



<b>EU consultations .....</b>	<b>1</b>
<i>EU consultation on sustainable aquaculture</i>	1
<i>EU consultations on agriculture policy (CAP)</i>	1
<i>EU consultation on environmental product claims</i>	2
<b>Information and events .....</b>	<b>2</b>
<i>European Research &amp; Innovation Days</i>	2
<i>EU mission on "Soil health and food" Mission</i>	2
<i>IFS agronomics webinars</i>	2
<i>Webinar on Nutrient recycling in the Baltic Sea Region</i>	2
<i>Sustainable Phosphorus Alliance Forum</i>	3
<i>Phosphorus Transport Modeling Group</i>	3
<b>Calls for materials for testing .....</b>	<b>3</b>
<i>Looking for samples: fertiliser testing of iron phosphate</i>	3
<i>Looking for biostimulant or iron releasing products for testing</i>	3
<b>ESPP members .....</b>	<b>3</b>
<i>UK Water Industry Research (UKWIR)</i>	3
<i>LCA of enhanced struvite recovery</i>	3
<i>Yara sustainable initiatives in Finland and Sweden</i>	4
<b>Policy .....</b>	<b>4</b>
<i>EU "Safemanure" (RENURE) report published</i>	4
<i>Mineral fertilisers recovered from manures not addressed</i>	4
<i>ESPP input to the EU on the Urban Waste Water Treatment Directive</i>	5
<i>Societal costs of eutrophication in Lake Erie</i>	5
<i>Limited effectiveness of detergent P bans</i>	5
<i>Irish Nutrient Platform launch webinar</i>	5
<i>How effective is phytase in pig feed?</i>	6
<b>Research .....</b>	<b>6</b>
<i>Call for papers: Sustainable phosphorus use in agriculture</i>	6
<i>Phosphorus flows in Brussels</i>	6
<i>LCA of enhanced struvite recovery</i>	6
<i>Review of struvite LCA studies</i>	7
<i>Struvite safety</i>	7
<i>Solubility of feed phosphates and overall P use efficiency</i>	7
<i>Microalgae to remove and recycle nutrients from digestates</i>	8
<i>Baltic BONUS RETURN final webinar</i>	8
<i>Technologies for nutrient management in the Baltic</i>	8
<b>Stay informed.....</b>	<b>9</b>
<b>ESPP members .....</b>	<b>9</b>

## EU consultations

### EU consultation on sustainable aquaculture

The EU has opened a public consultation on EU Strategic Guidelines for Aquaculture, **open to 27<sup>th</sup> October 2020**. The current Guidelines ([COM\(2013\)229](#)) are misleadingly titled "Sustainable Development of EU Aquaculture), whereas in fact they address only competitiveness (simplification of licensing, marketing, level playing field) and facilitating implantation (spatial planning). ESPP submitted to the prior Roadmap consultation suggesting to include nutrient efficiency of aquaculture feed and nutrient footprints (making the link to the nutrient strategy proposed in Horizon Europe) and underlined the need to reduce nutrient losses from both offshore and fresh water aquaculture and to develop nutrient recycling. Sustainability and fish feed do appear in the short online questionnaire for the current consultation.

EU consultation on aquaculture [HERE](#)

### EU consultations on agriculture policy (CAP)

The European Commission has opened, **to 22<sup>nd</sup> October 2020**, three public consultations on the impacts of EU agriculture policy on water, on habitats / landscape / biodiversity and on sustainable management of soil. The objective is to assess the impacts of the CAP (Common Agricultural Policy), as per the 2013 reform, which includes the obligation for farmers (condition of subsidies) to respect mandatory rules ("cross-compliance"), including both statutory management requirements (SMR) and standards of good agricultural and environmental conditions (GAEC). Additionally, there exist voluntary agri-environment-climate measures (AECM) and subsidies for farmers in areas subject to natural constraints (Natura 2000, Water Framework Directive restrictions). The consultation consists of a public questionnaire asking whether respondents consider that the CAP



contributes to different environmental objectives and questions on effectiveness or unintended consequences of CAP measures.

EU public consultations open to 22<sup>nd</sup> October 2020 on the impacts of the Common Agricultural Policy on [water](#), on habitats, landscapes and [biodiversity](#), and on sustainable management of [soil](#).

## EU consultation on environmental product claims

An EU public consultation is **open to 3<sup>rd</sup> December 2020** on “Substantiating claims of environmental performance for products, services and businesses”. This targets PEFs (Product Environmental Footprints) but also addresses ecolabels, greenwashing, environmental performance reporting, sustainability ratings, harmonisation of environmental information. The consultation aims to respond to the aim of establishing “labelling on the sustainability performance of food products” announced in the Farm-to-Fork Strategy. The announced objective is to identify policy options for substantiating environmental claims using Environmental Footprint methods. The online questionnaire addresses, in detail, what types of environmental claims should be authorised and under what conditions, how environmental footprint results should be communicated, how claims should be verified (conformity assessment).

EU consultation on product environmental claims and PEFs (Product Environmental Footprints) [HERE](#)

## Information and events

### European Research & Innovation Days

This EU annual event (this year virtual, [22-24 September 2020](#)) aims to make links between policymakers, researchers and stakeholders to shape the future of R&I in Europe. The event’s ten virtual ‘hubs’ include Green Deal, Missions and Horizon Europe. The programme includes, 22 September Green Deal Hub: 12h45-13h30 **Uncrossing Planetary Boundaries: How to get nutrient flows back within safe ecological limits?** and 14h-15h **Workshop on Circular and Bio-based: towards a carbon neutral and sustainable economy**

Programme and registration [here](#)

### EU mission on “Soil health and food” Mission

An [interview](#) of the chair of this Horizon Europe R&D “Mission”, Cees Veerman, suggests that the Mission seems to have changed its name to “Caring for soil is caring for life” and that there now seems to be now no content directly addressing food (other than that healthy soil is important for food production). The Mission now seems to be entirely orientated towards soil quality. (other than that healthy soil is important for food production). A short and confidential consultation (not announced on the EU’s public consultation website, 1<sup>st</sup> to 14<sup>th</sup> September 2020 only) [HERE](#) and [#MissionSoil](#) called for ideas for this Mission inviting submission of up to 5 short idea “proposals” (actions, priorities) to address soil health, and inviting to vote on proposals already on line. An [interview](#) of chair of the Mission Board, Cees Veerman, indicates that the Mission seems to have changed its name to “Caring for soil is caring for life” and there now seems to be now no content directly addressing food in the mission, which seems entirely orientate towards soil (other than that healthy soil is important for food production).

Online consultation [HERE](#) and [#MissionSoil](#)

### IFS agronomics webinars

To replace the annual Cambridge agronomy conference, the International Fertiliser Society (IFS) is organising a series of webinars, to February 2021, covering themes such as P availability and depletion in soil (2<sup>nd</sup> October), fertilisers from recycled materials (10<sup>th</sup> November), digital tools and soil nutrient sensors, accurate fertiliser application, nitrogen fertilisation of cereals, soil boron, ...

“Phosphorus (P) availability during the depletion of soil P”, Sophie Nawara, Fien Amery, Hilde Vandendriessche, Roel Merckx and Erik Smolders, Friday 2<sup>nd</sup> October 14h00 CEST

“Exploring variations in demand for fertilisers derived from recycling in NW Europe” and “New developments in the production of plant-available phosphorus from abattoir waste”, Romke Postma, Martin Blackwell, Tegan Darch, Tuesday 10<sup>th</sup> November 14h00 CEST

Full details of IFS webinar series (programme and registration): [HERE](#)

### Webinar on Nutrient recycling in the Baltic Sea Region

Organised in the framework of the [11<sup>th</sup> Annual Forum](#) of the EU Strategy for the Baltic Sea Region (EUSBR), with [SuMaNu](#) and [BSAG](#), this workshop will discuss input to the HELCOM Regional Nutrient Recycling Strategy to be adopted in 2021, including eutrophication mitigation, manure management, Circular Economy and links to climate change. Breakout groups will address markets for recycled fertiliser products, cooperation in P management in the Baltic region and reducing contaminants in sewage to ensure safety of recycled nutrient materials.

Webinar workshop: “Unlocking the nutrient recycling potential in the Baltic Sea Region” (SuMaNu – EU SBRS):

**30<sup>th</sup> September 2020, 13h-15h30 CET – [programme and registration](#)**

HELCOM Regional Nutrient Recycling Strategy: see presentation by Marja-Liisa Tapio-Biström, Finland Ministry for Agriculture, at the 12<sup>th</sup> HELCOM Meeting of the Working Group on Reduction of Pressures from the Baltic Sea Catchment Area 21/4/2020 [HERE](#)

## Sustainable Phosphorus Alliance Forum

The SPA's annual Forum is this year virtual, **30<sup>th</sup> September and 1<sup>st</sup> October**, 12h-15h00 EST. This year's programme addresses regulation of recycled nutrient products, nutrient recovery operation, climate change and eutrophication, pay-for-performance nutrient pollution mitigation, phosphorus transport modelling ...

*Sustainable Phosphorus Alliance Forum 2020, 30<sup>th</sup> September and 1<sup>st</sup> October, 12h-15h00 ET (New York time) on both days. [HERE](#).*

## Phosphorus Transport Modeling Group

The Sustainable Phosphorus Alliance Phosphorus Transport Modeling Group brings together researchers and practitioners to discuss use and improvement of soil, water and watershed P transport models, such as Annual Phosphorus Loss Estimator Tool (APLE) or Soil and Water Assessment Tool (SWAT). The group's second meeting in late 2019 identified the need to cross-validate models, to integrate across scales and to compare with real edge-of-field P runoff data.

*Sustainable Phosphorus Alliance Phosphorus Transport Modeling Group [HERE](#) and summary November 2019 meeting [HERE](#).*

## Calls for materials for testing

### Looking for samples: fertiliser testing of iron phosphate

The University of Seville is interested in samples of iron (II) phosphate (vivianite), which can form spontaneously in sewage works or in anaerobic digesters, for pot and field fertiliser tests. The objective, part of the EU-funded [P-TRAP](#) project, is to assess whether this form of iron phosphate can provide plant available phosphorus or iron to crops.

Contact [tayeyemi@us.es](mailto:tayeyemi@us.es)

### Looking for biostimulant or iron releasing products for testing

The University of Vienna is looking for biostimulant products possibly able to release phosphorus from iron in soils (certain ligands, humic substances, siderophores ...) for testing. As part of the EU-funded [P-TRAP](#) project, the objective is to identify products or chemicals which can be used to improve the fertiliser value of secondary materials containing iron phosphates (e.g. iron materials after use in phosphorus traps, sewage sludge from works operating chemical P-removal), or to deliver to crops in a combined fertilising product containing both iron phosphate (possibly as iron (II) phosphate, vivianite) and an iron-accessing biostimulant.

Contact [rouven.metz@univie.ac.at](mailto:rouven.metz@univie.ac.at)

## ESPP members

### UK Water Industry Research (UKWIR)



The UK & Irish water industry's joint research organisation, UKWIR, has joined ESPP. UKWIR is the national research organisation serving all the water companies in the UK & Ireland. Our members are the 19 water companies of England, Scotland, Wales, Ireland and Northern Ireland. Our research covers the whole managed water cycle and aligns well with the activities of ESPP in a number of key areas. In particular, how do we maximise recovery of useful resources and achieve zero waste?. Also, how will we deliver an environmentally sustainable wastewater service that meets customer and regulator expectations?. Maximising recovery

of phosphorus from wastewater, and limiting its use in the treatment and distribution of potable water, are real challenges for the water industry as a whole, here and world-wide. UKWIR is therefore keen to collaborate in new research projects through ESPP and learn from ESPP's member organisations and network both in Europe and around the world.

[www.ukwir.org](http://www.ukwir.org)

### LCA of enhanced struvite recovery

As part of the [LIFE ENRICH](#) project ([ESPP member](#)), a Life Cycle Analysis study compares two scenarios for struvite recovery before anaerobic digestion in a sewage works operating biological phosphorus removal (EBPR) in the Murcia-Este WWTP, Spain. In the first scenario WAS (waste active sludge) is thickened using dissolved air flotation and fermented during 24 h to maximize poly-P release then elutriated in gravity thickeners with primary sludge. Struvite recovery from the overflow was modelled, considering different thickening and mixing rates. In a second scenario, WASSTRIP-based phosphorus release was modelled: primary sludge was fermented to generate volatile fatty acids then mixed with WAS in anaerobic P-release tanks and the resulting soluble-P enriched solution, after dewatering, was sent to the struvite precipitation. The different scenarios were evaluated for the LCA based on real data from the existing WWTP and modelling of different configuration changes. The

modelling concludes that under the elutriation scenario around 43% of influent phosphorus (P inflow to the WWTP) could be recovered as struvite, increasing to 48% with WASSTRIP. Greenhouse effect and total costs (TAEC, per m<sup>3</sup> wastewater treated), related to the sludge line operation, were modelled to be respectively 2% and 18% lower with struvite recovery via elutriation than without struvite recovery, whereas they were both higher with the WASSTRIP-based configuration compared to without struvite recovery.

*“An integral approach to sludge handling in a WWTP operated for EBPR aiming phosphorus recovery: Simulation of alternatives, LCA and LCC Analyses”, M. Roldan et al., Water Research 175 (2020) 115647 [DOI](#)  
For further information, LIFE ENRICH project [website](#)*

## Yara sustainable initiatives in Finland and Sweden

Finland-based, global fertiliser company (and [ESPP member](#)) has launched in Finland a 100% recycled, organic granular fertiliser product, eligible for Organic Farming. BIO 8-4-2 (NPK) is recommended as a supplementary fertiliser for all crops, for spring or autumn application, including for oilseeds, cereals, grassland, potatoes ... 60% of P-content is calculated as plant accessible, and soil moisture facilitates nutrient release. Yara has also announced, with Lantmännen, a pilot project to use renewable energy for mineral fertiliser production, with the aim of reducing total CO<sub>2</sub> impact of cereals by -20%. By working with the whole food chain, the objective is to reduce climate impact whilst minimising the price impact for consumers, despite the higher cost of renewable energy. Lantmännen is an agricultural cooperative of 25 000 Swedish farmers, with 10 000 staff and operations in 20 countries, in agriculture, machinery, bioenergy and food products and brands including AXA, Bonjour, Kungörnen, GoGreen, Gooh, FINN CRISP, Schulstad and Vaasan.

Yara BIO 8-4-2 ([in Finnish](#))

*“Lantmännen and Yara lead the way towards world’s first fossil free food chain”, [13<sup>th</sup> September 2020](#)*

## Policy

### EU “Safemanure” (RENURE) report published

The European Commission has published the final JRC “Safemanure” report (now termed REcovered Nitrogen from manURE = RENURE), proposing criteria to authorise manure-derived recycled fertilising products to be used above the 170 kgN/ha for manure-derived nitrogen fixed by the Nitrates Directive.

This is absolutely not (proposed) “End-of-Manure” criteria, in that **RENURE materials will remain be subject to specific management and use constraints (additional to those applicable to mineral fertilisers) to be fixed regionally for each Nitrates Vulnerable Zone by each Member State**, concerning *“timing and application rates ..., good agro-environmental practices ... ammonium emissions on field ... and emissions to air resulting from storage”*.

The RENURE criteria also do not give an Animal By-Product End Point. Traceability and identification of RENURE materials as manure-derived will therefore be necessary.

In addition to these specific regional use criteria, RENURE materials must have a **TOC:TN ratio ≤ 3 or a mineral N:TN ratio ≥ 90%**. The JRC report suggests that such materials *“have a similar N leaching potential and agronomic efficiency to Haber-Bosch derived and equivalent chemical N fertilisers, when applied under good management practices”*.

ESPP input to the RENURE process underlined that these criteria effectively penalise organic carbon input to soil: ESPP suggested that the stability of the TOC should be taken into account. ESPP also noted that materials such as 90% raw manure spiked with 10% urea would pass the criteria, as do some raw manures and most liquid fractions of manures.

At this stage, these criteria are a JRC (EU Joint Research Centre) technical proposal which must now be validated by the Member States (EU Nitrates Committee) and will then face the risk of possible legal challenges, in that some environmental or agricultural NGOs and some Member States may consider that this is an attempt to facilitate intensive livestock production and allow increased manure spreading in nutrient surplus regions by circumventing the provisions of the Nitrates Directive to limit spreading of nitrogen, art. 2(g) *“excreted by livestock or a mixture of litter and waste products excreted by livestock, even in processed form”*

*“Technical proposals for the safe use of processed manure above the threshold established for Nitrate Vulnerable Zones by the Nitrates Directive (91/676/EEC)”, European Commission JRC, September 2020, D. Huygens et al., ISBN 978-92-76-21539-4*

<https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/technical-proposals-safe-use-processed-manure-above-threshold-established-nitrate-vulnerable>

### Mineral fertilisers recovered from manures not addressed

In March 2020, ESPP wrote to the European Commission concerning that the Safemanure approach (see above) *“can make a positive contribution to nutrient recycling by facilitating local use of nutrients in certain manure or digestate fractions, under appropriate and specifically defined conditions and in line with existing legislative requirements”* but underlining that this **“will not resolve the current obstacle posed by the Nitrates Directive to placing on the market of high-quality fertilising products derived partly or completely from manure”**.

ESPP suggested that, independently of Safemanure, the European Commission should develop criteria under which nitrogen chemicals extracted from manure, which no longer contain organic carbon, should no longer be considered manure “in a processed form” (art. 2(g)). ESPP suggested that organic carbon content <1% and conformity to Fertilising Products Regulation criteria for ‘Mineral Fertiliser’ would be appropriate to ensure that chemical properties are same as synthetic mineral N fertilisers (and so e.g. leaching risk). Also, biological and contaminant safety should be ensured.

ESPP letter to European Commission requesting action on mineral fertilisers recovered from manure, 10<sup>th</sup> March 2020  
<http://www.phosphorusplatform.eu/regulatory>

## ESPP input to the EU on the Urban Waste Water Treatment Directive

ESPP submitted input to the EU public consultation The European Commission (closed 8<sup>th</sup> September 2020, see [eNews n°46](#)), on revision of the EU Urban Waste Water Treatment Directive (UWWTD 1991/271). The UWWTD is recognised as having been effective in reducing pollution and in improving water quality. ESPP welcomes the proposed objectives of coherence with the Circular Economy (nutrient recycling) and “extended producer responsibility” for emerging contaminants of concern in sewage (industrial chemicals, pharmaceuticals, micro-plastics) which can be an obstacle to sewage sludge valorisation and nutrient recycling. ESPP underlined in particular the problem of perfluorinated chemicals (PFAS, PFOA). ESPP also welcomed that eutrophication is identified as a key issue needing to be addressed, in particular with storm overflows, small agglomerations < 2000 p.e. and septic tanks.

EU public [consultation](#) on the Urban Waste Water Treatment Directive” (closed 8<sup>th</sup> September 2020) and ESPP input submitted [HERE](#).

## Societal costs of eutrophication in Lake Erie

A new study estimates that (based on 2015 situation) algal blooms in Lake Erie (USA and Canada) cost some 272 million US\$/year, mainly from recreation and inherent value placed on the lake by residents living < 100km from its shores (115 M€), tourism economic losses (110 M\$) and loss of property value (36 M\$). Accounted over 30 years, this means a total cost of over 5.3 billion US \$. Actions to reduce nutrient losses, including reducing and improving fertiliser application, agricultural buffer measures, artificial wetlands, stormwater management and improvement of sewage treatment plants is estimated at 1.3 billion US\$, whereas such actions are estimated to reduce algal bloom costs by 2.8 bn\$ (over 30 years), so are considered cost-effective. There are few estimates of how much nutrient losses to surface waters cost to the economy and to society. Three are cited: Dodds 2007 (see [SCOPE Newsletter n°72](#)): eutrophication costs for the USA 1.5 – 4.8 bn\$; Hoagland & Scatasta [2006](#) algal bloom costs (only) USA 82 m\$ and EU 813 m\$; Steffensen [2008](#) management of algal blooms (only) Australia 180 – 240 mAus\$.

“Estimating the economic costs of algal blooms in the Canadian Lake Erie Basin”, R. Smith et al., *Harmful Algae* 87 (2019) 101624  
<https://doi.org/10.1016/j.hal.2019.101624>

## Limited effectiveness of detergent P bans

A discussion paper suggests that detergent phosphate bans in the USA will have only limited impact in reducing overall nutrient loads to surface waters. 95% of phosphate use in the USA is estimated to be in agriculture. Detergent P bans will not reduce inputs to surface waters where sewage passes through treatment works with binding P discharge consents, because operators will optimise to continue to discharge P to the specified limit, irrespective of changes in works inflow P load. In Minnesota, this was estimated to reduce the effectiveness of a detergent phosphate ban by 24 – 59%, and maybe by 80% in nutrient sensitive waters where most sewage treatment works are strictly consented. Local regulations, such as county-wide lawn P fertiliser bans, may show reduced effectiveness as consumers bypass the ban by purchasing online or in nearby regions: 40% of detergent purchases were estimated to be coming from outside the county when Spokane had a local dishwasher P ban. The authors argue for a wide approach to policy addressing all sources of phosphorus.

“The Effectiveness of Phosphate Bans in the United States”, D. Kaiser, *Review of Environmental Economics and Policy*, volume 14, issue 2, Summer 2020, pp. 331–338 [DOI](#)

## Irish Nutrient Platform launch webinar

The launch webinar of the island of Ireland (Ireland and Northern Ireland) Nutrient Platform registered nearly 100 participants, 3<sup>rd</sup> September. **Vincent O’Flaherty, NUI Galway**, explained that a three-year programme had been funded by the EPA, to assess the feasibility of such a platform and then to prepare its establishment. A meeting a year ago, with 26 participating organisations, agreed objectives and terms of governance. Key objectives are to enable networking, to facilitate business opportunities in recycling and nutrient management, and dialogue with regulators and policy makers. **Philip Cosgrave, Yara**, presented the company’s commitment ongoing improvement of fertiliser sustainability, from production through packaging to use on the farm, in particular with advice to farmers. Yara is also actively developing recycling, including via the Nutrient Upcycling Alliance (see ESPP [eNews n°41](#)), for example with the launch in Finland of a fertiliser including recycled organic phosphorus (see above). **Patrick Barrett, Department of Agriculture, Food and the Marine**, outlined national bioeconomy policy development and funding opportunities in Ireland and at the EU level for circular bioeconomy activities, and noted the potential of the new Platform to help develop and scale-up business opportunities and value-chains [and inform bioeconomy policy implementation](#). **Ian Marshall** led a final panel, including ESPP, which discussed the interest of developing a nutrient

balance for the whole island of Ireland, the challenges and opportunities for nutrient management from EU policies: fertiliser use commitments and the Integrated Nutrient Management Action Plan in the Green Deal, achievement of Water Framework Directive objectives with climate change, the new Common Agricultural Policy and the FAST (Farm Sustainability) Tool for Nutrients, Eu R&D funding possibilities ... The important role of nutrient platforms in facilitating dialogue and consensus between different industries and stakeholders was underlined.

<https://nutrientsustainability.ie/>

## How effective is phytase in pig feed?

The addition of phytase enzyme to pig feed to improve uptake of phosphorus is today standard procedure in most pig production. A significant part of phosphate in grains and seeds is in 'phytate', the plant's natural phosphorus storage molecule, which is not digestible for non-ruminants (pigs, chickens, humans). By breaking down phytate, phytase enables pigs to take up this protein, so reducing P-loss to manure and reducing the need to add mineral feed phosphates (e.g. calcium phosphates). Recent trials suggest however that standard agronomic recommendations may overestimate the benefits of phytase. 72 pigs were fed diets with different levels of added phytase for 25 days, with either a diet with adequate P for optimal growth, or a P-deficient diet. Phytase improved P digestibility by nearly 50% in the P-deficient diet, but only by 12% in the optimal diet. The authors note that P-release curves for phytase are based on research using P-deficient diets, in order to obtain clear results, so that current diet recommendations may be overestimating the effects of phytate use on pig P uptake, and so resulting in feed supplying below optimal P levels. In both diets, phytase slightly improved digestibility of dry matter, gross energy and crude protein.

*"Does phytase release less phosphorus than we think?", K. Olsen & J. Patience, Iowa Pork Industry Centre, Iowa State University, 7<sup>th</sup> July 2020*  
<https://www.nationalhogfarmer.com/nutrition/does-phytase-release-less-phosphorus-we-think>

## Research

### Call for papers: Sustainable phosphorus use in agriculture

Research or review papers are invited for a special issue of the journal *Agronomy* on sustainable use of phosphorus in agriculture: N and P in manure and crop requirements, soil-crop systems, from feed through livestock to manure nutrient mass balances and efficiencies, runoff and erosion, policies and governance, economics, ecotechnologies.

**Submission deadline is 31<sup>st</sup> March 2021.**

*Agronomy Journal special issue* [submission form](#)

### Phosphorus flows in Brussels

A study analysed phosphorus flows through the Brussels Capital Region, Belgium (1.2 million people, 160 km<sup>2</sup>, of which <1% agriculture). Currently wastewater is treated at two sewage works, most food waste is incinerated with municipal refuse, and green waste is collected and composted. P inputs in the food system are estimated from food consumed by population, visitors, and commuters (based on Belgium national Food Consumption Survey data) plus food waste generated in consumption and trade. P in pet food, detergents and green waste is also estimated. The data suggests an average per capita dietary intake of 1.2 gP/day. The study concludes that main annual inflows are (approximately) 700 tP/y in food products, 100 tP/y in detergents, 100 tP/y in pet food and 100 tP/y in wastewater from outside the region treated at one of the sewage works. The main outflows are (approximately) 560 tP/y in treated sewage sludge, 140 tP/y in sewage works discharge and 160 tP/y (mainly from food waste) in municipal refuse incineration ash. Currently, the sewage sludge is either [wet air oxidised](#), dried, then used as cover material in landfills, or incinerated in [Belgium](#) and [Germany](#). The principal opportunities for P recycling are from sewage sludge, and secondly from food waste when separate collection will be scaled up. P losses from the sewage works to surface waters (currently 16% of inflow P) should be reduced with ongoing upgrades to the two works. Separate collection and anaerobic digestion of food waste within the city would increase the amount of electricity generated; P-recovery from sewage sludge does not affect the energy balance, because energy from sludge digestion is already valorised within the sewage works. The authors conclude that the potentially recyclable phosphorus could cover the fertiliser needs of the two neighbouring Brabant provinces, but only if the regulatory framework and social acceptance of such recycling are improved.

*"Phosphorus and energy flows through the food system of Brussels Capital Region", A. Papangelou, W. Achten & E. Mathijs, Resources, Conservation & Recycling 156 (2020) 104687, [DOI](#).*

### LCA of enhanced struvite recovery

As part of the [LIFE ENRICH](#) project, a Life Cycle Analysis study compares two scenarios for struvite recovery before anaerobic digestion in a sewage works operating biological phosphorus removal (EBPR) in the Murcia-Este WWTP, Spain. In the first scenario WAS (waste active sludge) is thickened using dissolved air flotation and fermented during 24 h to maximize poly-P release then elutriated in gravity thickeners with primary sludge. Struvite recovery from the overflow was modelled, considering different thickening and mixing rates. In a second scenario, WASSTRIP-based phosphorus release was modelled: primary sludge was fermented to generate volatile fatty acids then mixed with WAS in anaerobic P-release tanks and the resulting soluble-P enriched solution, after dewatering, was sent to the struvite precipitation. The different scenarios were evaluated for the LCA based on real data from the existing WWTP and modelling of different configuration changes. The modelling concludes

that under the elutriation scenario around 43% of influent phosphorus (P inflow to the WWTP) could be recovered as struvite, increasing to 48% with WASSTRIP. Greenhouse effect and total costs (TAEC, per m<sup>3</sup> wastewater treated), related to the sludge line operation, were modelled to be respectively 2% and 18% lower with struvite recovery via elutriation than without struvite recovery, whereas they were both higher with the WASSTRIP-based configuration compared to without struvite recovery.

*"An integral approach to sludge handling in a WWTP operated for EBPR aiming phosphorus recovery: Simulation of alternatives, LCA and LCC Analyses", M. Roldan et al., Water Research 175 (2020) 115647 [DOI](#)*  
For further information, LIFE ENRICH project [website](#)

## Review of struvite LCA studies

Seven LCA studies of phosphorus recycling as struvite from wastewater are summarised, plus six of struvite from urine, dating from 2012 to 2018 (not including the paper above). The authors note considerable variation both in the LCA methodology and in the boundaries considered. Most of the LCAs include some "offset" for the environmental impacts of producing conventional fertilisers replaced by struvite, but some consider both N and P and some either only N or only P. Some of the LCAs include a sludge or nutrient management credit. Other aspects also vary considerably, with some of the LCAs, but not all, considering infrastructure, some considering that struvite might increase eutrophication (based on nutrient content of struvite applied as fertiliser), others that struvite reduces eutrophication (calculating the struvite nutrient content as removed from sewage works discharge), some but not all considering electricity consumption, etc. Furthermore, only two of the studies used data from full-scale struvite recovery installations, the others relying on literature or pilot plants. The authors suggest that that the most reliable (of the 13 studies assessed) is likely Remy & Jossa 2015 (P-REX [deliverable 9.2](#), see summary in [SCOPE Newsletter n°115](#)), which is based on data from full scale and pilot plants, includes fertiliser offsets and infrastructure, and considers a range of impact categories. This P-REX LCA concluded that struvite precipitation has net beneficial impacts on greenhouse emissions, and eutrophication and (for configurations with precipitation downstream of sludge dewatering) on human and environmental toxicity.

*"Life cycle assessment review of struvite precipitation in wastewater treatment", M. Sena, A. Hicks, Resources, Conservation & Recycling 139 (2018) 194–204 [DOI](#)*

*"Sustainable sewage sludge management fostering phosphorus recovery and energy efficiency", P-REX deliverable 9.2 report, C. Remy & P. Jossa, 2015, 86 pages [HERE](#)*

## Struvite safety

Two recent publications add to existing data confirming that struvite (magnesium ammonium phosphate, a form of phosphate in which phosphorus is recovered from wastewaters) is safe and non-toxic.

[Shim, Won et al.](#) (2019) tested the oral toxicity of struvite on rats. The struvite was precipitated from pig manure centrate in a 20 litre lab reactor, then pre-treated by microwave irradiation or heat sterilisation (550°C x 30 mins). 30 rats were fed, for 28 days, 1 or 10 mg/kg body weight/day either one of the two pre-treated struvites or no struvite (P levels as in standard rat diet). Rats were then sacrificed, body weight and blood metabolites measured and histopathological examinations carried out on liver, kidney, lung and heart. No significant differences were found in the struvite-fed rats and no abnormalities. The authors conclude no oral toxicity of struvite over 28 days at these doses. Based on solubility tests, they suggest that such pre-treated struvite could replace currently-used feed phosphates in livestock diets.

[Kim et al.](#) (2019, partly the same authors as Shim et al. above) tested the same pre-treated struvite in broiler chicken diet (204 chickens, inc. controls) for 28 days. Growth showed to be the same as with standard feed phosphate (dicalcium phosphate). No significant differences were found in histopathological examination of key organs: heart, kidney, liver, gizzard, intestines, tibia. The authors again conclude no oral toxicity under these conditions and at the dose of agronomic diet P levels, and possibility to use pre-treated struvite as a poultry feed P-additive.

NOTE: ESPP reports these studies because they add to other evidence of the toxicological safety of struvite, which is relevant for its handling etc. when used as a fertiliser or in industry. ESPP does not recommend using struvite recovered from wastewater or manure in animal feed, for reasons of public confidence. This might also be illegal in Europe because the Animal By-Products Regulations prohibit use of "faeces, urine ... (or) ... waste obtained from wastewaters ...irrespective of processing"

*"In Vivo Toxicity and In Vitro Solubility Assessment of Pre-Treated Struvite as a Potential Alternative Phosphorus Source in Animal Feed", S. Shim et al., Animals 2019, 9, 78, DOI:10.3390/ani9100785*

*"Evaluation of Struvite Recovered from Swine Wastewater as an Alternative Phosphorus Source in Broiler Feed", M. Kim et al., Agriculture 2019, 9, 221, DOI:10.3390/agriculture9100221*

See also: *"Design and optimization of fluidized bed reactor operating conditions for struvite recovery process from swine wastewater", S. Shim, S. Won, et al., 2020, Processes, 8, 422 – 438 DOI: 10.3390/pr8040422 (Open Access)*

See also: *"Simultaneous Removal of Pollutants and Recovery of Nutrients from High-Strength Swine Wastewater Using a Novel Integrated Treatment Process", S. Shim, S. Won et al., Animals 2020, 10, 835; DOI: 10.3390/ani10050835*

*S. Shim, A. Reza, S. Kim, N. Ahmed, S. Won, and C. Ra. 2020. "Simultaneous removal of pollutants and recovery of nutrients from high-strength swine wastewater using a novel integrated treatment process", animals, 10, 835 – 853.*

## Solubility of feed phosphates and overall P use efficiency

Tests with 384 piglets and modelling suggest that use of a highly water soluble phosphate feed additive significantly improves whole-system PUE (phosphorus use efficiency), increases pig weight gain and reduces manure phosphorus, compared to use of a less water soluble phosphate. The 35-day pig trials used four different diet levels (0.05% to 0.2%) of water soluble MDCP

mono-dicalcium phosphate and standard feed phosphate DCP dicalcium phosphate. Whole-system takes into account manure application to soil, feed crop production (soy, maize), fertiliser use, soil P accumulation and so phosphate rock consumption. The fertiliser value of manure from the piglets on different feeds was assessed by pot trials using lettuce, because manure is often recycled for vegetable production in China. Conclusions are that, for example, for 1 kg meat production, 0.1% water soluble phosphate feed additive improves whole system PUE by 18% compared to 0.2% DCP.

*"A higher water-soluble phosphorus supplement in pig diet improves the whole system phosphorus use efficiency", L. Liu et al., J. Cleaner Production 272 (2020) 122586 [DOI](#)*

## Microalgae to remove and recycle nutrients from digestates

A review from China presents data and summarises opportunities for use of microalgae to remove nutrients from anaerobic digester effluents, with data mainly from pig manure digestate. Microalgae production can be used for extraction of lipids, biofuel production, as biomass to feed back into the digester and increase methane production, or as an organic fertiliser and soil amendment. Microalgae have shown to tolerate high organic compound concentrations in digestates, and to be able to remove 30 – 96% of COD, 20 – 95% of ammonia-N and 20 – 98% of phosphorus, depending on conditions. Although microalgae prefer to metabolise ammonium nitrogen (rather than nitrate), high ammonium levels can be toxic to microalgae (> 120 mg/l). Another challenge is turbidity, limiting light and so microalgae photosynthesis. One simple solution to this is to dilute the digestate, but this poses logistic problems.

*"Nutrients removal and biomass production from anaerobic digested effluent by microalgae: A review", G. Li et al., Int J Agric & Biol Eng, 2019; 12(5): 8–13, [DOI](#) Open Access.*

## Baltic BONUS RETURN final webinar

The BONUS RETURN project final conference ([webinar 8 September 2020](#)), attended by ca. 50 stakeholders, presented conclusions and recommendations on how ecotechnologies can turn nutrients and carbon from environmental problems into circular solutions in the Baltic Sea Region. The program was moderated by Arno Rosemarin (SEI). In the first session, the coordinator Karina Barquet (SEI) welcomed the audience and gave a short introduction to the program. Biljana Macura followed with a review of ecotechnologies for circulating nutrients and carbon in the Baltic Sea Region. Erik Kärrman (RISE) and Soren Marcus Pedersen (UCPH) presented a sustainability analysis of the three catchment areas selected as target regions for the program – river basins of 1,000-2,000 km<sup>2</sup> draining to the Baltic Sea – Fyrisån River (Uppland, Sweden), Vantaanjoki River (Helsinki Metropolitan Area, Finland) and Slupia River (Slupsk, Poland), offering to study pressures from agricultural and forest activities as well as from large, densely populated agglomerations. Jari Koskiaho (SYKE) and Tomasz Okruszko (WULS) presented the SWAT modelling results of the impact of ecotechnologies on nutrient levels in the three river basins. After the coffee break Sten Stenbeck (RISE) introduced the circular innovations that were pilot-tested during the project, referring to three selected **emerging ecotechnologies for nutrient and carbon reuse** (see below). After a review of barriers and opportunities for closing the loop in the Baltic Sea Region presented by Linn Järnberg and Nelson Ekane (both SEI), Mark Rasmussen, Olle Olson (both SEI), Marek Gielczewski (WULS) and Jari Koskiaho (SYKE) gave an overview of project related success stories. The **use of phosphogypsum on cropland to retain phosphorus and reduce losses**, proved particularly promising for widespread application in the Baltic region, potentially preventing 2,000 annual tons of phosphorus inflows to the Baltic Sea if implemented over large areas in a number of the riparian countries (see [ESPP eNews n°36](#)). After altogether ten years of testing, this practice can now be recommended for extensive application, using low-contaminant phosphogypsum (a by-product from processing of igneous phosphate rock), or natural gypsum where available, without worries for soil health and water quality. Finally, Steven Bachelder (Uppsala University) showed an amusing learning game before Karina Barquet (SEI) summarized and closed the session with recommendations for future policy and research

*[BONUS RETURN](#) project, 2017-2020: a joint program of 6 science partners from Denmark (University of Copenhagen), Finland (SYKE) and Poland (Warsaw University of Life Sciences), Sweden (Stockholm Environment Institute, Research Institutes of Sweden, Uppsala University), coordinated by the Stockholm Environment Institute.  
[Recording](#) of 8<sup>th</sup> September 2020 webinar.*

## Technologies for nutrient management in the Baltic

The BONUS RETURN project (see above) has published final reports on ecotechnologies for nutrient management in river basins and for nutrient and carbon reuse.

The [report](#) on river basin management compared impacts of source separation of black water (toilet) and grey water (other household wastewater), nutrient removal in municipal wastewater and agricultural nutrient Best Management Practices (BMPs, including constructed wetlands). This concluded, in the catchments studied, that agricultural BMPs could reduce nutrient loads (N and P) by 30-40%, compared to 4-12% for actions addressing municipal wastewaters, or <1% by increasing agricultural soil carbon content. The report concludes that a combination of different measures will be needed, depending on local catchment situations, to reduce nutrient inputs to the Baltic, and that other benefits must also be considered such as nutrient recycling and soil productivity improvement.

BONUS RETURN also selected and tested three promising ecotechnologies for nutrient and carbon reuse, with pilot plants set up and tested in Sweden, Finland and Poland. The selection process is described in a first [report](#) 28/6/2018 (press release [5/4/2018](#)). An open "Challenge" was organised. Thirteen entries were received (not listed), from which four finalists and then

from these three winners for pilot testing and pre-commercialisation [support](#) were selected. The three selected for testing are: BioPhree (Aquacare, NL, see ESPP [eNews n°29](#)), Ravita (HSY Helsinki) and Terranova Energy (Germany), both see ESPP's SCOPE Newsletter [n°132](#)) and the fourth finalist was Carbonext, a [technology](#) for splitting biogas (methane) to produce a clean coke fuel and hydrogen gas.

[BioPhree](#) was tested in Knivsta Stockholm at pilot container scale. No data or results from the tests are provided at this stage.

[Ravita](#) post-precipitation recovery of iron phosphate was tested at a pilot plant at the Viikinmäki, Helsinki, municipal wastewater treatment plant (1000 p.e. scale, since 2019 see ESPP's SCOPE Newsletter [n°132](#)). Development of recovery of phosphorus, nitrogen and iron (recycling as a coagulant) from the iron phosphate is underway.

[TerraNova](#) was tested in Gävle, Sweden. see ESPP's SCOPE Newsletter [n°132](#). No data or results from the tests are provided at this stage.

*BONUS RETURN effective ecotechnologies in river basins Deliverable D.4.2. (29/2/2020) [report](#) and "Carbon and nutrient recycling ecotechnologies in three Baltic Sea river basins –the effectiveness in nutrient load reduction", J. Koskiäho et al., 2020 *Ecohydrology & Hydrobiology* in print, [DOI](#).*

*BONUS RETURN ecotechnologies for nutrient and carbon reuse: press release [5/4/2018](#) and Deliverable D.3.7 (28/6/2018) [report](#)*

## Stay informed

SCOPE newsletter: [www.phosphorusplatform.eu/SCOPEnewsletter](http://www.phosphorusplatform.eu/SCOPEnewsletter)

eNews newsletter: [www.phosphorusplatform.eu/eNewshome](http://www.phosphorusplatform.eu/eNewshome)

If you do not already receive SCOPE and eNews (same emailing list), subscribe at [www.phosphorusplatform.eu/subscribe](http://www.phosphorusplatform.eu/subscribe)

LinkedIn group: <https://www.linkedin.com/company/european-sustainablephosphorus-platform/>

Twitter: [@phosphorusfacts](https://twitter.com/phosphorusfacts)

Slideshare presentations: [www.slideshare.net/NutrientPlatform](http://www.slideshare.net/NutrientPlatform)

## ESPP members

