European Sustainable Phosphorus Platform

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SCOPE NEWSLETTER

Policy

European Commission
Conclusions on Sustainable P Use

The European Commission has published its summary of responses to the official EU consultation on sustainable use of phosphorus, identifying 10 areas for action.

Phosphate resources
UK Parliamentary Briefing

The briefing note by the UK Houses of Parliament concludes that more efficient management of phosphorus and P-recycling could reduce environmental damage and enhance supply resilience

Brittany / EU Commission
Converting biowastes to fertilisers

European Commission sees Brittany success stories in recycling manure phosphorus to agriculture and makes proposals to develop P stewardship.

Nutrient wastage
Food waste contribution to N pollution

Worldwide, food waste results in 9 MT/y nitrogen loss to air and water (greenhouse gases, eutrophication)

Action

Everglades Foundation
10 M US$ phosphorus prize

The Everglades Foundation is offering 10 million US$ to remove and recycle P from waterways

Innocentive Challenge
Winning Solutions for Nutrient Pollution

US EPA announces winners of the innovation ideas challenge addressing nutrient overloads

ESPP meeting
European Phosphorus Platform in action

Partners discussed regulatory actions, networking of expertise, fertilisers and nutrient use, P-recycling and contaminants, R&D.

Next ESPP meeting Brussels 2nd December 2014: P as an EU Critical Raw Material

Phosphorus recycling

Australia
P-recovery technology review

CSIRO review of technologies that will enable resource recovery from wastewater into the future.

Phosphate recovery
P precipitation in waste streams

Developments in P, N and K recovery by struvite-type mineral precipitation processes

Food waste hydrolysis
Nutrient recycling by algae production

Submerged fungal hydrolysis of food waste produces a nutrient-rich feedstock for algae cultivation

Agriculture

France
Changes in nutrient use

French fertiliser industry association UNIFA study of agricultural nutrient balances for French regions 1988 - 2013

Nitrates Directive
France condemned by European Court

Inadequate restriction of nitrate application in winter and on high-risk soils, insufficient rules on manure storage.

RISE report - Europe
Sustainable Intensification of Agriculture

IEEP-led report on sustainable intensification identifies nutrient management as a key aspect of a sustainable response to the challenge of global food security.

2nd European Sustainable Phosphorus Conference: call for presentations, success stories, posters – deadline 15th November 2014 http://www.phosphorusplatform.eu

The partners of the European Sustainable Phosphorus Platform

Policy

European Commission

EU consultation conclusions on Sustainable Use of Phosphorus

The EU Commission has published conclusions (SWD(2014)263) to the "Consultative Communication on the Sustainable Use of Phosphorus" (COM(2013)517, see SCOPE Newsletter n° 95). The Commission's 13-page summary of some 150 stakeholder inputs received underlines that "closing the phosphorus cycle is both possible and desirable" and identifies "a need for action in relation to various policies and stages of the phosphorus cycle".

The European Commission conclusions identify **10 areas for action**:

- **Increasing knowledge** of phosphorus supply (resources) and demand (flows)
- **Security of supply**, seen as an issue by most stakeholders
- **Risk of soil contamination by cadmium and other elements** in mineral phosphate fertilisers, but also by substances potentially present in recycled phosphates
- **Recycling phosphorus** from food waste and other biodegradable wastes
- **Phosphorus recovery and recycling from wastewaters**
- **Phosphorus use in agriculture**, including balanced fertilisation and manure processing
- **Innovation** in phosphorus use, processing, extraction (mining) and recycling
- **Developing research**, with key areas identified as P-flow monitoring, environmental impacts of phosphorus uses, agronomic P-efficiency, P-recovery and P-recycling
- **Policy instruments**: rather than mandatory P-recycling, the document recommends market tools, incentives, standards and innovation support (e.g. Horizon 2020, IEPs), as well as integration of phosphorus into existing legislation
- **Awareness raising**, including through the European Sustainable Phosphorus Platform and the European Sustainable Phosphorus Conferences

Supply security

Around 2/3 of respondents expressed concern about phosphorus supply security, both for phosphate overall and **specifically for high quality rock** (given concerns about contamination of mineral phosphates).

Most respondents agreed that information on worldwide supply of phosphate rock and demand for (use) of phosphorus is "*not sufficiently available, transparent or reliable*".

Proposals include establishing "*an EU-based geological survey and data collecting institution, e.g. a European phosphorus research and monitoring centre*" and improving knowledge of phosphorus flows in Europe.

Independently from the debate on phosphorus resources and how long they might last, most stakeholders consider that **the EU should take measures to reduce its dependency on phosphate rock**, in order to secure farming and food production.

Phosphorus recycling

The document proposes that "*the EU should prioritise reducing the use of mined phosphate in favour of recycled phosphates*" and that "*the recycling of organic wastes should be promoted*".

Anaerobic digestion and composting are the first two technologies cited for phosphorus recovery, with anaerobic digestion often mentioned as the technology with most potential.

Areas requiring further research are identified as: production of high-quality fertilisers from recycled streams, defining P-recovery potential of different phosphorus flows, environmental benefits of P-recovery and use of recovered phosphates, economic aspects (market uptake of new technologies, monetising environmental impacts).

Policy proposals address improving separation of waste streams with phosphorus content, improving agricultural use of compost and digestates (combining nutrient and energy recovery) and a system of incentives / benefits for P-recovery from waste streams and use of recovered phosphates on farms.

Phosphorus use and environmental impact

It is reminded that **policies should focus on the environmental impacts of phosphorus use (eutrophication),** both through implementation of existing EU legislation (Nitrates Directive, Urban Waste Water Treatment Directive, Water Framework Directive) and through new policies where appropriate.

Use efficiency, for both mineral and organic fertilisers, should be addressed through best practices and precision farming techniques (adapted to specific crops, soils, etc), improving crop phosphorus uptake through quality and performance of fertilisers and by developments in crop selection, precision feeding of livestock and phytase use in feeds. Cross-sectoral national partnerships and focus groups should be developed to support sustainable phosphorus use.

The **prevention of phosphorus losses** should be addressed through actions such as precision farming, crop rotation, erosion control, improvement of soil organic content, organic farming, adapting phosphorus levels in animal feeds.

Towards an integrated EU policy on sustainable phosphorus

The Commission notes that a message which clearly emerged is **the need for an integrated EU policy on phosphorus**, including :

- **monitoring** of phosphorus flows
- cooperative agreements with **phosphate rock producing countries**
- **reinforcing implementation of existing environmental legislations** which drive phosphorus management, in particular water quality and waste water treatment legislations
- **incentive systems** to encourage phosphorus use efficiency and appropriate use
- technologies and approaches to **reduce phosphorus losses in agriculture and develop balanced fertilisation**, including manure processing to recycle phosphorus, and cooperation for nutrient recycling between livestock and arable sectors
- defining **best practices**
- funding of **joint stakeholder projects** (involving farmers, enterprise, science) through EU policies such as Horizon 2020 and Rural Development Funding
- **review of national/regional policies** addressing phosphorus and recommendations for improvements
- **develop a common EU approach to phosphorus recycling**, covering recycling processes, market facilitation and recycled phosphorus product quality, and promoting the value of organic content of recycled phosphorus products
- specifically addressing **phosphorus losses in food wastes**
- EU standards, based on scientific evidence, to **prevent soil contamination** from substances in mineral fertilisers or in recycled products
- defining **research needs** to support phosphorus sustainability
- integrating the phosphorus cycle into EU R&D and **innovation** policies
- cooperation with concerned **stakeholder organisations and platforms**
- **awareness raising**

Overall, this European Commission document confirms and takes forward the approach proposed in the European Commission Communication of July 2013: **to integrate phosphorus sustainability into the full range of relevant existing EU policies** (water, fertilisers, agriculture, international cooperation, food, waste ….), supported by incentive policies, targeted innovation initiatives and cooperation with stakeholder platforms.

The European Sustainable Phosphorus Platform proposes to now work with each of the different European Commission services concerned, **to initiate work with Platform stakeholder members on implementation of sustainable phosphorus objectives in relevant policies**: Environment (water, waste), Agriculture and Rural Development, Research, Consumers & Food, International Cooperation, Enterprise.

European Commission sustainable phosphorus web pages:
http://ec.europa.eu/environment/natres/phosphorus.htm

European Commission document SWD(2014)263 "Summary of the responses to the Consultative Communication on the Sustainable Use of Phosphorus [COM(2013) 517]"
http://ec.europa.eu/environment/natres/pdf/phosphorus/SWD(2014)263%20final.pdf

All replies received in response to the consultation are published on the European Commission website
http://ec.europa.eu/environment/natres/pdf/phosphorus/replies.zip

Phosphate resources
UK Parliamentary Briefing

The UK Houses of Parliament Office of Science and Technology has published a 5-page 'POSTnote ' briefing on "Phosphate Resources" summarising phosphate deposit resources and supply security, phosphorus impacts in the environment (water and eutrophication, soil), possible measures to reduce demand (agriculture and meat production, food additives, detergents, drinking water dosing) and management efficiency measures, including phosphorus recycling and European policies.

The POSTnote briefing documents provide independent, balanced, and accessible briefings on public policy issues related to science and technology for members of both houses of the UK Parliament and staff, and are also accessible to the public online.

This note on 'Phosphate Resources' was produced after consultation of a number of industry experts and scientists involved in phosphorus management, water and food security. Its publication follows **the addition of phosphate rock to the EU list of "Critical Raw Materials" in May 2014.**

World food security

The POSTnote brief's starting point is that **world food security is dependent on phosphate fertilisers**, produced from finite deposits of phosphate rock ore, indicating that the localisation of a majority of reserves in a limited number of countries raises geopolitical risks.

Discussions concerning phosphate rock reserves and resources are summarised, concluding that **estimates are variable and information is lacking**. The economics of phosphate rock are summarised, indicating different factors which contributed to the 800% price peak in 2008: energy prices, global phosphate demand, lack of flexibility in supply (long lead in time for increasing mining capacity), sulphur prices, Chinese export taxes.

It is noted that the price peak was short-lived, but that prices fell back to levels higher than pre-2008.

Phosphorus in the environment

The mining of phosphate rock has quadrupled phosphorus flows into plants, soils and water. Phosphorus losses to water bodies, in particular fresh waters, have **negative effects on water ecology and quality (eutrophication).**

Total phosphorus causes 74% of water bodies to fail **EU Water Framework Directive** objectives.

The main sources of phosphorus to UK waters are sewage treatment plants (60-80%) and septic tanks. Phosphorus discharges from sewage works have been reduced by 50% from 1995 to 2010. However, this has largely been achieved by **chemical dosing** (chemical phosphorus removal, by adding iron or aluminium salts) and the resulting phosphate compounds are not readily available to plants where biosolids are recycled in agriculture.

Phosphorus discharge consents for medium and large sewage works and on some smaller works in sensitive areas are currently 0.5 – 2 mgP/l. **A reduction of these discharge consents to 0.1 mgP/l is being tested**.

Although the **P losses from agriculture** are only a small part of applied phosphorus (1-10%), they nonetheless represent 20-30% of input to waters.

The POSTnote indicates that **only 10-15% of phosphorus applied as fertiliser is taken up by crops**, and the majority remains in soil as a phosphorus reserve. Taking soil phosphorus into account can enable a reduction of fertiliser application rates.

Phosphorus is also applied in agriculture in sewage biosolids and manure. **75% of sewage biosolids are recycled to farmland in the UK**. Their efficient application is guaranteed (since 2014) by the "***Biosolids Assurance Scheme***" which fixes standards for treatment and use.

A number of initiatives encourage farmers to manage phosphorus more efficiently in areas at risk of eutrophication: Catchment Sensitive Farming (CSF), Tried and Tested Nutrient Management, SWARM Knowledge Hub … These are estimated to enable 7 – 9% reductions in agricultural phosphorus losses to waters.

See Water UK, 2013, Press release, Working towards an assurance scheme for biosolids recycling
http://water.wuk1.emsystem.co.uk/home/news/archive/environment/biosolids-assurance-scheme-03-10-2013

Reducing demand

The briefing document presents a number of possible routes for reducing phosphorus demand:

- **Improving efficiency of phosphorus use in animal feeds**, e.g. by using phytase
- **Reducing meat consumption** in diets: a vegetarian diet requires around a third of the phosphorus input
- **Phosphate food additives**, particularly in processed foods and soft drinks. There are currently few alternatives available, but an Environment Agency working group is addressing this issue.
- **Detergents**. In the EU, phosphates are already restricted in domestic laundry detergents (since 2013) and will be in domestic dishwasher detergents from January 2017.
- **Phosphate dosing of drinking water**, to meet safety levels for soluble lead. This contributes 5% of phosphorus in domestic sewage. To avoid this, pipes must be lined with polymers or replaced.
- **Phosphorus recycling in sewage works** (the examples of struvite recovery by Thames Water and Severn Trent are cited)
- Improving efficiency in **phosphate mining/processing**

Governance and policies

The POSTnote briefing notes that international efforts to manage phosphorus sustainably are necessary to ensure global food security, but that phosphorus is not currently covered by the remit of any international organisation.

European policy on phosphorus needs to be widened from currently only addressing phosphorus losses and eutrophication (under water quality regulation), to promote recycling and supply chain management, including supply security relations with phosphate rock producing countries.

POSTnote 477 August 2014 "Phosphate Resources", UK Parliamentary Office of Science and Technology
http://www.parliament.uk/briefing-papers/POST-PN-477/phosphate-resources

Brittany / EU Commission
Converting biowastes to fertilisers

The European Commission (DG Enterprise) workshop on "Regions at work for the Bio-Economy", Rennes, Brittany, 8-9 July 2014, studied Brittany success stories and business cases of manure nutrient recycling into fertiliser products used large-scale in agriculture, and developed regulatory, technology and economic proposals to incite further nutrient reuse and recycling. The EU Commission concluded the need for a systemic approach addressing all aspects of nutrient reuse and recycling from technology to market and the need for strong leadership by regions to structure bio-economies including organic fertiliser products.

The workshop was opened by **Michel Morin, Vice-President of Brittany Regional Council** and **Gwenole Cozigou, European Commission, DG Enterprise**, Director of Resources Based, Manufacturing and Consumer Goods Industries and then started with **site visits of successful nutrient recycling from biowastes in Brittany** (organised by the Zoopôle Saint Brieuc), with further examples presented by participating stakeholders:

Chicken manure

Participants visited a 160 000 laying hen chicken farm (**Yves Marie Baudet, photos below**), with a relatively low-cost (300 000 € investment), simple, but high-quality, SECONOV drying system which **processes the chicken manure to a transportable product. The product is sold as a fertiliser/soil amendment, conform to NF U 42-001**, at a price which depends on mineral fertiliser prices. Running costs are low because warm air from the hen house is used for drying (using the chickens' body heat). The system avoids smell nuisances for nearby houses, limits dust and flies, and enables no insecticide to be used on the chicken farm

Laurent Caravec, Doux Group (one of Europe's largest poultry producers), explained that the company produces some **19 000 tonnes of chicken manure per year, of which around half is used as a fertiliser / soil amendment after drying and around half is composted**. The company is currently looking at dry methanisation to recover energy.

Michael D'Arcy, BHSL Ireland, indicated that his company wishes to develop onsite (fluidised bed) incineration of broiler chicken (production for meat) manure. This manure, unlike laying hen manure, contains straw, using the heat to produce renewable electricity. An obstacle that BHSL has overcome is the cost of implementing flue gas treatment requirements (NOx abatement) for small-scale on-farm installations to conform with the emissions standards included in the new EU Regulation 592/2014 on the use of on animal by-products and derived products as fuel in combustion (See *http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:JOL_2014_165_R_0012*)

For information, **chicken manure is already successfully incinerated for renewable energy production in large scale installations for 15 years now in England and the USA**, with the ash being processed into a high-value fertiliser product (see for example Fibrowatt, now Energy Power Resources Ltd, producing Fibrophos fertiliser *www.fibrophos.co.uk* and treating around 1.5 million tonnes of poultry litter per year). These plants however are subject to questions from some organisations concerning possible air pollution by arsenic, dioxins or acid gases (see *http://www.energyjustice.net/fibrowatch* - includes list of plants)

Pig manure and other biowastes:

The visit to the **agricultural cooperative COOPERL (photos below)** saw a combined operation, valorising nutrients and energy from slaughterhouse wastes and byproducts, pig manure, local sewage sludge and recovered waste fats and oils. The cooperative's farmer members have some 6 million pigs. The manure is first treated on-farm (biological treatment and solid-liquid separation), then the liquid part is reused directly on local farmland, the sludge is transported to the COOPERL site where it is dried (hygienisation) and processed. **The site produces 80 000 tonnes of organic fertilisers per year, in some 400 different formulations sold in different agricultural regions of France, with characteristics and nutrient balance adapted for different local crops and soils**.

Non-conform imports

In order to market these organic fertilizers, made with animal by-products, COOPERL's factory is conform to the EU 1069/2009 regulation. **However, the site faces difficulties because of imports of products which are not EU certified (1069/2009) from Flanders and Netherlands.**

Traceability

It is emphasised that the marketability of the recovered nutrient fertilisers is absolutely dependent on traceability. COOPERL can trace the biosolids in every fertiliser produced back to identified farms' manures. This is **essential to ensure customer confidence**.

Hervé Videlot, Glon Sanders Sofiproteol (agri-food group *www.groupe-glon.com*) and Cyrille Anfray, Terrial (a subsidiary of Sofiproteol *www.terrial.fr*) explained that **Terrial currently produces around 150 000 tonnes/year of fertilisers and organic soil amendments from manures**, mainly from Brittany.

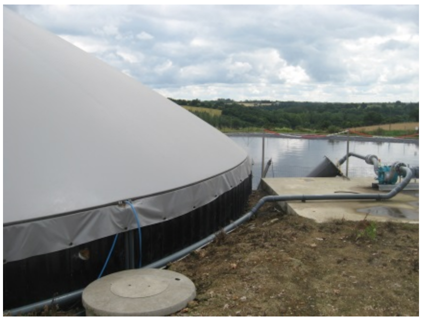
These products are valorised in France's cereal growing regions (West, Centre, North). The objective is to ensure coherence between the animal and crop production activities of the Sofiproteol Group, as a circular economy.

Isabelle Robin (Evalor *www.evalor.fr*) explained that the SME has developed **processes now implemented in around 200 pig farms in Brittany to produce organic fertilisers** which are sold through wholesalers (IF2O, see below) to cereal growers in grain producing regions of Western France.

Stephanie Sommier, representing IF2O (Interprofession des Fertilisants Organiques de l'Ouest, Saint Brieuc, Brittany = West France organic fertilisers organisation) indicated that an estimated

total of 400 000 tonnes of organic fertilisers are produced from manures from around 1 500 of Brittany's livestock farms which cannot use their manure locally (Brittany has a total of over 34 000 farms). This total includes the examples cited above. These organic fertilisers are mostly sold in other French regions, where agriculture has a need for nutrient input.

Sylvie Detoc, Loire-Bretagne Water Agency, at the France Phosphorus Network meeting (the previous day) explained that the Agency has an active policy to reduce eutrophication of surface waters, including subsidises for phosphorus treatment systems. **The Agency also funds storage and distribution installations for organic fertilisers produced from manures in Brittany**, and some are now operational in the Centre region of France, enabling export of phosphorus outside eutrophic river basins and supply of these products to meet the nutrient demand there for arable crop production.



At the **GAEC Clos de la Pierre pig farm** (391 sows), participants saw an innovative on-farm process (**photos below**) where the pig manure and local vegetable crop waste is first methanised (to produce energy to heat the farm and electricity) then composted (using forced aeration) **to generate a high-quality organic fertiliser**. This is currently pending accreditation, because the innovative process is not covered by current French fertiliser standards.

At the **SPIE (Veolia) site (photos below)**, participants saw **production of a marketable compost from the mechanically separated part of mixed domestic refuse**. The process involves drying at 45° for 4 days, mechanical separation (sieving to 10mm, separation of heavy elements, of metals). Tests are also being carried out to compost green algae collected from Brittany's beaches.

Jacques Le Stum (SEDE, Veolia Group) explained that **the group currently valorises in agriculture nutrients from over 2/3 of its sewage sludges in France**, **with around one third of this being first composted to French standard NF U 44-095 and End-of-Waste status.**

Industrial bioeconomy

Frédéric Bernard, Zoopôle Saint Brieuc, presented the actions led by this business centre to support innovation and employment in agriculture and food related industries in Brittany. **Brittany has some 120 000 jobs today in these sectors, representing 40% of industrial employment in the Region**. The Zoopôle offers training, an incubator for innovation companies, R&D, quality and analysis services. Nutrient management and recycling are a key aspect of developing environmental quality, essential to maintain Brittany's place as a European leader region in the agri-food industry.

Anthony Zanelli (ICL Fertlisers) presented the company's objective to use 100% recovered phosphate products to supply its Amsterdam fertiliser production site by 2025, as well as recycling potassium and magnesium from such recovered materials. The site is already using for around 15% of its raw materials a range of secondary nutrient materials, including recovered struvites, meat and bone ash, sewage sludge incineration ash. He underlined the company's absolute commitment to **ensure that fertilisers produced from such materials are completely safe for the human food chain, farmers, animals and the environment.**

Johnny Pallot (Roquette Frères), presented the biorefinery operated by the company at Lestrem, northern France. Roquette is the world's 5th largest starch producer from cereals, and the Lestrem plant produces a range of bio-products (starch, proteins, polyols) from agricultural and biocultivated raw materials including maize, wheat and microalgae. The site processes around 2 million tonnes/year of agricultural crops (maze, wheat …).

Regulatory framework, technical aspects, financial instruments

The EU Commission workshop addressed three policy aspects of the question:

- "*How to help entrepreneurs to convert bio-wastes into efficient fertilisers in a fair regulatory framework and a financially de-risked environment*",
- within the overall objective of "*Regions at work for the bio-economy*".

The first policy group, looking at the **regulatory framework**, noted the shared interest to move to an economy based on renewable resources and recycling, with demand from the chemical and fertiliser industries looking for renewable-sourced raw materials. Participants underlined the importance, for industrial use of recycled raw materials, of **European framework quality and contaminant criteria** and of an EU standardised legal framework, including standardised reporting methods.

The second policy group, looking at **technological aspects**, also recognised the need for EU harmonisation but at the same time emphasised the **importance of traceability**, in addition to labelling information, that is knowing from which site material has been input into each product sold, in order to ensure farmer and consumer confidence.

The group noted that "scaling" can mean **either bigger, more centralised treatment installations, or replication, optimisation and concerted marketing of many small on-farm processing units**, depending on what is optimal for logistics of different biomaterials regional flows.

The importance of **demonstration of fertiliser production and use** from bio-materials was underlined: full-scale units are needed in different regions, with accompanying assessment and communications. Existing and demonstration cases should be used to develop references for best practices, covering both agronomic value (agricultural use of recycled fertiliser products) and farm – distribution - user value chain systems (business cases).

The third policy group, looking at **financial and economic aspects**, identified as the key challenge the pricing of the organic content of recycled fertilisers from manures and biosolids, particularly in the context of strong development of feed-in tariffs for electricity from methanisation (which destroys much of this organic value). **The sale price for organic fertiliser products is currently fixed by the market price of inorganic nutrients (phosphorus, nitrogen), which is relatively low** despite recent increases (compared to high value recycled products such as starch for the food industry, as above) and is very volatile and so unreliable. Current market prices for phosphorus are around 1€/ kg P_2O_5 in DAP. Proposals for valorising the organic content of recovered fertiliser products included adapting the (existing) CO_2/greenhouse Emissions Trading Scheme ETS (for example, to include agriculture and farm manures, soil amendment carbon and soil as a carbon sink, more administrative flexibility for smaller participants) or a phosphorus/nutrient trading scheme.

Importance of traceability

The workshop emphasised that recovered fertiliser products must above all **correspond to users' requirements:**

- **nutrient balance and micronutrients**,
- **physical characteristics** (adapted to farmers' existing fertiliser spreading equipment)
- **volumes** (not the same product or marketing for major cereal regions as for niche markets).

A key identified element was the **essential importance of full traceability for recovered organic fertilisers**: the fertiliser supplier must be able to tell the farmer exactly from which site (farm, sewage works) came the biosolids processed into the fertiliser sold. This traceability is the guarantee for the farmer that there will not be health or safety problems with the product, and therefore is vital for confidence. **This means that farmers do not wish to use organic fertilisers which are sold in anonymous packets as "CE" products.**

However, product quality standards (contaminant levels, nutrient content) remain important in parallel to this traceability, and can be standardised at the European level by the revision of the EU Fertiliser Regulation taking in organic fertilisers.

Enforcement of standards for imports

Participants also emphasised the importance that quality norms/standards must be policed and enforced.

Brittany's quality organic fertiliser producers (from manures and other biowastes) particularly underlined the **problems posed by products entering northern France from other EU member states and not respecting French quality standards for organic fertilisers NF U 42-001 and NFU 44-051**. Further opening of a single European market is only positive if accompanied by better enforcement.

Fertiliser industry action

Philippe Eveillard, UNIFA (French national union of fertiliser industries) indicated that industry is interested to integrate biowastes into organic fertiliser production, as a renewable raw material, and will launch an inventory of production sites in France capable of taking such materials. This will complement the **action already engaged by Fertilisers Europe** to map inorganic fertiliser production sites in Europe able to potentially take inorganic recovered phosphates (struvite, biowaste incineration ash …).

Reinhard Büscher, Head of the Chemicals Industry Unit, European Commission DG Enterprise, closed the workshop by summarising progress with the underway recast of the EU Fertiliser Regulation. This will enlarge the scope of this regulation to cover not only inorganic fertiliser, but also organic fertilisers, soil amendments and plant biostimulants. **The objective is to ensure harmonised health, safety and environmental protection standards across Europe**, whilst allowing products already on sale to remain on national markets. The Fertiliser Regulation will only ensure minimum quality standards (e.g. nutrient content, physical characteristics) as these can ensured by the market. The objective is to harmonise with End-of-Waste criteria, as far as possible, and not to modify the Animal By-Products Regulation (1069/2009) which will continue to apply.

Calls for projects

Mr Büscher noted two upcoming calls for projects:

- **Horizon 2020, Bio-Based Industry Public-Private Partnership call**, deadline 15/10/2014, for projects addressing R9: Valuable products from heterogeneous biowaste streams, R10: Nutrient recovery from biobased waste streams and residues, D5: Cost efficient manure valorisation on large scale. See: *http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/6056-bbi.vc4.r9.html*
- **DG Enterprise call for "model demonstrator regions for recycled fertiliser products in a bioeconomy"**.
  This call will be launched shortly with the aim of developing public-private partnerships and providing EU expertise, communication and support to a number of regions wishing to take leadership in this area.

Industrial or small scale?

A central question appearing during the workshop discussions was that of industrial or decentralised nutrient recycling. Suggestions that biosolids recycling to fertilisers and nutrient recovery should move towards industrial processing, enabling high-quality products, were met with **the reality of experience in Brittany where hundreds of thousands of tonnes of manures are currently recycled to organic fertilisers, then transported, sold and used in cereal and crop producing regions of France**.

These products are mainly **produced by small-scale, on-farm processing, with a strong emphasis placed on full traceability of the final product** (identification of the farms producing the manure and other sources of biowastes through to the final product supplied to each user), as a guarantee of supplier responsibility.

The manures treated on-farm, in quality control and standardised processes, are then collected by cooperatives, commercial or public distributors, for sale to end-users in other regions of France where agriculture needs nutrient input.

The workshop also underlined the importance of such decentralised value chains, processing to organic fertilisers, in **conserving and valorising to soils the organic carbon content** of manures and biowastes.

Nutrient wastage

Food waste contribution to nitrogen pollution

For the first time, a study estimates nitrogen losses to the environment resulting from food wastage, suggesting that the contribution to anthropogenic perturbation of the N cycle is significant. In the EU alone, 0.4 MtN/y are thrown away in food waste, resulting in 1.1 MtN/y emissions in producing this wasted food. 35% of these emissions are to the atmosphere as greenhouse gases (NH_4, NO_x), and 65% to water (eutrophication or groundwater pollution).

The study is based on a streamlined Life Cycle Assessment, using LCA Food Database data (*www.lcafood.dk*) and FAO statistical data from 2007 (FAOSTAT Food Balance Sheets), considering environmental compartments air, soil and water. Food nitrogen was estimated on the basis of protein content for different foodstuffs, using a 16% estimate for N content of protein. Food waste is defined in five steps (cf. Gustavsson, FAO Report Rome 38-39, 2011): losses in agricultural production, post-harvest handling and storage, processing, distribution, consumption. Estimates of food losses in the different steps in different regions of the world are based also on this 2011 FAO report. Nitrogen losses inherent in producing the wasted food nitrogen is estimated using 'virtual nitrogen' and 'nitrogen footprint' methods (Galloway et al. 2007, Leach et al. 2012).

Nitrogen lost because of food waste

The authors' calculations suggest that 2.7 MtN/y are present in food waste worldwide (of which 0.4 MtN/y for the EU) that is **9% of total nitrogen in the global food supply and more than 2% of world annual nitrogen fertiliser consumption**.

Europe has 1.4x the world average level (%) of protein (and nitrogen) in food, but the nitrogen in food waste is 2.1x world average, because of a higher level of food wastage.

The virtual nitrogen associated with global food waste (nitrogen lost to produce the protein present in wasted food) is calculated to be 6.3 MtN/y (of which 1.1 MtN/y for the EU) that is **around 5% of total world nitrogen fertiliser consumption** (total food waste N plus N lost in producing this wasted nitrogen = 7% of world N fertiliser use).

These food waste related nitrogen losses are 2/3 to water (principally as nitrate to surface waters, potentially **contributing to eutrophication problems**) and 1/3 to the atmosphere (mainly as NH_4 but also as NO_2 and N_2O, which is a **greenhouse gas**).

Impact of meat and dairy

Over half of total food production nitrogen emissions, for Europe, are related to meat production (54%), and the part of food waste nitrogen emissions related to meat is slightly lower (48%). Dairy (excluding butter) contributes a further 16% of total EU food nitrogen losses (9% of food waste N losses), and cereals 12% (but 25% of food waste N losses).

The authors also remind of previous reports which have underlined the **significant impacts of food wastage:**

- **3% of Europe's greenhouse gas emissions** (EU Commission 2010)
- consumer and retail food waste in the USA estimated at **166 billion US$/year** (Buzby & Hyman 2012)

"The contribution of food waste to global and European nitrogen pollution", Environmental Science & Policy, 33, 186-195, 2013
http://www.sciencedirect.com/science/article/pii/S1462901113001251

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Everglades Foundation
10 M US$ phosphorus prize

The Everglades Foundation, a non-profit science based organization, has announced a 10 million US$ prize that will be awarded to any innovator who can successfully develop and execute a process to remove excessive phosphorus from waterways. The prize was announced on September 24, 2014 in the City of Chicago, during the Mayors' Clean Drinking Water Summit. The summit was organized in response to this summer's algae blooms in the Great Lakes that impacted the drinking water of half a million people in Toledo, Ohio.

10 million US$ prize

The US EPA calls nutrient pollution "*one of America's most widespread, costly and challenging environmental problems*".

Excess phosphorus causes eutrophication problems, in particular development of algae. 40% of US rivers and streams have high phosphorus levels. The Great Lakes and the Everglades are particularly impacted regions.

The Everglades are highly impacted by phosphorus runoff from sugar industry farmland and pastures. Efforts to control this phosphorus problem have cost more than 1 billion US$, including creating more than 26 000 hectares of artificial wetlands.

P-removal from dilute waters, P-recycling

"The Grand Challenge" is looking for innovative research and **technology to remove phosphorus from waterways and lakes** (where it is present at relatively low concentrations compared to waste streams, such as manure or sewage) **and to recycle the phosphorus**.

The Everglades Foundation has met experts, businesses and governments over the last year to define the Challenge criteria. The technology must be scalable, cost effective and able to perform under variable conditions in both cold and warm weather climates. The Grand Challenge will officially launch in February 2015, and selected participants will test the processes full scale through to 2022.

Applicants for the 10 million US$ prize will be screened and benchmarked, with results monitored by an independent panel of scientists, through 2022.

In addition to the 10 million US$ Grand Prize, a series of smaller prizes totalling 1 million US$ will be awarded annually to those who successfully contribute to the process of removing phosphorus, while finding uses to recycle the recovered phosphorus.

See also SCOPE Newsletter n° 105

For further information on The Grand Challenge, please visit:
http://www.evergladesfoundation.org/grandchallenge/

Innocentive Challenge
Winning Solutions for Nutrient Pollution

The Innocentive Challenge for ideas for reducing nutrients in waterways at any stage of cycle (see SCOPE Newsletter 99) has announced three winners. All three address nutrient management at the local scale (watershed, farm, field) with decision support, real-time measurement and pay-for-performance incentives. The submitters of the winning ideas each win a 5 000 US$ award.

The ideas Challenge was launched by innovation promotion company Innocentive, in partnership with the Everglades Foundation, US EPA (Environmental Protection Agency), White House Office of Science and Technology Policy, US Department of Agriculture, US National Oceanic and Atmospheric Administration, US Geological Survey, Tulane University.

The objective was to collect ideas about N and P removal targeting the Mississippi watershed and the dead zone in the Gulf of Mexico.

The three winning ideas were selected on criteria including technical feasibility and accompanying strategic plans for making solutions available and useful.

Data, decision support and incentives

Aaron Ruesch and Theresa Nelson, Bureau of Water Quality, Wisconsin Department of Natural Resources: combining data sources into a **rapid decision support tool to estimate runoff, erosion and soil loss on farms**. This is used to give an index of vulnerability, used to support implementation of actions. The award money will allow further outreach and training.

David White, Ecosystem Services Exchange: a real-time **measurement system for water flow and nutrient loading in field tile drains**, to provide quantified evidence of nutrient reductions. A test project is under discussion with Charles City, Iowa. Phase two of White's solution would involve a nutrient trading program based on the measured reductions, in order to reduce the cost of nutrient management.

Jon Winsten, Winrock International: a **pay-for-performance incentive approach based on "model at the farm, measure at the watershed",** using models to estimate nutrient losses on individual fields using farmers' knowledge of their lands. Farmers would receive a performance-based incentive to find the most appropriate and cost-effective actions for their specific farms and fields, with secondary incentive payments when their entire watershed met reduction goals.

Summary of Challenge winning ideas:
http://blog.epa.gov/science/2014/05/winning-solutions-for-nutrient-pollution/

Challenge objectives:
https://www.innocentive.com/ar/challenge/9933112

ESPP meeting
European Sustainable Phosphorus Platform in action

The second meeting of European Sustainable Phosphorus Platform members took place in Brussels, 5th June 2014. Full minutes are published on *www.phosphorusplatform.eu* (Downloads). Actions engaged to date (Platform launch mid-2013) and proposed actions for the coming year, in particular the 2nd European Sustainable Phosphorus Conference, Berlin 5-6 March 2014.

The meeting discussed **policy developments on phosphorus sustainability at the EU level and in Sweden, Denmark, Baltic, Germany and Switzerland**. The German Phosphorus Platform was launched end 2013, phosphorus networks are launched in the UK and being developed in France. At the international level, a North America Phosphorus Partnership is being launched and Arnoud Passenier (ESPP President) is part of the panel designated by GPNM (Global Partnership on Nutrient Management) to make proposals for an international initiative on phosphorus.

Regulatory dossiers

ESPP is active on a number of regulatory dossiers concerning phosphorus management, eutrophication and P-recycling:

- recast of the EU Fertiliser Regulation
- REACH (EU Chemical Regulation, application to digestates and recovered products),
- Nitrates Directive
- Groundwater Directive
- ISO275 (proposed ISO standard for 'Sludge recovery, recycling, treatment and disposal')
- EU Ecolabel
- BAT BREFs
- …

European Sustainable Phosphorus Conference, Berlin 5-6 March 2014

ESPP members confirmed the importance of this Conference in **taking forward phosphorus sustainability in Europe**, and as a key opportunity for companies and governments to present products and actions and meet with other value-chain stakeholders.

The Conference will centre on high-level awareness and mobilisation around the phosphorus challenge, with a strong emphasis on showcasing success stories and examples of practical implementation.

Other regional/thematic meetings are also planned on **farm nutrient use in the Danube / Black Sea region** (fertilisers, improving nutrient use for productivity, limiting eutrophication) and on P-recycling and contaminants (Baltic / Scandinavia).

Engaging members and stakeholders

Actions decided for ESPP for the coming year aim to **improve networking, exchange of expertise and access to information for members**. Technical webinars for members on thematic questions will enable contact with experts and answers to specific regulatory or technical questions.

Upgrading of the website will improve **showcasing of members' competence and products**.

Identification of **Horizon 2010 R&D opportunities** will enable joint projects.

A **database of competence** will improve ESPP's capacity to enable members to access specific competence and ESPP's capacity to provide expertise and assessment of projects.

A "phosphorus vision" thinking group will be established, to work on a vision for sustainable phosphorus management throughout society in Europe. This high-level group, involving companies and decision makers, will take forward the debate launched by the special issue "sustainable phosphorus vision" SCOPE Newsletter n° 106.

The meeting also took a number of decisions concerning ESPP administration: validation of accounts and budget, admission of 'in kind' members, designation of a Steering Committee and a SCOPE Newsletter Editorial Committee.

ESPP 2nd members' meeting, Brussels, 5th June 2014. Full minutes on www.phosphorusplatform.eu *under Downloads.*

Next ESPP meeting Brussels 2nd December 2014: P as an EU Critical Raw Material

Phosphorus recycling

Australia
P-recovery technology review

The recovery of phosphorus (P) from wastewater cannot be approached in isolation from the competing needs of treating the water to a required quality and recovering additional resources, such as recycled water and energy. CSIRO Australia has carried out an extensive review of technologies that will enable resource recovery from wastewater into the future.

The study showed that there are **four key products likely to be recovered increasingly from wastewater** using existing or emerging technologies:

1. Recycled **water**
2. **Energy** through methane capture
3. **Phosphorus** recovery through methods such as crystallisation
4. **Biosolids** with improved bioavailability.

Whilst wastewater contains significant concentrations of **ammonia**, its recovery is not currently commercially viable in most instances and requires a step-change in technology for its recovery.

Benchmark Technologies

A series of benchmark technologies for the management of the individual components of wastewater were identified:

- **Water**: coagulation/flotation, membrane filtration, source control
- **Energy**: autotrophic bacteria (energy saving), anaerobic digestion (energy production)
- **Heat**: recovery for heating, improving process efficiency (anaerobic digestion, biosolids improvements, membrane distillation)
- **Phosphorus**: biological accumulation and release, crystallisation as struvite, source control
- **Nitrogen**: removal by autotrophic bacteria, incorporation into struvite, source control.

Synergies

Key synergies which exist between these benchmark technologies were identified:

1. **Separation of C and N in primary wastewater treatment**. This enables the implementation of deammonification technologies for N removal, requiring lower amounts of C for biological denitrification, and enables more C to be used for energy generation using anaerobic digestion.

2. **Use of membranes in conjunction with anaerobic digestion**. This enables greater water recycling, increased solids retention time to increased methane yield, and reduces digester size (capital investment).

3. **Use of waste heat to improve anaerobic digestion**. This enables reduced digester size, increased methane yield and decreased biosolids production.

4. **Combination of anaerobic digestion with struvite precipitation followed by deammonification to remove ammonia**.

5. **P-adsorbents** developed for the polishing of treated wastewater may be **incorporated directly into biosolids**.

Future Outlook

The combined use of these benchmark technologies (*as depicted in Figure 1*) when applied to municipal wastewater treatment will lead to the production of

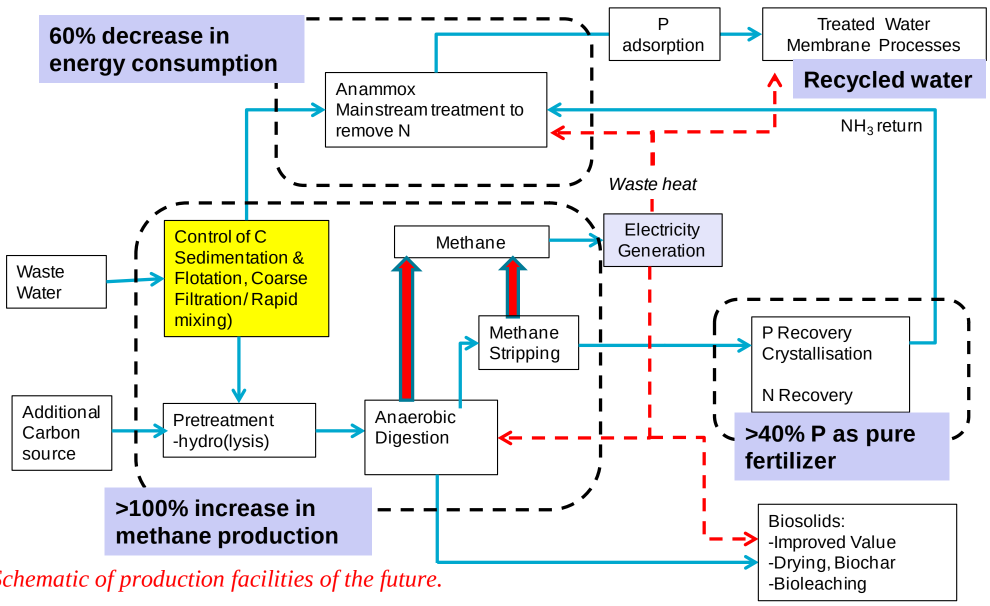

Figure 1. Schematic of production facilities of the future.

recycled water, approximately 2 GJ/ML of energy, a 40% conversion of total P to struvite, and the production of useable biosolids. Local regulations in some countries restrict the land use of biosolids and utilise more energy-intensive means to convert to char and ash. The direct application of biosolids, char or ash to land does not lend itself to competitive agricultural productivity, however, struvite is a transportable and high-value P source which has been demonstrated to provide agricultural yields matching those of bulk commercial fertilizers.

There are **already existing treatment facilities that recover approximately 40% P as struvite**, however, no technologies exist that can competitively extract greater than this amount at present.

Article submitted by: Tim H. Muster, Stewart Burn, Anna H. Kaksonen, Grace Tjandraatmadja, Commonwealth Scientific and Industrial Research Organisation (CSIRO) Gate 5 Normanby Rd Clayton 3168 | Private Bag 33, Clayton South MDC, Victoria 3169, Australia Tim.Muster@csiro.au

Phosphate recovery

Perspectives for P precipitation in waste streams

Crystallisation of struvite-type phosphate minerals from waste water streams has proven to be a successful route for recovery of phosphorus as a value-added, marketable material for recycling. The authors, based at the University of British Columbia which developed the struvite precipitation process now commercialised and implemented in a number of sewage works worldwide by Ostara, discuss future perspectives for recovery of other nutrients and adaption of such processes to other waste streams.

Struvite (magnesium ammonium phosphate hexahydrate) has been known for some time to **cause operating problems in wastewater treatment plants by forming nuisance deposits**, blocking and impeding pipes, filter presses, centrifuges, etc. In biological nutrient removal operating sewage works, struvite recovery installations resolve these problems, and recover the struvite which can be sold as a quality fertiliser.

PHREEQC model

In order to identify other waste streams where this technology can be applied, UBC has developed an **enhanced aqueous equilibrium model** based on PHREEQC software and is also working to improve understanding of the precipitation process: nucleation, crustal growth, agglomeration and reactor fluid dynamics.

Nitrogen recovery and ammonium

Many wastewater treatment plants have issues with ammonium discharge, and sludge dewatering liquor ammonium may contribute up to 30% of this discharge. Ammonia recover processes exist for treating such waste streams, but to date pose issues of high operating costs, for example ammonia gas stripping at high pH or high temperature, followed by re-fixing in sulphuric acid. This also produces an ammonium sulphate solution of only low concentration, difficult to valorise.

UBC are looking at **using a circular struvite precipitation system to recover ammonium**, without requiring dosing of phosphorus and magnesium (to achieve 1:1:1 stoichiometry of struvite). An innovative process enables struvite to be decomposed at relatively low temperatures (dry heat process), releasing the ammonium and producing magnesium hydrogen phosphate. The ammonium can be captured to recycle the nitrogen (e.g. as fertiliser). The magnesium hydrogen phosphate is readily soluble and can be re-used as a P and Mg source for the struvite precipitation process (ammonium removal from the wastewater). Other authors are looking at a wet-process where, under certain conditions, struvite can release ammonium into solution, allowing ammonium stripping to recover the nitrogen and giving a phosphorus and magnesium solution which can be used for struvite precipitation.

Potassium

A number of agricultural waste streams contain high levels of potassium, as well as magnesium and phosphate, so that precipitation of K-struvite (magnesium potassium phosphate hexahydrate) can be achieved, allowing recovery and recycling as fertiliser of these different nutrients. A key parameter appears to be low ammonium:potassium ratios. K-struvite and “normal” (ammonium) struvite can co-precipitate, so that it is also possible to recover all four nutrients.

“Briefing: Nutrient recovery from wastewater streams by crystallisation”, J. Environmental Engineering and Science, vol. 9, Issue JS3, 2014
http://www.icevirtuallibrary.com/content/article/10.1680/jees.13.00008

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Food waste hydrolysis

Nutrient recycling through algae production

Submerged fungal hydrolysis of food waste produces a nutrient-rich feedstock for algae cultivation

The authors tested **submerged fungal fermentation** to hydrolyse food waste to a nutrient-rich feedstock. This was then tested for heterotrophic cultivation of different microalgae species. 100g of food waste (dw = dry weight) resulted in 10-20g of biomass (dw) rich in carbohydrate, lipids, proteins and fatty acids.

The fungal hydrolysis used submerged fermentation by *Aspergillus awamori* and *A. oryzae*. 80-90% of the food waste was degraded within 36-48 hours to a **liquid feedstock containing glucose, free amino nitrogen FAN and soluble phosphate** (at respectively 143 g glucose/l, 1.8 gFAN/l and 0.5 gP-PO_4/l). This work used canteen and bakery food wastes, fermented in a stirred 2.5 litre laboratory reactor at 55°C, pH 4-4.5. The fermentation proved effective with solid contents of 13 – 43% in the influent food waste. The remaining 10 – 20% non-hydrolysed solids are lipid-rich and could possibly be used in biofuels.

The authors note that with other treatment routes for food waste (anaerobic digestion, composting) carbon and nutrients are converted to energy / soil improvers, whereas **the fungal hydrolysis route produces a feedstock which can be used subsequently to produce high value-added microalgae biomass**.

Algal production

The authors then tested the nutrient-rich feedstock produced from food wastes for cultivation of microalgae: *Shizochytrium mangrovei*, *Chlorella pyrenoidosa*, *Chlorella vulgaris*. Good growth was obtained in the pure food waste hydrolysate and the majority of fatty acids in the microalgae grown were suitable for biodiesel production. Also, the protein content, polyunsaturated fatty acids (PUFAs), docosahexaenoic acid (DHA) and alpha linolenic acid (ALA) contents suggest that **the algae would be valuable as human food or animal feed components**. Overall, some 10 – 20g (dw) of microalgal biomass was produced from 100g (dw) food waste input.

The tests with *C. vulgaris* suggested that **optimal algal growth rates (0.8/day)** were obtained in 1:4 diluted (20%) food waste hydrolysate. This growth rate is comparable to that reported elsewhere in growth media or waste water (0.7 – 1.1/day).

"Recycling of food waste as nutrients in Chlorella vulgaris cultivation", Bioresource Technology in print, 2014
http://dx.doi.org/10.1016/j.biortech.2014.07.096

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"Fungal hydrolysis in submerged fermentation for food waste treatment and fermentation feedstock preparation", Bioresource Technology 158 (2014) 48–54
http://www.sciencedirect.com/science/article/pii/S0960852414001643

D. Pleissner, T. H. Kwan, C. S. K. Lin, as above

"Food waste as nutrient source in heterotrophic microalgae cultivation", Bioresource Technology 137 (2013) 139–146
http://dx.doi.org/10.1016/j.biortech.2013.03.088

D. Pleissner, Wan Chi Lam, C. S. K. Lin, as above and Z. Sun, College of Fisheries and Life Science, Shanghai Ocean University, Shanghai 201306, China

Agriculture

France

Changes in nutrient use

France's fertiliser and soil amendment industry association UNIFA has published an assessment of agricultural nutrient application and export (P, K, Mg), covering inorganic fertilisers, manures and other organic sources, calculating nutrient balances for the 21 French regions for 1988 – 2013. A balance is not calculated for nitrogen, however, because data is incomplete for nitrogen deposition from atmosphere and fixation from nitrogen in the air by crops and soil microorganisms,

Over the last 24 years, **use of mineral fertilisers in France has fallen by -70%,** resulting in an approximately 50% reduction in total application levels of phosphorus and potassium. Total magnesium application levels have fallen by around a third over the last decade, for which data is available.

The UNIFA assessment is based on:

- Commercial **fertiliser sales**
- National **agricultural statistics** for numbers of livestock (manure nutrients) and crop and grass production (export of nutrients off land)
- **Data for land use** (arable, permanent grassland,

vegetable and flower production, allotments, nurseries …)

- **Coefficients for nutrient levels** in different animal manures (per unit livestock), in different crops (per tonnage produced) and in livestock uptake from permanent grassland (grazing)
- **Industry and local authority data** for: sewage biosolids, manure treatment, food industry wastes, industrial sludges, vineyard wastes, meat industry byproducts
- **Import/export of nutrient-containing products** (manures, treated biosolids products) between French regions and with other EU Member States (statistics from customs and from waste agencies)

The study estimates the total nutrients being applied to agricultural land and the nutrients removed in crops and grass (grazed or harvested), for each of the 21 French regions. This results in **"nutrient balances"** for each region. The study does not assess unavoidable losses of nutrients to water by leaching and run-off. The reported balance for P, K and Mg should therefore be slightly positive if soil nutrient reserves are not being depleted.

Lower phosphorus application

Phosphorus application as inorganic fertiliser has fallen in France by 66% from 1988/1989 to 2012/2013 and **application from animal manures has fallen by 11%** over the same period, as a result of decreasing animal numbers. Data for other sources of phosphorus (biosolids and other wastes) are only available since 2005/2006: over this period, these sources have increased by 41% (as a result of increases in manure products from neighbouring member states and in phosphorus application from sewage sludges and other organic wastes), but nonetheless total phosphorus application (fertilisers, manures, other sources) has fallen by 42%.

Taking into account outflows of phosphorus in crops and exports, **the calculated (positive) phosphorus balance has been reduced by 77%** since 1988/1989.

UNIFA notes that the **use of phytate in pig and chicken feeds** over recent years has reduced phosphorus levels in their diet and manures, but that this is not taken into account (P coefficient per animal unit not modified).

Regional differences in phosphorus sources

Phosphorus from animal manures is the biggest phosphorus source in regions with high livestock production: Brittany, Limousin and Auvergne. Mineral fertilisers are the principal phosphorus source in regions with little livestock production and intensive arable: Centre, Champagne Ardenne, Picardie, Ile de France. Other sources are significant in regions with high urban populations or agri-food industry: Ile de France, Nord Pas de Calais, Provence, Picardie, Champagne Ardenne.

The total calculated phosphorus balance for France has fallen from around 1.3 million tonnes P_2O_5 in 1988/1989 to around 0.3 million tonnes P_2O_5 in 2012/2013 (11 kg P2O5 /ha or 4.8 kg P/ha of agricultural land). However, this total positive balance shows **considerable regional differences**, and the phosphorus balance is negative in several central-northern French regions: Bourgogne, Centre, Haute Normandie, Ile de France, Picardie. The balance is also considered low <5 kgP_2O_5/ha/year in more regions, where it is likely that this effectively means a small net annual reduction in soil phosphorus content, taking into account losses in soil erosion and run off.

Potassium, magnesium

Potassium balances show a similar pattern to those for phosphorus, but reaching **a total net negative balance for potassium for France in 2008/09**. Total applications of potassium have fallen from over 4 million tonnes K_2O per year (France) in 1988/1989 to 2.4 million in2012-2013.

Data for **magnesium** are only available since 1998/1999 and show a c. 10% reduction in total applications over the decade to 2012-2013. Data for sources other than national manure and mineral fertilisers are available since 2005/2006 only, showing a two-fold increase due principally to imports of manure products from neighbouring member states and agricultural use of other biowastes. As for other nutrients, Brittany shows a high magnesium surplus (positive balance), whereas 12 regions show a small positive balance (probably corresponding to soil magnesium depletion because of losses) and three regions show a negative magnesium balance (Alsace, Centre, Languedoc Roussillon).

Overall, **UNIFA concludes that over the past 24 years application rates of phosphorus, potassium and magnesium have fallen very significantly in France, because of both lower usage of mineral fertilisers and reductions in animal numbers (and so manures).** At the same time, offtakings from agricultural land in crops have increased. This results in nutrient balances which are in some regions negative and are widely low enough to signify that soil nutrients are being depleted (by losses to surface and ground waters). UNIFA underlines the considerable variations between different French regions.

"Evolution des bilans régionaux de fertilisation en France de 2012 à 2013 pour les trois éléments nutritifs: phosphore, potassium, magnésium", in French, 38 pages, available online at http://www.unifa.fr/index.php/31-mediatheque/librairie.html *UNIFA (Union des industries de la fertilisation), Le Diamant A, 92909 La Défense Cedex, France* www.unifa.fr www.engrais-agriculture.com

Nitrates Directive

France condemned by European Court

France has again been condemned by the European Court of Justice for inadequate implementation of the EU Nitrates Directive, resulting in failure to protect surface and groundwaters from agricultural nutrient pollution.

Following complaints brought by the European Commission, the European Court considered that France's regulations

- **do not adequately limit application of mineral fertilisers and manures over the winter**, when plant uptake of nutrients is low and risk of nutrient losses to ground or surface water are high;
- in particular, **limits for fertiliser application to spring and autumn planted arable crops and to grassland** were considered inadequate
- **manure application limits were inappropriate**, because calculated nutrient values of manures did not take into account levels of milk production in cows or used incorrect N volatisation coefficients
- **limits to application on frozen or snow-covered ground, and on steeply sloping ground**, were inadequate, with increased risk of nutrient losses;
- **allowed storage of (solid straw) manure** on land for too long
- **do not provide for accurate calculation of nitrogen application**, to enable balanced fertilisation

This follows previous condemnations of France in the European Court of Justice for **failure to adequately designate Nitrate Vulnerable Zones** (where nutrient pollution limitation plans are enforced) and for repeated violations of nitrates and pesticides concentrations in drinking water (EU Directive 98/83/CE) in Brittany and in other areas of Western France: see SCOPE Newsletter n° 95.

Judgement of the European Court of Justice C237/12, 4th September 2014, European Commission vs. France http://curia.europa.eu/juris/document/document.jsf?text=&docid=157342&pageIndex=0&doclang=en&mode=req&dir=&occ=first&part=1&cid=296601

RISE report

Sustainable Intensification of European Agriculture

This report for the RISE Foundation (Rural Investment Support for Europe), directed by IEEP (Institute for European Environment Policy) with BOKU Vienna and Technical University of Munich, looks at how to respond to the global challenge of food security (driven by population and economic growth) whilst addressing scarcity of agricultural land, water, climate change, agricultural pollution and biodiversity loss. Nutrient management (specifically nutrient recovery and recycling) is one of three key issues examined, along with land quality and biodiversity.

The prime logic behind sustainable intensification is that **it would be unacceptable to expand global agricultural production by further destruction of forest, grassland and wetlands**, leading to the conclusion that further increases in food output must come mainly from higher yields on existing agricultural land, in addition to reduction in food consumption and waste.

In Europe: improving sustainability

The report notes that Europe's agriculture is already highly intensive, so that **in Europe "sustainable intensification" must principally accent improving sustainability**.

The **environmental output of land** (e.g. biodiversity, pollinators …) should be considered equally with food and energy outputs, and "production" not be considered to cover only these outputs.

Farmers' two roles of producing food and environmental services must both be recognised.

"*Sustainable intensification means improving productivity of crops and animals whilst reducing: the leakages of nutrients, crop protection chemicals and greenhouse gases; soil erosion and biodiversity, habitat and species loss; and expanding conservation outputs of agriculture*"

Nutrient pollution is identified as one of the major environmental impacts of farming. Although the nitrogen and phosphorus balances have improved for many European countries over recent years, diffuse pollution by nutrients from agriculture remains a major cause of the poor water quality currently observed in parts of Europe. It is also noted that feeding techniques to improve digestive nutrient capture are important in reducing the greenhouse impact of livestock production.

Organic carbon

The first case study in the RISE report looks at land quality, in specifically soil performance and resilience. The report notes that organic carbon is "*an important factor concerning the ability to intensify agriculture … the basis of soil biology and influences most soil properties, including the filter, buffer, transformation, and water holding capacity … Organic carbon is also a source of energy for microbial activities and provides better nutrient availability, bulk density and cation exchange capacity (CEC), which are intrinsically important factors for high resilience and performance. CEC and pH determine the mobility of nutrients and their availability for plants.*"

Nutrient recycling often accompanies organic carbon recycling (e.g. in manure reuse, composts, digestates) and the RISE report underlines that best management practices for European conditions are generally the use of farmyard manure (FYM) and compost application, crop rotation and non-inversion tillage.

Nutrient management case study

One of the three case studies in the report addresses **nutrient surpluses resulting from intensive livestock production**. Presented by the Technical University of Munich, the case study considers nutrient management issues related to specialisation of agriculture and urbanisation, resulting in crop regions which export nutrients in their products and need to import them, intensive livestock production regions with excess nutrients in manures, and urbanised regions with excess nutrients mainly in wastewaters.

The case study looks at intensive livestock production and compares the option of **manure nutrient recycling** (nutrient recovery and transport costs) to the option of **moving livestock production into crop-producing areas** (loss of farm specialisation and economies of scale). Thermophilic anaerobic digestion of manure, with recycling of the nutrients in digestate, with different options of treatment (screw press dewatering, ultrafiltration) before transport, is assessed. Economies of scale are assessed for dairy production. **Results suggest that the economically optimal herd size is likely to be lower if manure has to be transported longer distances** to reach a region needing nutrient input. An alternative to reducing herd size could be to invest in large scale, regional manure treatment centres, producing high quality recycled fertiliser products.

The conclusions are that **recycling nutrients offers the possibility to maintain competitive livestock production whilst significantly improving the environmental performance** of this production and reducing nitrate and phosphate pollution to water. Combined with the recovery and recycling of nutrients from sewage waste this could also significantly increase the return of organic material to soils and produce methane and thus energy by digestion of these materials. The challenges identified are the economics of the processing and transportation and to get the public buy-in for the recycling of nutrients recovered from sewage sludge.

The two case studies taken together show that **recycling of organic carbon and nutrients together (e.g. in treated manures, digestates, composts) is essential for sustainable intensification**.

"Sustainable Intensification of European Agriculture. A review sponsored by the RISE Foundation", A. Buckwell, J. Poláková, IEEP (Institue for European Environmental Policy, Institute for European Environmental Policy, London and Brussels. A. Nordang Uhre, A. Williams, RISE Foundation, Brussels. W. Blum, J. Schiefer, G. Lair, Institute for Soil Research, University of Natural Resources and Life Sciences, BOKU, Vienna. A. Heissenhuber, P. Schießl, C. Krämer, W. Haber, Agricultural Production and Resource Economics, Technische Universität München, Weiheenstephan. www.risefoundation.eu *online IEEP* http://www.ieep.eu/work-areas/agriculture-and-land-management/sustainable-land-use/high-nature-value-farming-and-forest-management/2014/07/sustainable-intensification-of-european-agriculture

Agenda

- 3-5 Nov 2014, Long Beach, California **ASA, CSSA, SSSA** (US & Canada soil and agronomy) meetings, Water Food, Energy, Innovation for a Sustainable World *www.acsmeetings.org*
- 4 Nov 2014, Paris, French Chambers of Agriculture (APCA) **bio-economy valorising crops and nutrients**
- 4 Nov 2014, Brussels **ACR+ Circular Economy** for cities and regions working group *info@acrplus.org*
- 7 Nov, Lucerne, Switzerland **Swiss Water Association (VSA) P-recycling and waste water treatment** *http://www.svut.ch/up/files/20141107_P-Recycling_Ausschreibung.pdf*
- 12 Nov, Leeds, UK, BioRefine / ESPP **UK nutrient network meeting** *http://link2energy.co.uk/biorefine-nutrient-platform-event*
- 17-19th Nov, Manchester UK, 19th **European Biosolids & Organic Resources Conference**. Session on energy and resource recovery *www.european-biosolids.com*
- 21 Nov, Berlin, **German Phosphorus Platform (DPP)**. P and planetary boundaries. Vote of DPP statutes (not for profit association). *www.deutsche-phosphor-plattform.de*
- 27 Nov., Strasbourg, 13° RITTMO professional workshop: **European Harmonisation of fertilisers & growing media**, in French *http://www.rittmo.com/IMG/pdf/programme_des_23emes_rencontres_professionnelles_rittmo.pdf*
- 2 December, Brussels: **ESPP (European Sustainable Phosphorus Platform) meeting**: legal establishment of the Platform, P as an EU Critical Raw Material *www.phosphorusplatform.eu*
- 4-5 December, Florence, Italy: 1st International **Conference on Sustainable P Chemistry** *www.susphos.eu/ICSPC*
- 6-8 December 2014, Lisbon, Portugal **Nutriplanta2014** *www.congressos.abreu.pt/Nutriplanta2014*
- 11-12 December, Cambridge, England., IFS **International Fertiliser Society Conference** 2014 *http://fertiliser-society.org*
- 5-6 March 2015, Berlin: 2nd **European Sustainable Phosphorus Conference** *www.phosphorusplatform.eu*
- 23-25 Mar 2015, Tampa, Florida: **Phosphates 2015** (CRU) *www.phosphatesconference.com*
- 29 March – 3 April 2015, Australia. **Beneficiation of phosphates VII** *http://www.engconf.org/conferences/mining-and-metallurgy/beneficiation-of-phosphates-vii/*
- 4-8 May 2015, Morocco: **SYMPHOS** (dates to be confirmed) *www.symphos.com*
- 1 May – 31 Oct. **Expo2015** Feeding the planet, energy for life, Milano *http://en.expo2015.org/*
- 18-22 May 2015, Washington DC: P-RCN synthesis workshop and **launch of the North America Phosphorus Partnership (NAPPs)** *https://sustainablep.asu.edu/*

Calls for papers

20th October 2014: call for papers - **Resources, Conservation and Recycling**: Losses and Efficiencies in P Management http://www.journals.elsevier.com/resources-conservation-and-recycling/

15th November 2014: call for presentations, success stories, posters – **2nd European Sustainable Phosphorus Conference** http://www.phosphorusplatform.eu/conference/espc2015.html

December 2014: call for papers – **Science of the Total Environment** - Taking stock: Phosphorus supply from natural and anthropogenic pools in the 21st http://www.journals.elsevier.com/science-of-the-total-environment/call-for-papers/special-issue-on-sustainable-phosphorus/

Nutrient Platforms

Europe: ***www.phosphorusplatform.eu***

Netherlands: ***www.nutrientplatform.org***

Flanders (Belgium): ***http://www.vlakwa.be/nutrientenplatform/***

Germany: ***www.deutsche-phosphor-plattform.de***

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