.

3.2 Key Challenges and Policy Recommendations

C7 Lack of harmonised methodology for measuring environmental benefits

No regional standard exists for quantifying and comparing the environmental performance of different RNF value chains. CiNURGi developed the SOUP (Single Operation Unit Process) method specifically to address this gap, enabling consistent cross-country comparison of nutrient recycling impact (NRI), direct emission impact (DEI), and guiding social cost (GSC) across 11 value chains (Foged et al., 2026a). The results confirm that performance varies strongly by feedstock, processing technology, and baseline practice replaced, with NRI ranging from −9% to 100% across the assessed cases. Without a harmonised methodology, evidence-based investment targeting across the BSR remains impossible. Relevant across all BSR countries.

R2.1 Develop a regional environmental performance framework for RNF value chains

National authorities and research bodies, coordinated through HELCOM and PA Nutri, should develop a harmonised methodology for measuring and comparing the environmental performance of RNF production and use, covering N and P retention, GHG emissions, ammonia volatilisation, and soil health impacts. CiNURGi's SOUP method provides a proof-of-concept basis for such a framework, and can be expanded to include relevant factors. This framework should guide the prioritisation of public investment toward value chains with the highest verified environmental returns, particularly those replacing high-loss baseline practices in the municipal and industrial waste sectors.

Priority and actors: Medium-term. Actors: research institutes, HELCOM, and national environment ministries.

C8 Insufficient integration of sludge and digestate into nutrient cycling

Sewage sludge and biogas digestate represent major secondary nutrient resources, yet regulatory barriers, safety concerns, and logistical constraints limit their safe and efficient return to agriculture across much of the BSR. HELCOM data show that strict wastewater treatment effluent limits have reduced direct discharges, but approximately 90 to 95 percent of influent phosphorus is typically captured in sewage sludge, which requires safe recovery routes (HELCOM, 2021c). The CiNURGi value chain assessment found that sludge-based chains replacing incineration (with sludge ashes going to landfill) deliver among the highest NRI and most favourable guiding social costs (Foged et al., 2026a). Country-specific variations apply, and the issue is more pronounced in some Baltic States.

R2.2 Establish safe and efficient recovery routes for sewage sludge phosphorus

Governments and wastewater utilities should invest in phosphorus recovery from sewage sludge, building on the framework of the EU Sewage Sludge Directive (Council Directive 86/278/EEC; EUR-Lex, 1986) and the FPR (Regulation (EU) 2019/1009; EUR-Lex, 2019). National roadmaps should define minimum phosphorus recovery rates for large wastewater treatment plants and clarify the end-of-waste classification of recovered phosphorus products.

Priority and actors: Near-term to medium-term. Actors: national environment ministries, wastewater utilities, European Commission.

C9 Regulatory disincentives favouring linear models.

In many BSR countries, regulations, tax systems, and subsidy structures create a competitive disadvantage for recovered secondary materials relative to primary mineral fertilizers, through complex and costly registration procedures and the absence of robust fiscal incentives (Foged et al., 2026b). Policy analysis confirms that failure to integrate the full set of HELCOM-prescribed agricultural measures into national legislation undermines BSAP goals and maintains structural barriers to nutrient recycling (Brady et al., 2022). Relevant across all BSR countries, with specific bottlenecks varying by country.

R2.3 Create a level regulatory and fiscal playing field for RNFs versus mineral fertilizers

National governments should review whether current subsidy structures, VAT rates, and registration requirements inadvertently undermine the socio-economic benefits of a given RNF relative to mineral fertilizers, and propose corrective measures where such disadvantages are documented.

Priority and actors: Medium-term. Actors: the national finance and agriculture ministries, European Commission.

C10 Absence of a regulatory definition distinguishing fertilizers from soil improvers

The EU Fertilising Products Regulation (EU) 2019/1009 does not provide a functional definition that distinguishes fertilising products with a primary nutrient supply role from soil improvers whose intended function is the physical or biological improvement of soil properties. This gap has direct consequences for nutrient recycling: where nutrient-rich organic wastes are processed into products classified or marketed as soil improvers rather than as fertilizers, the potential for nutrient recovery may be substantially undermined, since soil improvers are typically applied at doses calibrated to organic matter function rather than to nutrient supply, generally resulting in greater losses of nitrogen and phosphorus. CiNURGi's work on industry standards confirmed that this confusion is operationally significant: project partners applied the terms fertilizer, soil improver, and bio-based fertilizer inconsistently, impeding the development of common standards, comparable statistics, and achievable recycling targets (Foged, 2026; Sindhöj et al., 2025). Relevant across all BSR countries.

R2.4 Establish a clear regulatory definition distinguishing recycled nutrient fertilizers from soil improvers

The European Commission and BSR national governments should work toward a regulatory definition that functionally distinguishes fertilising products from soil improvers on the basis of their intended agronomic function and nutrient content. A working criterion proposed through CiNURGi's standards development work is that a bio-based fertilizer contains more plant-available N + P_2O_5 than the content of effective organic matter divided by 20 (Foged, 2026). Adopting such a definition would allow producers, regulators, and statisticians to categorise products consistently, and would provide the basis for nutrient recycling targets and monitoring frameworks that extend beyond the livestock manure sector. Definitions should align with the EU Soil Mission framework and inform revisions to the FPR and national waste classification systems. This recommendation concerns the regulatory classification and nutrient accounting of products, not the restriction of any specific treatment or processing technology. Composting and other processing pathways remain valid and valuable, provided that the resulting products are accurately classified according to their agronomic function and nutrient content.

Priority and actors: Near-term. Actors: European Commission, national agriculture and environment ministries, HELCOM.

C11 Insufficient farm-level accountability for nutrient losses prior to field application

In several BSR countries, regulatory frameworks for nitrogen management in livestock production are calibrated against manure values measured at the point of field application

(ex-storage), rather than at the point of excretion (ex-animal). This approach structurally excludes from accountability the nutrient losses occurring in animal housing and manure storage, which, even under good management, may reach approximately 30% of total excreted nitrogen, primarily through ammonia volatilisation. Some national systems further apply a partial nitrogen field-effect coefficient, making farms legally accountable for only a fraction of the nitrogen applied. These provisions create weak incentives for adopting best available technology for manure management and reduce the effective ambition of nutrient recycling targets. The issue is documented across BSR countries, with the specific regulatory mechanisms differing by country (Foged et al., 2026b). Relevant across all BSR countries, most pronounced where intensive livestock production coincides with weak agro-environmental enforcement.

R2.5 Move toward full farm-gate nutrient balance accountability

National governments should review whether current agro-environmental frameworks adequately incentivise the reduction of nutrient losses in animal housing and manure storage. Where national regulations account for nitrogen only at the ex-storage stage, or apply partial field-effect coefficients, governments should consider transitioning toward farm-gate nutrient balance requirements that make farms accountable for all nutrients entering the system. Such an approach would incentivise broader adoption of low-emission housing systems, covered storage facilities, and precision application technology, aligning national nitrogen governance more closely with HELCOM BSAP ambitions (HELCOM, 2021a) and with the principle of full nutrient cycle accountability.

Priority and actors: Medium-term. Actors: national agriculture and environment ministries, European Commission (Nitrates Directive review).

4 Objective 3: Safe Nutrient Recycling

BSRNRS Objective 3 / BSAP measure E33 (HELCOM, 2021a): Safety requirements for recycled fertilizer products should be developed by 2027. Nutrient recycling must minimise environmental and human health risks from contaminants, and knowledge sharing on safe practices must be improved across the region.

4.1 Background

Ensuring the safety of RNFs is a prerequisite for building user confidence and regulatory acceptance. The EU FPR (EU) 2019/1009, which entered into force in July 2022, establishes a harmonised framework for contaminant limits, CE marking, and labelling for fertilising products available on the EU single market (EUR-Lex, 2019). The EU Sewage Sludge Directive (Council Directive 86/278/EEC; EUR-Lex, 1986) and the Animal By-Products Regulation (Regulation (EC) No 1069/2009; EUR-Lex, 2009) provide additional safety governance. National regulated limits further add complexity, while none of these instruments is adjusted to the EU's recently introduced Soil Mission and its associated mapping of soil health.

CiNURGi's Task A1.2 has developed a quality assurance (QA) matrix and draft industry standards for RNF evaluation, covering hygienisation and stability, nutrient availability (N and P), contaminants (heavy metals, organic pollutants, antibiotics, physical impurities), and practical properties (storability, transportability, applicability) (Sindhöj et al., 2025). A key finding is that national frameworks across the BSR deviate significantly from the EU FPR baseline, fragmenting the market. For RNFs with low nutrient content and high logistics costs per nutrient unit, one-size-fits-all compliance burdens can raise unit costs and close otherwise viable markets, underscoring the need for proportionate, risk-based QA approaches (Sindhöj et al., 2025).

Voluntary quality assurance schemes, such as SPCR 120/152/178 in Sweden, Laatulannoite in Finland, and BGK in Germany, complement legislation with stricter contaminant limits and product transparency, and have demonstrated success in building market trust. Organic and emerging contaminants, including microplastics, PFAS, pharmaceuticals, antimicrobials, and novel compounds, remain poorly characterised in the regulatory frameworks of most BSR countries.

4.2 Key Challenges and Policy Recommendations

C12 Inadequate regulation and monitoring of emerging contaminants

Microplastics, PFAS, pharmaceuticals, antibiotics, antimicrobial resistance genes, and novel compounds are poorly regulated across BSR countries. Measurement methods are not harmonised. Current EU regulatory frameworks, including the Sewage Sludge Directive (Council Directive 86/278/EEC; EUR-Lex, 1986), are largely outdated and do not address growing concerns about these substances (Pozzebon & Seifert, 2023; Pepper et al., 2023). CiNURGi's A2.2 work found that some project-produced pellets had to be tested in greenhouse pot conditions rather than production fields due to cadmium content exceeding Polish and EU limits (6.6 ppm vs 5 ppm threshold), illustrating the real-world relevance of contaminant governance. Relevant across all BSR countries.

R3.1 Introduce a soil health-based regulatory framework for RNF field application

BSR countries should consider transitioning from purely product-based contaminant limits to a soil health-based regulatory approach, conditioning field spreading decisions on the receiving soil's contamination status. This approach aligns soil protection with principles already applied in water and air regulation and would align with the EU Soil Mission framework.

Priority and actors: Medium-term. Actors: national environment ministries, the European Commission, and research institutes.

C13 Knowledge gaps on long-term soil and health risks

Evidence on the long-term accumulation of contaminants in soils, crop uptake pathways, and ecosystem effects remains incomplete. As an example, research has demonstrated that past sewage sludge applications can result in macro- and microplastic contamination detectable in agricultural soils 30 years later (Weber et al., 2022). Risk-based spreading limits and application guidelines for many RNF categories cannot yet be robustly justified without further longitudinal research. Relevant across all BSR countries.

R3.2 Harmonise analytical standards and strengthen research on emerging contaminants

BSR countries and the European Commission should prioritise the development of harmonised analytical methods for microplastics, PFAS, pharmaceuticals, antimicrobial resistance, and transformation products. A coordinated BSR research programme on emerging contaminants in RNFs, funded through Horizon Europe or Nordic Council mechanisms, should be established, with results directly informing regulatory updates.

Priority and actors: Near-term. Actors: national research funding bodies, HELCOM, the European Commission, and research institutes.

C14 Variable product quality and insufficient safety assurance infrastructure

Production processes lack standardisation across RNF categories, resulting in inconsistent product quality and contaminant profiles. Transparent, harmonised labelling aligned with EU FPR standards is not universally applied. Certification schemes, particularly for organic farming compatibility, remain underdeveloped in several BSR countries. CiNURGi's QA matrix (Sindhöj et al., 2025) provides a practical tool for producers, researchers, and regulators to structure evaluation against consistent criteria. Country-specific variation is significant.

R3.3 Support long-term studies on soil accumulation and crop uptake

National and transnational long-term monitoring programmes should be established to track contaminant accumulation in agricultural soils receiving RNFs, crop uptake, and ecosystem effects. A regional knowledge platform should synthesise emerging evidence and translate findings into risk-based practical guidance for regulators and practitioners.

Priority and actors: Medium-term. Actors: research institutes, national environment and agriculture ministries, HELCOM.

C15 Weak preventive practices and cross-sector awareness

Source separation of contaminated and "clean" waste streams, exclusion of hazardous feedstocks, and adoption of best available techniques for contaminant minimisation are not consistently applied. Upstream source control, reducing contaminants entering organic waste streams at source, is the most cost-effective strategy for minimising public health and ecosystem risks associated with RNF use (Barquet et al., 2020; Pepper et al., 2023). Relevant across all BSR countries.

R3.4 Strengthen preventive measures to reduce contaminants entering biomass streams

National authorities should require improved source separation of contaminated waste streams, removal of packaging materials, and exclusion of hazardous feedstocks from RNF production pathways. Best available technique guidance for contaminant minimisation in organic wastes should be developed or updated and made readily accessible.

Priority and actors: Near-term. Actors: national environment agencies, industry associations, HELCOM.

R3.5 Establish harmonised quality assurance, labelling, and certification for RNFs

All BSR countries should work toward full implementation and consistent application of the EU FPR (Regulation (EU) 2019/1009; EUR-Lex, 2019) quality assurance and labelling requirements for CE-marked fertilising products. The CiNURGi QA matrix (Sindhøj et al., 2025) provides an immediately applicable tool for this purpose. To further support RNF market acceptance, the following additional voluntary information should be promoted: organic farming compatibility; assumed humification coefficient with scientific reference; nutrient availability data, including mineralisation rate for N and water-extractable P fraction; and practical guidance on storage, transport, and field spreading requirements. These labelling elements correspond directly to the quality declaration framework developed through CiNURGi's standards work (Foged, 2026). This recommendation emphasises the importance of maintaining quality standards and ensuring regulatory coherence at the EU level.

Priority and actors: Near-term. Actors: national agriculture ministries, industry associations, European Commission.

R3.6 Build stakeholder capacity and shared risk understanding

Targeted training programmes for farmers, operators, regulators, and technology providers should cover updated knowledge on contaminant risks, safe handling practices, and regulatory requirements. Communication should clearly distinguish between evidence-based risks and unfounded concerns.

Priority and actors: Near-term. Actors: national agricultural advisory services, industry, research institutes, HELCOM.

5 Objective 4: Knowledge Exchange and Awareness Raising

BSRNRS Objective 4: Knowledge on RNF production, properties, and safe use must be substantially improved and more equitably distributed across the BSR. Awareness among farmers, advisors, food chain actors, and policymakers must be raised to support informed decision-making and behavioural change.

5.1 Background

A lack of accessible, reliable, and actionable knowledge about RNFs constitutes one of the principal barriers to market uptake across the BSR. CiNURGi stakeholder consultations confirm that farmers remain the most critical target group: their acceptance of RNFs is decisively shaped by product quality certainty, cost competitiveness, independent safety certification, and practical agronomic guidance (Foged et al., 2026b).

CiNURGi's stakeholder engagement across the BSR, including farmer surveys in Sweden (Lima et al., 2024), Denmark (Thuesen et al., 2024), and Finland, the Borgeby Field Days 2024 (19,900 visitors, dedicated CiNURGi tent with farmer survey), and the Turku Agri-Environmental Knowledge Exchange Workshop (November 2024, 32 participants), generated consistent findings on what drives and constrains farmer acceptance. Key barriers identified were: price sensitivity relative to mineral fertilizers; uncertainty about nutrient release timing and consistency; practical challenges of storage, application, and equipment compatibility; and regulatory and certification uncertainty (Foged et al., 2026b). Consumer concerns influence the RNF market primarily indirectly, through food supply chain actors' reputational risk management rather than direct purchasing decisions.

5.2 Key Challenges and Policy Recommendations

C16 Data access and knowledge gaps across the value chain

Reliable, up-to-date data on nutrient-rich biomass availability and properties are not systematically accessible to RNF producers or policymakers. Industries and municipalities typically face no obligation to report on nutrient turnover in their waste streams. The BSAP identifies evaluation of mineral fertilizer substitution by recycled nutrients (E32) as a key measure, yet implementation is hampered by the absence of comprehensive national nutrient flow data (HELCOM, 2021a). Relevant across all BSR countries.

R4.1 Mandate transparent data reporting on nutrient turnover in waste and biomass streams

National legislation should require all industries and municipalities managing waste to report on nutrient content (N and P) in waste streams under their management. This data should be integrated into national nutrient flow monitoring systems (see R1.1) and made accessible to RNF producers and policymakers through a public platform.

Priority and actors: Near-term. Actors: the national environment and agriculture ministries, and regional authorities.

C17 Limited farmer acceptance and trust

Despite recognition of potential benefits, many farmers retain significant reservations about RNFs, principally concerning safety, agronomic performance consistency, application practicalities, and cost. CiNURGi's stakeholder events found that farmers consistently preferred pelletised or granulated RNFs and BBFs for their ease of storage, efficient transport, and compatibility with existing farm machinery (Foged et al., 2026b). Some food buyers do not allow the delivery of food from farmers who use sewage sludge (and other sewage products) on their land. Independent field trial evidence and trusted certification are the most effective trust-building mechanisms identified across the CiNURGi evidence base (Foged et al., 2026b). Relevant across all BSR countries.

R4.2 Enhance the digital fertilizer label with practice-relevant RNF information

Building on the mandatory labelling requirements of Regulation (EU) 2019/1009 (EUR-Lex, 2019) and the digital labelling framework of Regulation (EU) 2024/2516 (EUR-Lex, 2024), national authorities and industry associations should promote voluntary enhanced labelling for RNFs, including: organic farming approval status; nutrient availability indicators from independent analysis; humification coefficient; and practical guidance on storage, transport, and application equipment. The CiNURGi QA matrix (Sindhöj et al., 2025) provides the technical basis for identifying which information is most meaningful to farmers. The possibility of additional, voluntary labelling that goes beyond statutory requirements will present RNF as a product offering full information to the end user and will highlight the added value of the product, supporting awareness of its use within the circular economy.

Priority and actors: Near-term. Actors: national agriculture ministries, RNF producer associations, European Commission.

C18 Weak integration of RNFs into formal education and advisory systems

Nutrient recycling and RNFs are not consistently included in agricultural education curricula at secondary or tertiary level, nor in the continuing professional development of agricultural advisors. CiNURGi stakeholder engagement found that advisory tools and cross-sector learning platforms are essential for closing knowledge gaps among practitioners (Foged et al., 2026b). These findings align with research showing that knowledge gaps among practitioners, rather than a lack of technology, are the primary constraint on the adoption of recycling practices in agriculture (Stein-Bachinger et al., 2015). Relevant across all BSR countries.

R4.3 Integrate nutrient recycling into formal agricultural education and advisory training

Governments should work with agricultural education institutions to integrate RNF science and practice into curricula at secondary and tertiary levels, within soil science, plant nutrition, agricultural technology, waste management, and environmental protection courses. Continuing professional development programmes for agricultural advisors should include regularly updated modules on RNF properties, regulations, and practical guidance.

Priority and actors: Near-term to medium-term. Actors: national education ministries, agricultural universities, and farmer advisory bodies.

C19 Fragmented and uncoordinated research and project knowledge

BSR research on RNFs is conducted by many actors, but coordination between projects is limited. The SuMaNu platform synthesised over a decade of Interreg BSR project results to demonstrate that accumulated knowledge from projects such as Baltic Manure, Baltic Slurry Acidification, Manure Standards, and BONUS PROMISE is insufficiently reaching practitioners and policymakers (SuMaNu, 2021). Project achievements are often scattered across numerous reports, and knowledge does not reach the relevant stakeholders and decision-makers. Relevant across all BSR countries.

R4.4 Prioritise demonstration trials and farmer-to-farmer learning

Awareness campaigns should be grounded in independent field trial results, demonstrating crop yield, quality, and soil health outcomes from RNF use under real conditions. Farm demonstration networks, including open-field visits and farmer-to-farmer exchange, have been identified as the most effective mechanism for building trust and practical knowledge (Foged et al., 2026b). National subsidy schemes should provide incentives for farmers who host demonstration trials or contribute to learning networks.

Priority and actors: Near-term. Actors: national agriculture ministries, advisory services, research institutes, and farmer organisations.

R4.5 Create open-access knowledge infrastructure and multi-stakeholder platforms

Innovations, best available technique data, field trial results, and research outputs on RNFs should be systematically compiled and made publicly available through open-access platforms. Multi-stakeholder hubs linking farmers, SMEs, local authorities, and researchers at local, national, and regional levels should be established and supported. Research funding should require open-access publication and engagement with practitioner communities.

Priority and actors: Near-term to medium-term. Actors: national research funding bodies, EU (Horizon Europe), HELCOM, and project networks.

R4.6 Strengthen cooperation across research projects on RNFs

National and EU research funding bodies should introduce specific incentives for joint applications between projects addressing RNF-related challenges and require deliverables accessible to practitioners. A dedicated BSR knowledge exchange platform, possibly hosted by HELCOM or PA Nutri, should coordinate research activities, prevent duplication, and translate results into actionable policy guidance.

Priority and actors: Medium-term. Actors: European Commission, HELCOM, PA Nutri.

6 Objective 5: Creating Business Opportunities

BSRNRS Objective 5: Nutrient recycling should become a genuine driver of green economic growth in the BSR, generating viable business models, attracting private investment, stimulating innovation, and developing a functioning regional market for RNF products and technologies.

6.1 Background

The economic opportunity represented by nutrient recycling in the BSR is substantial but largely unrealised. Phosphate rock, the primary raw material for P fertilizers, is a critical raw material under EU classification. The EU imports over 90 percent of its supply, while domestic waste streams contain recoverable phosphorus that could cover an estimated 20 to 30 percent of EU demand (NUTRIMAN, 2022).

Despite this potential, the BBF market remains in the early stages of development. CiNURGi's assessment of 11 value chains found that only one achieves cost parity with mineral fertilizers under current conditions, and that fewer than half are socio-economically justified when accounting for full value chain costs (Foged et al., 2026a). Farmers' willingness to pay for nutrients in BBFs is approximately half the market price of equivalent nutrients in mineral fertilizers, creating a structural market gap that is partly technically driven and partly policy-driven, through the absence of instruments that internalise the environmental and societal value of nutrient recycling (Foged et al., 2026b). Closing this gap requires targeted policy instruments that redirect verified societal value to value chain operators, alongside continued technological optimisation and improved product quality.

6.2 Key Challenges and Policy Recommendations

C20 Underdeveloped and fragmented RNF market

The BSR RNF market is underdeveloped: products are typically more expensive than mineral fertilizers, less predictable in performance, and more difficult to apply. Uniform quality standards are missing. Socio-economic values are not transferred to value chain actors, and market instability discourages investment. Systems to reward those who contribute to nutrient recycling and the ecosystem services they deliver to society are not yet in place (Foged et al., 2026b). These challenges are observed in individual Baltic Sea Region countries to varying degrees, and they discourage entrepreneurs from increasing activity in the RNF market; for example, Marcinek & Smol (2025) indicate that barriers specific to Poland include high production costs, limited infrastructure, and regulatory uncertainty. Relevant across all BSR countries.

R5.1 Implement harmonised regulatory frameworks to enable cross-border RNF trade

Common quality standards, streamlined registration procedures, and agreed rules for cross-border RNF trade should be developed through HELCOM's regulatory coordination function, building on the EU FPR framework and the BSR harmonisation needs identified in CiNURGi's policy analysis (Foged et al., 2026b). Regulatory alignment in this area will directly strengthen

the credibility and recognition of RNFs in terms of quality and will increase their cross-border mobility.

Priority and actors: Near-term to medium-term. Actors: national governments, European Commission, HELCOM.

C21 High investment costs and inadequate support mechanisms

Nutrient recovery technologies require significant capital investment. In a performed assessment of 11 value chains, CiNURGi found that net value chain costs average approximately 1,073 EUR per 1,000 kg N+P processed, and that only five of the eleven assessed value chains delivered positive societal returns (Foged et al., 2026a). Available support mechanisms are often short-term, insufficiently scaled, or poorly adapted to the cross-sectoral nature of nutrient recycling ventures. Access to testing, certification, and research infrastructure is particularly limited for SMEs and start-ups. Relevant across all BSR countries.

R5.2 Establish a comprehensive and long-term RNF investment support framework

Governments should develop multi-instrument, long-term support frameworks that reduce investment risk at each stage of the RNF value chain. The instruments should be designed to redirect to value chain operators the verified societal benefits they generate, including reduced nutrient losses, avoided GHG emissions, and displacement of mineral fertilizer imports, regardless of the specific technology or facility type involved (Foged et al., 2026a). Recommended instruments include: investment grants for RNF production, processing, and logistics infrastructure; operational support or tax credits differentiated by verified environmental performance; purchase incentives for farmers, such as vouchers, rebates, or tax relief on RNF purchases; funding for testing, certification, and demonstration activities; carbon and nutrient credit schemes rewarding verified nutrient retention and GHG emission reductions; and public procurement mandates requiring certified RNFs in municipal landscaping, urban greening, and public land management.

Priority and actors: Near-term. Actors: national governments, EU (CAP, Cohesion Policy, EIB instruments), municipalities.

C22 Infrastructural and logistical bottlenecks

Effective nutrient recycling requires facilities for separation and P recovery, as well as logistics chains for biomass collection and RNF distribution. Transport costs for bulky, low-concentration materials can exceed the market value of recovered nutrients, requiring either local processing capacity or investment in nutrient concentration technology. The regional surplus-deficit imbalance in the BSR is a structurally documented constraint (SuMaNu, 2021; Luostarinen et al., 2021). The need for concentrated, transportable RNF and BBF products is confirmed by farmer preference data (Foged et al., 2026b). More acute in specific Baltic country regions.

R5.3 Develop regional nutrient logistics and processing infrastructure

Strategic investment in regional nutrient processing hubs, located where organic waste concentrations and redistribution needs are greatest, as identified in CiNURGi's biomass mapping (Luostarinen, 2025), should be supported through public co-financing and public-private partnerships. Infrastructure planning should prioritise technologies that concentrate nutrients for long-distance transport, enabling surplus-to-deficit redistribution across the BSR. This approach aims to eliminate increases in RNF costs resulting from the logistical challenges associated with the local concentration of nutrients and the varying mobility of fertilizer products determined by their nutrient content.

Priority and actors: Medium-term. Actors: national governments, regional authorities, utilities, and EU Cohesion Policy.

C23 Fragmented and inconsistent regulations impeding cross-border trade

Divergent national regulations on waste classification, product registration, and end-of-waste criteria hinder cross-border trade and the development of shared regional standards. The CE-marking process under the EU FPR involves high costs, particularly burdensome for small-scale producers, further restricting market access for innovative RNF products (Foged et al., 2026b; Neset et al., 2021). Relevant across all BSR countries.

R5.4 Increase dedicated research and innovation funding for RNF technologies

National and EU research funds should increasingly target funding for development and pilot-scale testing of advanced RNF technologies, with specific provisions for SME and start-up participation. Access to shared research, testing, and certification infrastructure should be expanded and co-financed by public funds. Funding criteria should explicitly reward cross-sector collaboration and open-access knowledge outputs.

Priority and actors: Near-term to medium-term. Actors: national governments, European Commission (Horizon Europe), and industry associations.

R5.5 Strengthen cross-sectoral partnerships and regional circular economy clusters

Existing regional circular economy clusters, industrial symbiosis networks, and working groups should be leveraged and supported to facilitate joint investment, shared business models, and knowledge exchange across agriculture, water and wastewater, food industry, and technology sectors. Support instruments should explicitly reward cross-sector partnership applications with verified environmental and economic impact.

Priority and actors: Medium-term. Actors: national governments, the EU, regional authorities, private sector.

R5.6 Integrate RNF use into CAP instruments and national farm advisory services

CiNURGi's policy analysis found that possibilities for offering financial incentives for nutrient recycling as part of CAP measures are given low or no prioritisation in most BSR Member State Strategic Plans (Foged et al., 2026b). EU Member States should explore and deploy available options within the CAP eco-scheme and agri-environment-climate measure frameworks to reward farmers for using certified RNFs, creating demand-side pull, and complementing supply-side investment support. National farm advisory services should be adequately funded

and trained to advise farmers on RNF substitution options within holistic nutrient management plans.

Priority and actors: Near-term (CAP programming period 2023–2027). Actors: national agriculture ministries, European Commission (DG AGRI), and farm advisory services.

7 Objective 6: Improving Policy Coherence

BSRNRS Objective 6: Effective nutrient recycling requires coherent, coordinated, and complementary policy frameworks across agriculture, environment, water, waste, energy, and trade. Regulatory fragmentation and conflicting incentives must be resolved at both national and regional levels.

7.1 Background

CiNURGi's policy analysis identified six major regulatory barriers affecting the 11 assessed BBF value chains: complex approval processes under the EU Organic Farming Regulation (Regulation (EU) 2018/848; EUR-Lex, 2018); costly and time-consuming CE-marking under the FPR (Regulation (EU) 2019/1009; EUR-Lex, 2019); non-harmonised end-of-waste criteria under the Waste Framework Directive (Directive 2008/98/EC; EUR-Lex, 2008); insufficient fiscal incentives; the outdated Sewage Sludge Directive (Council Directive 86/278/EEC; EUR-Lex, 1986); and inadequate implementation of nutrient recycling ambitions in Member State CAP Strategic Plans (Foged et al., 2026b). Across these barriers, the consistent finding is not simply that different countries have different rules, but that regulatory fragmentation and lack of clarity exist within individual countries as well as between them, across the interfaces between waste law, fertilizer law, agricultural support, and environmental protection.

The same policy analysis identified five active incentives, including the EU Green Deal's Farm to Fork targets, the revised Urban Wastewater Treatment Directive's phosphorus recovery requirements, the EU Organic Farming Regulation's support for certain recycled inputs, the critical raw materials designation of phosphorus, and the EU Carbon Removals and Carbon Farming Certification framework, but found that regulatory barriers systematically outweigh these incentives across most assessed value chains (Foged et al., 2026b). Resolving this incoherence is the central challenge of Objective 6.

7.2 Key Challenges and Policy Recommendations

C24 Incoherence across sectoral legislation at EU and national levels

Nutrient recycling sits at the intersection of waste law, fertilizer law, agricultural policy, water policy, and energy policy, each governed by different EU directives and transposed differently across Member States. This creates regulatory gaps where products or processes fall between frameworks, and contradictions where requirements in one sector create barriers in another. The absence of a dedicated EU policy instrument for bio-based fertilizers is a structural gap (Foged et al., 2026b). Relevant across all BSR countries.

R6.1 Establish inter-ministerial coordination mechanisms for nutrient recycling policy

Each BSR country should establish or formalise a coordination mechanism that brings together ministries responsible for agriculture, environment, water, waste, energy, and trade to develop coherent national nutrient recycling strategies. These mechanisms should be mandated to resolve regulatory contradictions identified in national frameworks, drawing on the barrier analysis in CiNURGi's policy work (Foged et al., 2026b) as a starting point.

Priority and actors: Near-term. Actors: national governments, inter-ministerial coordination bodies.

C25 HELCOM-prescribed measures are insufficiently integrated into national legislation

Policy analysis confirms that failure to integrate the full set of HELCOM-prescribed agricultural measures into national legislation undermines BSAP goals and maintains structural barriers to nutrient recycling (Brady et al., 2022). The gap between regional strategic commitments adopted at the Lubeck Ministerial level and their operational implementation in national legislation and CAP Strategic Plans indicates that important elements of nutrient recycling policy are not yet sufficiently integrated, harmonised, or consistently implemented across the BSR.

R6.2 Accelerate national implementation of BSAP nutrient recycling measures

National governments should undertake systematic reviews of their transposition of BSAP eutrophication measures E32, E33, E35, and E36 into national legislation and CAP Strategic Plans (HELCOM, 2021a), with HELCOM providing a coordination and peer-review function. Implementation gaps should be reported publicly and remedied within defined timeframes, with HELCOM's Contracting Party review process used as an accountability mechanism.

Priority and actors: Near-term to medium-term. Actors: the national environment and agriculture ministries, HELCOM.

C26 Insufficient coordination between EU-level and regional policy instruments

The EU's Green Deal ambitions for nutrient recycling, including the Farm to Fork target of a 20 percent reduction in fertilizer use and a 50 percent reduction in nutrient losses by 2030, are not yet operationally connected to HELCOM's BSRNRS objectives and BSAP measures. PA Nutri Action 3 is mandated to deliver this connection but requires stronger institutional support. Relevant across all BSR countries.

R6.3 Strengthen the PA Nutri coordination function and resource base

The PA Nutri should be adequately resourced and empowered to coordinate between EU-level instruments (Green Deal, Farm to Fork, FPR, revised Sewage Sludge Directive) and HELCOM's BSRNRS implementation. PA Nutri should develop a monitoring framework that tracks progress against both EU and HELCOM targets for nutrient recycling across BSR countries.

Priority and actors: Near-term. Actors: PA Nutri coordinators, European Commission, HELCOM, and national governments.

R6.4 Develop a BSR roadmap for nutrient recycling policy convergence

Drawing on CiNURGi's evidence base, including the SOUP-based value chain assessments, the barrier-incentive matrix, and the stakeholder engagement findings, HELCOM and PA Nutri should jointly develop a BSR Nutrient Recycling Policy Roadmap that sets out concrete milestones for regulatory harmonisation, market development, and monitoring system establishment, with assigned responsibilities and review timelines aligned with the BSAP 2027 targets. The roadmap should incorporate a principle that public subsidies and fiscal incentives

for nutrient recycling value chains are conditioned on demonstrated positive socio-economic returns, as evaluated through tools such as the CiNURGi BBF evaluation tool (Foged, Sylwan, & de Morais Lima, 2026).

Priority and actors: Medium-term. Actors: HELCOM, PA Nutri, national governments, European Commission.

8 Conclusions and Cross-Cutting Priorities

The 27 recommendations presented in this report collectively constitute a roadmap for accelerating the transition to a circular nutrient economy in the Baltic Sea Region, aligned with the HELCOM Baltic Sea Action Plan (BSAP) (HELCOM, 2021a), the HELCOM Baltic Sea Regional Nutrient Recycling Strategy (BSRNRS) (HELCOM, 2021b), and the EU Green Deal's Farm to Fork programme. Delivering on this roadmap requires action across all six BSRNRS objectives, but several cross-cutting priorities stand out as particularly foundational.

P1 Regulatory clarity and coherence, within and across countries

The single most pervasive barrier identified across all objectives is the lack of regulatory clarity, not only between countries but within individual national frameworks, on waste classification, end-of-waste criteria, permitting, and quality standards. CiNURGi's policy barrier analysis found that the CAP implementation gap (B6) and fiscal incentive deficit (B4) affect all 11 value chains assessed in CiNURGi, while the Sewage Sludge Directive (B5), Organic Farming Regulation (B1), FPR complexity (B2), and non-harmonised end-of-waste criteria (B3) affect those involving municipal and industrial waste streams most severely (Foged et al., 2026b). Policy coherence within countries (R6.1, R6.3) and harmonisation across the BSR (R1.2, R5.1, R6.2) are the highest-priority systemic interventions.

P2 Economic incentives that reflect real environmental value

RNFs systematically lose to mineral fertilizers on price and predictability in the current market. CiNURGi's value chain assessment quantified this gap: the price farmers are willing to pay for nutrients in BBFs is close to half the price of nutrients in mineral fertilisers. On the other hand, the social and economic cost of producing BBFs is higher than the prices of mineral fertilisers, and the gap is partly policy-caused through the absence of instruments that internalise verified environmental benefits (Foged et al., 2026a; Foged et al., 2026b). Corrective economic instruments, including performance-based payments, investment support, purchase incentives, and public procurement mandates, are essential to bridge this gap (R1.3, R5.2, R5.6, R6.3). These instruments should be directed at value chains demonstrating verified environmental performance, not at specific facility types or technologies.

P3 A harmonised regional monitoring and data infrastructure

Without comparable, reliable data on nutrient flows, recycling potential, product quality, and environmental performance, it is impossible to track BSAP progress, target investments, or evaluate policy effectiveness. CiNURGi's biomass mapping (Luostarinen, 2025) and the SOUP-based value chain assessment (Foged et al., 2026a) have contributed the first systematic cross-country evidence base, but the data gaps and methodological inconsistencies they revealed confirm that a permanent regional monitoring framework (R1.1, R6.4) is a prerequisite for all other interventions.

P4 Farmer trust as the decisive market development lever.

Farmers remain the ultimate gatekeepers of the RNF market. CiNURGi's stakeholder evidence shows that trust is built primarily through: RNFs product qualities that better meet farmer valuation criteria; independent quality certification; transparent labelling; accessible field trial results; and integrated advisory support (Foged et al., 2026b). Developing RNF products that meet farmer needs is as important as the policy framework and should be treated as a parallel strategic priority alongside regulatory and economic interventions (R3.5, R4.2, R4.3, R4.4).

Operationalisation of these recommendations will require the commitment of national governments and relevant EU institutions, sustained investment in research, infrastructure, and advisory capacity, and continued transnational collaboration through HELCOM, PA Nutri, and the network of BSR Interreg projects. CiNURGi commits to supporting the dissemination of these recommendations to relevant policymakers at national and EU levels, and to facilitating their uptake through ongoing stakeholder engagement.

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