Baltic Marine Environment Protection Commission

Overview of

# Nutrient recycling in the Baltic Sea countries

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# Foreword

The HELCOM Group on Sustainable Agricultural Practices (Agri group) agreed in 2016 to prepare an overview on the state of the art of nutrient recycling in the Baltic Sea region and the need for further actions within the HELCOM framework. A drafting group was established for this purpose, consisting of representatives of the HELCOM countries and EU as well as HELCOM Observers. The aim was to create a baseline for the HELCOM Ministerial Meeting 2013 commitment to enhance the recycling of phosphorus (especially in agriculture and waste water treatment) and to promote development of appropriate methodology. The lead countries for the action were Finland and Germany.

The drafting group with the help of the Secretariat compiled the overview including short descriptions of the Baltic Sea countries' national policy priorities and EU policies related to nutrient recycling. Based on the first draft of the compilation, which showed that the Baltic Sea countries are in different stages and have different understanding of the topic, the lead countries suggested to organize a workshop. The HELCOM Workshop on nutrient recycling in the Baltic Sea countries was held on 27-28 March in Berlin, Germany. It was organized by Julius Kühn-Institut and HELCOM in cooperation with the European Union Strategy for the Baltic Sea Region Policy Areas Bioeconomy, Hazards and Nutri.

After the workshop, the HELCOM countries had a possibility to amend their texts. The draft overview was discussed further in the meetings of Agri group (AGRI 4-2017) and Pressure group (PRESSURE 6-2017) in spring 2017 and finally agreed by the groups in the end of 2017 (AGRI 5-2017 and PRESSURE 7-2017).

Taking into account the current rapid development of the national political and legal framework for nutrient recycling, the country descriptions in the overview include a reference to the date when the information was last updated by Contracting Parties.

# Contents

# Summary

Phosphorus and nitrogen are essential nutrients to the growth of plants and food production. Phosphorus is an unrenewable resource. The global phosphorus resources are limited and situated in geopolitically delicate areas. The mined phosphorus reserves will eventually be exploited and, at the same time, we should produce 60 % more food by 2050 to feed the growing world population. As for nitrogen, the production of nitrogen fertilizers is a very energy intensive process and produces a lot of greenhouse gases.

Nutrients that have leached into the Baltic Sea cause eutrophication. The valuable resources have turned into a serious problem, when in the wrong place. There is a need to start recycling nutrients to reduce the impact on watercourses and the climate as well as preserve phosphorus resources for the future generations.

Nutrient recycling aims at optimal use of nutrients in plant production. Nutrients should not go to waste, e.g. in form of leaching or food waste, in any part of the production or consumption chain. Key issues are fertilization according to the plant's needs, good soil health for optimal nutrient intake, efficient manure management, returning of nutrients from food industry's side products back to the fields, reduction of food waste from retailing and home consumption and proper treatment of the sludge from waste water treatment plants returning the nutrients back to the soil in a safe manner.

The HELCOM Contracting Parties agreed in the Ministerial Meeting in 2013 to enhance the recycling of phosphorus (especially in agriculture and waste water treatment) and to promote development of appropriate methodology. HELCOM can spearhead the development of more efficient food systems and this way also improve the health of the Baltic Sea.

At present, the countries around the Baltic Sea are at different stages. In most countries, a holistic strategy and targets for nutrient recycling do not yet exist but some issues are still addressed, e.g. targets for recovering phosphorus from sewage sludge (Denmark, Finland, Germany) or reducing organic waste (e.g. Denmark, Estonia, Latvia, Sweden). Finland has launched a programme to promote the recycling of nutrients and improve the ecological status of the Archipelago Sea as well a government key project aiming at nutrient recycling. In Germany, P-recovery (recycling) will be compulsory for sewage sludges containing more than 2% of phosphorus in waste water treatment plants of certain size.

# 1. Introduction

Tarja Haaranen, Ministry of the Environment of Finland
Marja-Liisa Tapio-Biström, Ministry of Agriculture and Forestry of Finland

*Nutrient recycling - the unified principle for improved productivity and decreased eutrophication*

Nutrient recycling is an integral part of an efficient food system and a good example of circular economy. In a circular economy, the value of products, materials and resources is maintained as long as possible, and the development of waste is prevented when products and services are designed for reuse, remanufacture or recycling.

Nutrient recycling aims at optimal use of nutrients in plant production, securing that nutrients while passing the whole food chain from food and feed to food processing, retailing, consumption and waste management are in the end returned back to soil for plant production - and the circle begins again. All sources of waste from different parts of the circle are minimized as well as the introduction of new nutrients to the circle.

Key issues are fertilization according to the plant's needs, good soil health for optimal nutrient intake, efficient manure management, returning of nutrients from food industry's side products back to the fields, reduction of food waste from retailing and home consumption and proper treatment of the sludge from waste water treatment plants returning the nutrients back to the soil in a safe manner. This leads to decreased nutrient leaching to the Baltic Sea and makes a significant contribution to solving the eutrophication problem.

*Phosphorus and nitrogen – essential for food production*

Phosphorus and nitrogen are essential nutrients to the growth of plants and food production. Phosphorus is an unrenewable resource. The global phosphorus resources are limited and situated in geopolitically delicate areas. In the EU, there are only small raw phosphate reserves, the biggest producers are Morocco, China and the USA. The mined phosphorus reserves will eventually be exploited and, at the same time, we should produce 60 % more food by 2050 to feed the growing world population.

EU has added phosphorus on the list of critical raw materials in 2014. Increasing demand of phosphorus is foreseen, since especially African agriculture needs more phosphorus for increased productivity, and increases in feed demand are linked to the increasing demand of meat. At the same time, phosphorus causes major problems in the Baltic Sea being a key factor in the eutrophication process. We have a valuable resource, which has turned into a serious problem, when in the wrong place. There is a need to start recycling phosphorus properly before it runs out from the reserves.

Production of nitrogen fertilizers is a very energy intensive process and produces a lot of greenhouse gases. There are, however, differences in the production processes and modern factories produce less GHGs compared to older ones. Nitrogen circle is a complex process, since nitrogen is released both into the air and into the water in different forms. Aerial emissions end up also partly into the Baltic Sea and are thus part of the problem. At the same time the "retention" of phosphorus in the P-pool in the soil body is far more complex than for nitrogen. We have rather good models of how big a share of the fertilized nitrogen might leach to ground water. For phosphorus this loss is far more dependent on soil properties like e.g. texture and phosphorus saturation.

Targeted and tailored fertilization giving the plants the amount of nitrogen needed at a right time while tailoring phosphorus fertilization to the specific soil properties is the key for more efficient plant production and decreasing emissions into the Baltic Sea. Fertilizers made of recycled nutrients must meet the nutrient needs of the plants and be suited for existing machinery for easy adoption.

### *Nutrient recycling can improve the state of the environment and offer business opportunities*

The present situation, where throughout the food system at different stages losses of both phosphorus and nitrogen occur, is an important reason for the eutrophication of the Baltic Sea, and raises concern about the availability of phosphorus at a reasonable price in the future.

To protect the environment, especially the Baltic Sea, nutrient recycling is a necessity. When nutrients are recycled, less virgin raw materials are needed and large amounts of fossil fuels are saved, contributing also to climate change mitigation. Manure is a key source of nutrients and organic matter, which in many areas accumulate in such a manner that spreading to nearby fields is not an option. Thus more advanced processing solutions are needed. Active and optimized recycling of nutrients in manure, sewage sludge and industrial organic side products helps the protection of waterways and the soils when these biomasses are processed to easily used and safe fertilizer products. There is a need for new innovations and technologies for nutrient recycling which can thereby create new business opportunities.

### *HELCOM work delivering to nutrient recycling*

The HELCOM Contracting Parties agreed in the Ministerial Meeting in 2013 to enhance the recycling of phosphorus (especially in agriculture and waste water treatment) and to promote development of appropriate methodology.

The EU Circular Economy Package was adopted by the European Commission in the end of 2015. The Circular Economy Package consists of an EU Action Plan for the Circular Economy that establishes a concrete and ambitious programme of action.

Efficient manure management is one of the key factors to nutrient recycling and reducing nutrient loading to the Baltic Sea. Treating manure, not as a waste, but as a resource, requires taking manure nutrients appropriately into account when fertilizing the crops. The work of HELCOM Group on Sustainable Agricultural Practices (Agri group) to develop advanced manure standards and to apply nutrient accounting on farm level in the Baltic Sea region is an important step towards nutrient recycling.

Also other nutrient resources, such as sewage sludge, need to be taken into account. HELCOM Recommendation 38/1 on sewage sludge handling was adopted in 2017. The objective of the recommendation is to assure maximum utilization of the valuable components contained by the sludge, and simultaneously minimize possible negative environmental impact. It is important that the recycled nutrients should be in such a form that they can be effectively and safely utilized by the crop. The draft recommendation considers application of treated sewage sludge and its products in agriculture, forestry, landscaping and land reclamation and other spheres.

Sustainable practices are considered also by the HELCOM Recommendation 37/3 on sustainable aquaculture. The document inter alia implies recommendations aimed at prevention of additional nutrient discharges by optimizing nutritive requirements and encouraging the use of regionally sourced products as fish feed ingredients.

### *Challenges and opportunities*

There is a market for developing new organic fertilizer products. The challenge is to produce fertilizers, which are competitive in price, easy to use with present equipment and preferably tailor-made for the specific needs of different plants. It is possible that some kind of levelling mechanisms is needed in the beginning to create markets for organic fertilizers. The renewal of the EU Fertilizer Regulation will pave way for European markets for organic fertilizers. We also need new innovative logistics to connect those with excess nutrients with those, who can use them. The solutions are information intensive and based on digital systems.

Digital technologies will have a key role in developing nutrient recycling. Precise knowledge of the nutrient needs of different plants is the starting point. Tailor-made fertilizer products offer great potential for yield improvements. Precision equipment for spreading the fertilizer, based on crop and soil needs in various parts of the parcels, will improve nutrient use efficiency and reduce nutrient leaching to the waterways. Part of the excess nutrients can then be caught with catch crops. Also plant cover during wintertime will prevent nutrient loss through erosion. Digital technologies will also have a role in planning the animal feeding that will influence the nutrient amounts in manure.

Reduction of food waste is also an important measure in nutrient recycling. Consumers and producers can be better connected to reduce the length of the food chain, by making the consumers aware of the production systems and valuing the food more, thus preventing waste. There are several examples of innovative ideas for connecting those who have excess food products with those, who need and can use these foods.

Nutrient recycling is part of the new vision of a productive and sustainable food system. There is a great need to move towards this direction to increase national and global food security and to create a profitable and prosperous farming sector as a back bone of the food system. HELCOM can spearhead the development of more efficient food systems and this way also improve the health of the Baltic Sea.

## 1.1 EU approach to enhance nutrient recycling

Marco Bonetti, European Commission

27 June 2016

Eight out of nine Baltic Sea countries are EU members as well as HELCOM Contracting Parties. The European Union has in place a comprehensive range of legislation directly and indirectly concerning nutrient use and nutrient recycling. This legislation covers, among others, the manufacturing and trade of fertilizers, the use and management of nutrients in agriculture and the protection of water resources. Thanks to these instruments the EU has reduced its nutrient surplus and increased the nutrient use efficiency. Environmental legislation has helped address nutrients as a valuable resource. For instance, the Nitrates Directive, which encouraged balanced fertilization, technological developments in manure processing and efficiency of fertilizer use on farms, has helped EU farmers to stop considering livestock manure as a waste and to start addressing it as a valuable resource.

Nutrient use and nutrient recycling are also addressed in the 7th Environment Action Programme (EAP)[1], which guides the European environment policy until 2020 and sets out a vision of where it wants the EU to be by 2050. In its commitments the 7th EAP mentions the need to manage the nutrient cycle in a more sustainable and resource-efficient way by reducing emissions of nitrogen and phosphorus through, inter alia, better source control and the recovery of phosphorus.

The EU Commission is also working on developing additional knowledge of the nutrient cycles, including physical and economic modelling, in order to mainstream sustainable nutrient management. In this regard, several studies were promoted also concerning nutrient recycling, for instance on manure processing activities in Europe[2], on sustainable use of phosphorus[3] and on closing mineral cycles at farm level[4].

In 2013 the EU Commission carried out a Consultative Communication on the Sustainable Use of Phosphorus[5]. The Communication encompassed many policy areas, such as resource efficiency, the circular economy, food production, agriculture productivity, soil and water quality, and waste. It confirmed that closing the phosphorus cycle is both possible and desirable. Among the actions to unlock phosphorus recycling potential, the Communication recognised the need to overcome the differences in rules and quality standards between Member States.

A key role on nutrient recycling in the EU is also played by the Circular Economy Package adopted in December 2015 by the European Commission. The Package consists of an EU Action Plan for the Circular Economy[6] that establishes a programme of action, with measures covering the whole cycle: from production and consumption to waste management and the market for secondary raw materials. The EU Action Plan recognizes that recycled nutrients are a distinct and important category of secondary raw materials. The action plan also acknowledges that the sustainable use of recycled nutrients in agriculture can reduce the need for mineral-based fertilizers, the production of which has negative environmental impacts.

In March 2016, as one of the first deliverables of the Circular Economy Package, the EU Commission proposed a revision of the EU regulation on fertilizers[7]. The proposal[8] supports nutrient recovery from secondary raw materials by establishing a clear and predictable legal framework for placing among others organic fertilizers

[1] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013D1386
[2] http://ec.europa.eu/environment/water/water-nitrates/pdf/manure_processing.zip
[3] http://ec.europa.eu/environment/natres/pdf/phosphorus/sustainable_use_phosphorus.pdf
[4] http://mineral-cycles.eu/
[5] http://ec.europa.eu/environment/consultations/phosphorus_en.htm
[6] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614
[7] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32003R2003
[8] https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-157-EN-F1-1.PDF

on the EU market. The proposed approach will facilitate the EU wide recognition of organic and waste-based fertilizers, thus stimulating the sustainable development of an EU-wide market.

The EU Commission also acknowledges that the reuse of treated wastewater is a promising and under-exploited option in Europe. Water reuse in safe and cost-effective conditions can both alleviate pressure on natural resources that are already scarce and contribute to nutrients recycling by substitution of solid fertilizers. Therefore, the EU Commission is planning to take action to facilitate water reuse, including a legislative proposal on minimum requirements for reused water, for instance for irrigation.

The action plan also identifies biomass and bio-based products as a priority sector in the Circular Economy action plan. This includes the drafting of guidance and dissemination of best practices on the cascading use of biomass and support for innovation in the bioeconomy.

The issue of nutrient recycling is also addressed in the context of the European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI)[9], which contributes to the European Union's strategy 'Europe 2020' for smart, sustainable and inclusive growth[10]. Among other things, the EIP-AGRI contributes to integrating different funding streams and includes a Focus Group sharing knowledge and experience on how to improve the agronomic use of recycled nutrients from livestock manure and other organic sources[11].

At EU level, a range of funding instruments (e.g. Horizon 2020[12], COSME[13], the Structural and Investment Funds[14], the Fund for Strategic Investments[15]) is available to enhance nutrient recycling. For instance, research and innovation support for nutrient recycling is available under Horizon 2020[16], the EU research and innovation programme, and through the InnovFin initiative[17] launched by the European Investment Bank Group in cooperation with the EU Commission. This initiative consists of a series of financing tools and advisory services offered by the EIB Group, covering the entire value chain of research and innovation (R&I) in order to support investments from the smallest to the largest enterprise.

[9] https://ec.europa.eu/eip/agriculture/en
[10] http://ec.europa.eu/europe2020/index_en.htm
[11] https://ec.europa.eu/eip/agriculture/en/content/nutrient-recycling
[12] https://ec.europa.eu/programmes/horizon2020/
[13] http://ec.europa.eu/growth/smes/cosme/
[14] http://ec.europa.eu/contracts_grants/funds_en.htm
[15] http://ec.europa.eu/growth/industry/innovation/funding/efsi/index_en.htm
[16] Under Horizon 2020, calls have been launched on sustainable crop production - management of external nutrient inputs (work programme 2014-15) and on closing loops at farm and regional levels - focus on carbon, nitrogen and phosphorus cycling in agro-ecosystems (work programme 2016-17). Further efforts on of nutrient management and nutrients recycling challenges are planned also for the Horizon 2020 work-programme for 2018-20.
[17] http://www.eib.org/products/blending/innovfin/

# 2. Country descriptions

## 2.1 Denmark

Wibke Christel, Danish Environmental Protection Agency
Linda Bagge, Danish Environmental Protection Agency
4 August 2016

*Legislation, policies or strategies to enhance the recycling of nutrients*

One central objective of the Danish agricultural regulation is to optimize the nitrogen cycle within the agricultural production system by increasing efficiency of (re)using nutrients from organic sources, e.g. animal slurry, within the system and by limiting the introduction of chemical fertilizers to the system to obtain a sustainable level. Following and optimizing nitrogen flow both at farm and at national level are the main objectives in Danish agricultural regulation, consisting of the following key elements and tools:

- Obligatory fertilizer accounting (IT-based), including all nitrogen fertilizer types, for approx. 90% of all Danish farms, depending on their annual monetary turnover and amount of livestock manure, administered by the Danish AgriFish Agency[18]
- Limiting nitrogen fertilization at farm level to an automatically calculated quota, based on a balance between the foreseeable nitrogen requirement of the crops (dependent on composition/distribution of crops/soil types and crop-specific standards) and the nitrogen supply to the crops from the soil (incl. e.g. residual effect of the previous crop ) and from fertilization
- Comparatively high requirements for nitrogen use efficiency for fertilization in livestock manure and other organic waste, to be accounted for (up to 85%, e.g. 70%/75% for cattle/pig slurry, resp.), which in turn promote the investment in and use of advanced slurry application techniques, which minimize nitrogen losses, primarily as ammonia, during spreading
- Danish "harmony rules": requirements for the minimum size of the area a livestock holding must have available for spreading livestock manure from the respective livestock production
- Permits for livestock holdings: establishments, expansions or modifications of livestock holdings must receive a permit complying with the Environmental Approval Act of Livestock Holdings, setting thresholds to ensure environmental protection in terms of odour, ammonia emissions, leaching of nitrates and phosphorus surplus, issued by the respective municipal authority
- Efficient administrative control and on-site inspections on selected farms, based on a risk assessment in the Fertilizer Accounting System, conducted by the AgriFish Agency
- Continuous knowledge transfer to the farmers via specialist advisory services (e.g. SEGES[19]).

The vast majority of the nutrients in livestock manure are therefore recycled within the agricultural sector. While the agricultural policies so far have focused on regulating nitrogen application, phosphorus application has been regulated indirectly through the "harmony rules", i.e. by limiting manure application per hectare at farm level and directly for some of the livestock holdings with an environmental permit. Such holding-specific, stricter phosphorus limitation than indirectly through "harmony rules", are issued by municipalities, taking into account local knowledge, soil type, drainage conditions and the phosphorus status in the soil (Olsen-P-analysis). In accordance with the political agreement on a Food and Agriculture package of December 2015, a new geographically targeted environmental regulation of agriculture will be established in Denmark from August 2018. For this purpose, a new direct phosphorus regulation model has been developed and is currently being negotiated at political level. The model contains elements, which limit phosphorus application to a lower level on farms with areas located in the catchment areas of large lakes as

[18] http://agrifish.dk/
[19] www.seges.dk/en

targeted in the River Basin Management. It is possible that some water bodies – and hence their respective catchment areas – will be added or removed from the respective maps, which are expected to be updated during the coming years.

For organic waste, typically food waste from households and the service sector, the so-called "Resource Strategy – Denmark without waste"[20] has been developed. It aims at recycling more than twice as much waste as today and thereby meeting the EU objective of separating 50% of "dry" household waste in 2020. More organic waste is expected to be used for biogas production as a feedstock material together with livestock manure where digestate serves as fertilizer. The Government is setting even more ambitious national goal, in which the "wet" organic waste is also included. It is expected that Denmark will separate up to 300.000 tons organic waste in 2022 (currently 50.000 tons). The national Resource Strategy also aims at collecting and utilizing (for biogas production) four times as much organic waste from the service sector, expecting a rate of 60% by 2018. With respect to sewage sludge, the Resource Strategy initiates 80% of P to be recycled by exploiting the phosphorus in the ash from incinerating sludge as fertilizer, or by spreading it on agricultural soil. Today, approx. 76 % of the sewage sludge is already recycled. In legislation, the use of sewage sludge and organic waste is regulated in accordance with the order on the use of waste for agricultural purposes ("Sludge Order", no. 1650, 13/12-2016). This order regulates the quality of the waste, used in agriculture, with respect to the content of heavy metals and hazardous substances. In the future, the regulation of the nutrients N and P are expected to be transferred to the Fertilizer Accounting system, while the regulation with respect to heavy metals and hazardous substances will remain in the sludge order.

[20] http://eng.mst.dk/topics/waste/denmark-without-waste

## 2.2 Estonia

Kaire Kikas and Peeter Eek, Ministry of the Environment
Karmeli Kütt, Ministry of Rural Affairs
2 May 2017

### *Legislation, policies or strategies to enhance the recycling of nutrients*

The goal of the national waste management plan is to increase collection and recycling of biodegradable waste. The target rate is: the bio-waste recycling percentage from municipal waste total amount, 2011 - 5% and 2020 - 13%.

To promote the composting and anaerobic digestion (AD), Ordinances have been issued under the Waste Act, which define conditions and procedures by which treated bio-waste becomes a product (compost or digestate). This is so called 'End-of-Waste' legislation. Another Ordinance of the Ministry of the Environment stipulates requirements for municipalities to organize source separation of the bio-waste (as a part of general requirements on source separation) to promote recycling of the municipal waste. The National Waste Management Plan for 2014-2020 includes analysis that set targets for the recycling of the municipal waste, which could not be achieved without recycling of bio-waste. Hence, there is a purpose to recycle more bio-waste and to find more users for compost and for digestate. If the treated waste is defined as a product, it does no longer legally belong to the so called 'waste regime'. It means that the final users of such products (treated waste) do not need waste permits anymore and do not need to present waste reports, which are a basic requirement as long as material is considered as waste.

The end-of-waste criteria for the treated sewage sludge (product named then as 'sewage sludge compost or digestate) is in the adaptation process also. Current sewage sludge ordinance does set limitations for the use of treated sewage sludge (as waste). Those limitations are included in the new draft End-of Waste ordinance too. Sewage sludge, or respective sewage sludge compost or digestate (as product) must not be applied on land during the cultivation of fruits and vegetables and herbs nor is it to be applied on land intended for coming cultivation of fruits and vegetables and herbs within one year before harvest etc.

There is an ongoing bioeconomy study, where one of the goals among others is to identify opportunities in the use of Estonian coastal and marine natural processes from both environmental and economic perspective. Analysis must be based on the resource found in the sea (seaweed, clams, mineral or organic material etc.) which can help to reduce the negative impacts on the environment and be economically reasonable. The main requirement is that it helps to take out nutrients (and to recycle) which cause eutrophication.

### *National financing programmes and other tools to enhance nutrient recycling*

There is a support scheme available through the Environmental Investment Centre[21]. The construction of compost places and recycling of bio-waste collected by type are supported. There is also RDP investment support available for setting up biogas plants. The National Waste management Plan 2014-2020 gives clear preference for the AD treatment, as on environmental comparison it is preferable to simple composting. Yet there is little interest by existing biogas producers to handle also source separated and pretreated bio-waste in their facilities.

### *Phosphorus sensitive areas*

All Estonian territory is phosphorous sensitive area according to the urban wastewater treatment directive. However, Estonian soils are not phosphorus sensitive in general.

[21] http://www.kik.ee/en

## 2.3 Finland

Tarja Haaranen, Ministry of the Environment
Marja-Liisa Tapio-Biström, Ministry of Agriculture and Forestry
31 January 2018

*Legislation, policies or strategies and financing programmes to enhance the recycling of nutrients*

In Finland Prime Minister Sipilä's Government Programme 2015-2018 has launched under strategic theme "Bioeconomy and clean solutions" a key project "Breakthrough of a circular economy, getting waters into good condition". The goal is to utilize the growing opportunities offered by circular economy. Actions to promote a good ecological status of the Baltic Sea are taken in cooperation with domestic and international actors. The amounts of nutrients and organic material leaching to the waters will be reduced, while the nutrient and energy self-sufficiency of agriculture will be enhanced. Business in the circular economy will grow and new jobs will be created. The recovery of nutrients will be increased especially in areas that are sensitive with regard to the Baltic Sea and other waters so that at least 50 percent of the manure and community waste water sludge will be covered by advanced processes by 2025.

Increase recycling of nutrients and step up actions to protect the Baltic Sea and other waterways are:

- An experimental programme funding product development and innovation related to renewable energy and nutrient recycling will be conducted, including demo and reference projects. Under the programme funding will be provided to farms, SMEs and processing plants. Industrial symbioses and innovations will also be promoted. Financing 2016-2018 12.4 million euros.
- One or two pilot projects will be launched for building a full-scale test site for treating sludge from a waste water treatment plant for a community of 20,000-50,000 residents, its purpose being to separate phosphorus from ash for fertilizers and to process fermented sludge to recover phosphorus and nitrogen also for use in fertilizers. Financing 2016-2018 2.1 million euros.
- Horse manure, like all manure from domestic animals, should be used as a fertilizer or entered into an advanced treatment system so that the nutrients in the manure may be recycled. A horse manure nutrient recycling project will be set up, and provision will be made for the use of horse manure as fuel.
- In order to secure attainment of the Government's nutrients recycling goals and in order to fully leverage the measures included in the Rural Development Programme, the Programme to promote recycling of agricultural nutrients (MoA) and the second phase of Programme to promote recycling of nutrients (RAKI, MoE) (2016–2019) will be implemented.
- Government project 02/2017 - 08/2017: "Recirculation of phosphorus from waste water – economic and legal tools". The aim of the project is to identify suitable tools for the Finnish circumstances by elaboration of phosphorus fluxes in general, recovery and recirculation technologies, and relevant legislation and other instruments implemented in other countries.

*Nutrient recycling program in Finland (RAKI)*

In 2010, the Government of Finland made a commitment to take intensive measures to ensure a good ecological status of the Archipelago Sea by 2020. Furthermore, Finland committed to become a model region in terms of the recycling of nutrients. The commitment contains eight different sets of measures.

In spring 2012, Ministry of the Environment of Finland launched the Programme to promote the recycling of nutrients and improve the ecological status of the Archipelago Sea 2012–2015. The programme is aimed at developing and supporting specific projects related to, for example, water protection and nutrient recycling in agriculture and water bodies, treatment of manure, sludge and bio waste, and waste water treatment. In

February 2012, a working group was established to follow up on the programme and has since been steering the programme. By now 51 projects have been granted support to a total amount of approximately EUR 11 million. At the beginning of 2016, the programme was renewed and is to be continued as a one of the Finnish government key projects until 2019. The main focus of the new programme is to reduce eutrophication of Baltic Sea. In the programme and new projects to be funded, special attention is paid to communication and putting results into actions and practical solutions.

### *Phosphorus sensitive areas*

Erosion is a major source of particulate phosphorus to surface waters and the development of erosion risk on field parcels is one of the international agri-environmental indicators. To reduce soil erosion it is important to target the measures to those fields and parts of fields, which are under the highest risk. Natural Resource Center published in 2014 a study "Map-based classification of soil erosion risk in Finnish agricultural fields"[22]. The objective of this research was to produce maximum coverage of calibrated erosion maps within limits of the LIDAR-survey area.

[22] http://jukuri.mtt.fi/bitstream/handle/10024/482347/mttraportti133.pdf?sequence=1Nitrogen%20legislation

## 2.4 Germany

Andrea Roskosch, Federal Environment Agency

5 September 2017

*Legislation, policies or strategies to enhance the recycling of nutrients*

Within the coalition contract from 17.12.2013 for the 18th legislative period, the German government agreed on phasing out the use of sewage sludge as fertilizer in agriculture and instead to regain phosphorus and other nutrients. The German Bundestag and Bundesrat adopted the novel regulation (Sewage Sludge Ordinance (AbfKlärV)) in March and May 2017[23]. Within this revised ordinance the recovery/recycling of phosphorus from sewage sludge is to be regulated.

Contents of the revised ordinance on sewage sludges (AbfKlärV): P-recovery (recycling) will be compulsory for sewage sludges containing more than 2% of phosphorus. A recovery ratio (efficiency) of at least 50% of the MWWTP-influx will also be compulsory. Regulations will be valid for sewage treatment plants with more than 100,000 population equivalents after 12 years and for 50,000 population equivalents) after 15 years. There will be no detailed prescriptions on the methods/processes how to meet these objectives; i.e. it will be possible (legally and technically) either to regain phosphorus from sludge/sludge water (by extraction, precipitation, stripping etc.) or by mono-incineration of sewage sludge and treatment (extraction or decontamination) of the ash. Co-incineration of sewage sludge with high amounts of phosphorus will be prohibited.

The use of sewage sludge in agriculture is currently (since 1st of January 2015) regulated by the fertilizer regulations; i.e. standards and limit values of the ordinance on fertilizer quality (Düngemittelverordnung) are also applied for sewage sludges applied in agriculture. Some additional limit values are still regulated by the ordinance on sewage sludge (AbfKlärV).

Numerous research and development projects were performed on technologies to regain phosphorus both from wastewater/sewage sludge and from sewage sludge ash. In some cases a large scale technological P-recovery from wastewater/sewage sludge was successfully achieved. From sewage sludge ash a general P-recovery is not yet BAT.

Authorization of the corresponding recycling-fertilizers must be performed within the fertilizer legislation. Some recycling fertilizers as well as ashes are already successfully placed on the market.

*National financing programmes and other tools to enhance nutrient recycling*

The protection of resources and the recovery of nutrients are examined in the German resource efficiency program[24] (ProgRess).

In Environmental Innovation Program[25] of the BMU technical methods will be funded, in which the recovery of phosphorus from sewage sludge is realized industrially.

[23] http://www.bmub.bund.de/en/topics/water-waste-soil/waste-management/details-waste-management/artikel/sewage-sludge-ordinance-abfklaerv/?tx_ttnews[backPid]=608

[24] http://www.bmub.bund.de/en/service/publications/downloads/details/artikel/german-resource-efficiency-programme-progress/

[25] http://www.bmub.bund.de/themen/forschung-foerderung/foerderprogramme/umweltinnovationsprogramm/

## *Phosphorus sensitive areas*

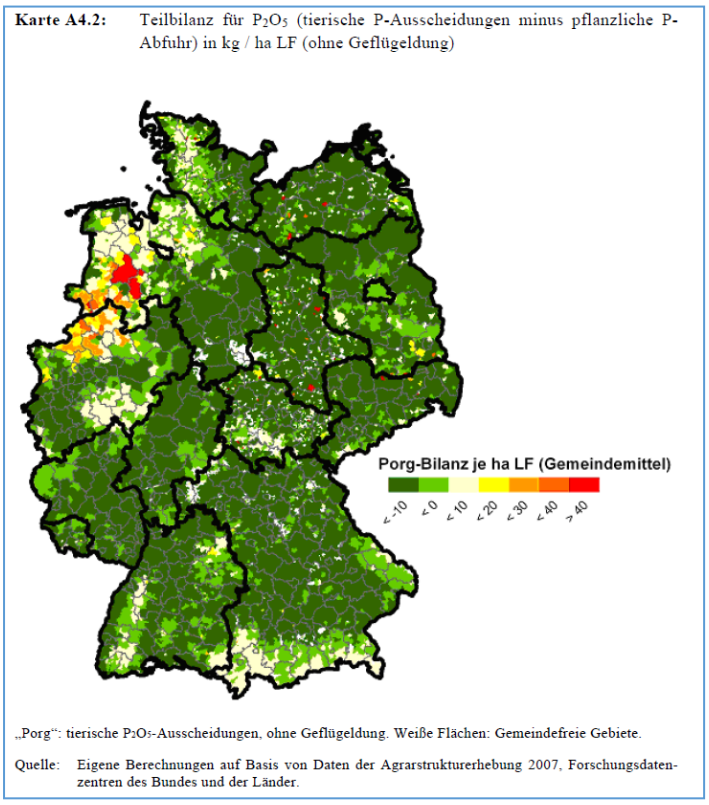


*Figure 1. Partial balance for P2O5 (animal P-excretion minus P outputs by crop) in kg/ha agricultural area (without poultry manure).*

## 2.5 Latvia

Iveta Ozolina, Ministry of Agriculture

20 October 2017

*Legislation, policies or strategies to enhance the recycling of nutrients*

In order to promote the recycling of nutrients, the Rural Development Program (2014 - 2020) provides support for farmers who have manure and crop residues derived in their farms for energy production use (see point on financing programmes).

There is a Regulation of the Cabinet of Ministers on Requirements for Circulation of animal by-products and derived products not intended for human consumption[26] in accordance with relevant EU regulations. According to this Regulation, the requirements for composting of food waste, feedstuff, organic waste from parks and requirements of utilization of such composts are set up. There are special requirements for feeding of fur-bearing animals according to which the processed animal protein derived from the carcass of the same animal species is allowed for feeding. Also for feeding of dogs it is allowed to use the animal by-products of second and third category. The surveillance and control of such activities is carried out by State Food and Veterinary Service.

According to the Cabinet Regulation No. 362 (adopted on 2 May 2006) Regulations Regarding Utilization, Monitoring and Control of Sewage Sludge and the Compost thereof, strict requirements on using of sewage sludge and its compost in agriculture and on control measures are set up. Currently this Cabinet Regulation is under revision to establish new requirements for using sewage sludge in biogas production and for using digestate produced from sewage sludge.

National Environmental Strategy 2014 - 2020 (adopted by Cabinet of Ministers 26 March 2014) recognizes and underlines that certain actions must be taken to reduce the amount of all kinds of landfilled waste to reach the goals stated by EU Framework Directive on Waste management.

The Waste Management Plan 2013-2020 (adopted by Cabinet of Ministers on 21 May2013), giving references to existing situation in the field of municipal waste management, states certain actions to be taken for coming years with respect to biodegradable waste as well (Table 1).

*Table 1. The amount of biodegradable waste 2010-2020 according to the Waste Management Plan 2013-2010.*

| Year | Planned amount of biodegradable household waste, tons | Amount of biodegradable household waste which is allowed to be landfilled, tons | Amount of biodegradable household waste which is not allowed to be landfilled, tons |
|---|---|---|---|
| 2010 | 607 000 | 345 000 | 262 000 |
| 2013 | 632 000 | 230 000 | 402 000 |
| 2020 | 461 228 | 161 000 | 299 798 |

[26] Available in Latvian: www.likumi.lv

A revised regulation on waste collection and sorting sites was approved recently – The Regulation of Cabinet of Ministers No. 788 (adopted on 13 December 2016) Regulations Regarding Waste Collection and Sorting Sites. This regulation prescribes ways of waste collection and sorting sites, requirements for establishment and management of waste collection and sorting sites as well as requirements for establishment and management of biodegradable waste composting sites.

According to Cabinet Regulation No. 34 (adopted on 22 January 2002) "Regulations Regarding Discharge of Polluting Substances into Water" an operator shall ensure useful utilization of wastewater and sewage sludge (including the use of wastewater and sludge from wastewater in the fertilization of the soil and improvement of the territories in accordance with the procedures specified in laws and regulations).

### *National financing programmes and other tools to enhance nutrient recycling*

The Rural Development Program (2014 - 2020) provides support for farmers, who have manure and crop residues derived in their farms for energy production use in their farms. The support for energy production from renewable energy resources is envisaged to ensure that all produced energy derived from production of agricultural products in farms should be used effectively.

The State support is envisaged for collecting, transportation, processing and disposal of animal cadavers. The aim of the support is to exclude infection and poisoning of humans and animals and release of pathogenic microorganisms into environment. The surveillance and control of such activity is carried out by the State Food and Veterinary Service.

### *Phosphorus sensitive areas*

Phosphorus sensitive areas are not defined in Latvia. Therefore the maps of such areas are not available. At the same time all territory of Latvia is defined as a phosphorus sensitive area in accordance with Urban Wastewater Treatment Directive 91/271/EEC. About 50% of agricultural land the content of phosphorus is low or very low.

## 2.6 Lithuania

Aira Šakūrienė, Ministry of Agriculture

28 April 2017

*Legislation, policies or strategies to enhance the recycling of nutrients*

Lithuania has the following national regulations related to nutrients (nitrogen and phosphorus) access into environment (including from agricultural sources) and recovery:

1. Order of the Minister of Environment and the Minister of Agriculture of the Republic of Lithuania "On Approval of Environmental Requirements for Manure and Slurry Management" [27];
2. Order of the Minister of Environment of the Republic of Lithuania related to approval of regulation of waste water management[28];
3. Description of environmental protection requirements related to economic activities in the Lithuanian Northern intensive karstic region[29];
4. Order of the Minister of Agriculture of the Republic of Lithuania "Rules for technological designing of manure and wastewater management buildings ŽŪ TPT 03:2010"[30];
5. Order of the Minister of Agriculture of the Republic of Lithuania "Rules for technological designing of poultry farms ŽŪ TPT 04:2012"[31];
6. Order of the Minister of Agriculture of the Republic of Lithuania "Rules for technological designing pigs buildings ŽŪ TPT 02:2010"[32];
7. Order of the Minister of Environment of the Republic of Lithuania "Requirements of the use of sewage sludge for fertilization and re-cultivation LAND 20-2005"[33];
8. Description of temporary environmental requirements for use of biodegradable waste for fertilization [34];
9. Strategy for Baltic sea environment protection [35];
10. Order of the Minister of Environment of the Republic of Lithuania "Rules for installing filtration equipment in natural conditions of environmental domestic waste water"[36].

For management of manure and slurry, requirements with provisions of national and EU regulations should be followed. Fertilization rate should be up to 170 kg / ha of nitrogen. Stricter standards are applied only for specific country regions. Accumulated nitrogen from manure and sewage is determined in farms depending on calculations of number of animals (SG) that are kept in the farm. It is considered that from 1 SG/per year one get 100 kg total nitrogen. Farms, which fertilize with manure or slurry more than 30 hectares of agricultural land during the calendar year must prepare a fertilization plan. The plan should include soil testing (not older than 3 years old data related to nitrogen and phosphorus accumulation in fertilized fields), estimated nutrients needed for plant nutrition in order to ensure growth of the planned crop yield (annual fertilization rate, single fertilization rate, annual and single emission load). Nitrogen, phosphorus and other

[27] http://www.infolex.lt/ta/91985?nr=1
[28] https://www.e-tar.lt/portal/lt/legalAct/TAR.4D0DFCDD673A/GYdugGvOlU
[29] http://www.infolex.lt/ta/66008?nr=1
[30] http://www.infolex.lt/ta/134708?ref=6
[31] http://www.infolex.lt/ta/157526
[32] http://www.infolex.lt/ta/129241
[33] http://www.infolex.lt/ta/6820
[34] http://www.infolex.lt/ta/145107
[35] http://www.infolex.lt/ta/138232
[36] http://www.infolex.lt/ta/54614

substances quantities in waste water (including from agricultural sources) are separately regulated by legislation (2).

### *Phosphorus sensitive areas*

The situation with the level of phosphorus in Lithuanian soils may differ compared with Nordic countries. Restrictions for fertilizing with organic phosphorus fertilizers might be impracticable. Monitoring and control of requirements that are listed in legislation are under responsibility of Ministry of Agriculture and the Ministry of Environment.

## 2.7 Poland

Karina Makarewicz, Ministry of Agriculture and Rural Development
Beata Jurga, Institute of Soil Science and Plant Cultivation – State Research Institute
15 November 2017

*Legislation, policies or strategies to enhance the recycling of nutrients*

There are many national legal acts that, at the moment, enhance the recycling of nutrients from agriculture and food industry, waste water treatment (sewage sludge), households (food waste) or other sectors. Just to enumerate some of them: the Legal Act on fertilizers and fertilizing, the Waste Law, the Law on Renewable Energy as well as the Water Law and the Nitrate Directive; also the Strategy for Sustainable Development of Rural Areas, Agriculture and Fisheries. As for agricultural production, the most important issue which is tackled by Poland via Polish legislation, policies or strategies is to optimize the N level within its natural cycle to the sustainable one. Tools to achieve that are, among others, the following:

- The limit of 170 kg of nitrogen per hectare per year from livestock manure is set out at the whole polish agricultural area, the farms that need to comply with the Industrial Emissions Directive (IED) are obliged to have a fertilization plan prepared in accordance with the principles of good agricultural practice, same for all agricultural holdings farming on nitrates vulnerable zones (NVZ); some of Rural Development Programme's (RDP) agri-environmental measures are also dedicated to reducing directly nitrogen and phosphorus footprint.
- The new Water Law Act dated 20 July 2017 was published in the Polish Journal of Laws on 23 August 2017. The Act will replace the current Water Law Act and largely enter into force on 1 January 2018. Major introduced improvement is, among others, establishing of one action programme for the whole Poland (instead of designating NVZs) aiming at reducing the outflow of nitrates from agricultural sources into waters.
- Efficient knowledge transfer to the farmers via services offered by the agricultural advisory centres, soil testing carried out by the National Chemical Agricultural Station provide the basis for rational fertilization planning. Furthermore, tools are widely available to support the agricultural advisory e.g. counselling programs such as fertilizer programs NawSald, Macrobil, Plano RSN or application calculating amounts of natural fertilizers.
- Sewage sludge used in agriculture should be of proper quality and therefore should not pose any risk to the environment. Control measures are set up, sewage sludge prior its use in agriculture is tested for organic matter content, as well as total nitrogen and phosphorus, heavy metals, calcium and magnesium and pathogenic bacteria and parasites contamination. Moreover, the Regulation on waste recovery so-called R10 "land treatment on a field that brings benefits to agriculture or improves the environment" is dedicated to reuse of some types of waste acceptable for such recovery.
- As animal nutrition represents another nutrient (carbon, phosphorus and nitrogen) storage pool, the level of protein and phosphorus in animal feed is regulated by the norms of Animal Nutrition (separately for ruminants and other animals). The obligation for their use is inscribed within the Act on the feed, as well as within the Law on Animal Protection.
- Effective administrative control is managed by the Chief Inspectorate of Environmental Protection.
- Rational fertilizers management promotion. In 2014 the nationwide information campaign entitled "Rational fertilizer management" has been initiated by the Ministry of Agriculture and Rural Development. The campaign consisted of training, educational material and brochures, which reached more than one million farmers. In order to promote the conscious management of nutrients

within a field, holding, region and country, the websites[37] dedicated to those issued have been developed as well. Last year, a training for more than 10,000 farmers was organized to promote good agricultural practices on NVZs.

Phosphorus application and phosphorus managements are regulated indirectly through above mentioned measures.

### *National financing programmes and other tools to enhance nutrient recycling*

At the moment, there are new tools in preparation to enhance nutrient recycling in Poland. Some regions dedicate special funds for nutrient recycling as they acknowledge bioeconomy and bioresources processing as the key specialization in regional development. A new research project BioEcon, funded under HORIZON 2020 is conducted. It is aimed at the development of bio-economy in Poland with a special focus on intensive interaction with policymakers and stakeholders to mobilize regional support and transfer research outcomes as well as on massive dissemination of bioeconomy methods.

### *Phosphorus sensitive areas*

Currently, there are preparations to create maps of phosphorus sensitive areas. Factors that are analysed are status of waterbodies, soil fertility status, soil acidity, risk of water erosion, animal density and gross phosphorus balance (soil surface balance). Some of the thematic layers are already in place and some will be available via chemical agricultural station sample reports on the status of soil fertility[38][39].

Additionally, governmental research is financing research focused on estimating the risk of phophorus losses based on a P-Index concept that includes not only soil phosphorus (Mehlich 3) but also P-saturation parameter.

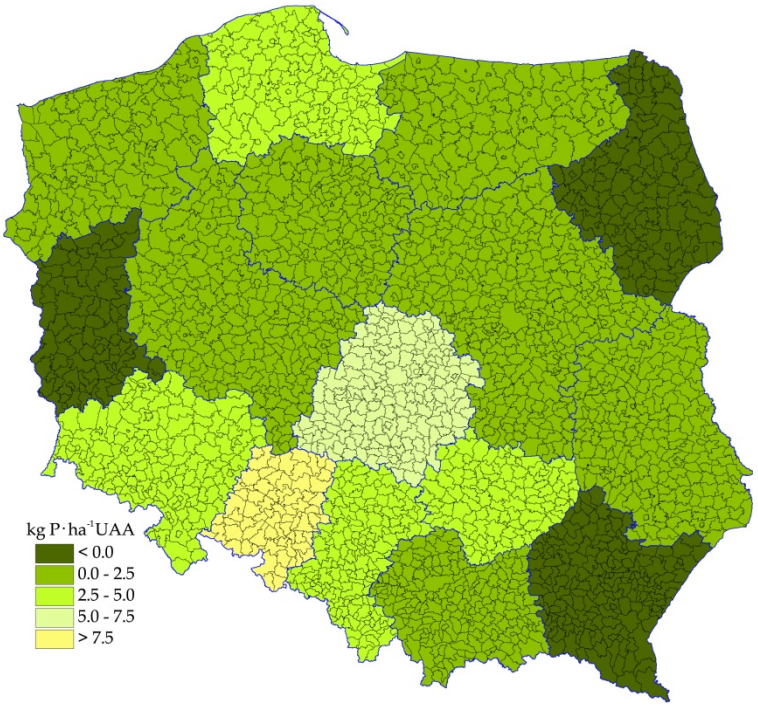


*Figure 2. Soil surface phosphorus balance for 'gminas' of Poland.*

[37] http://iung.pl/dpr_eng/
[38] http://www.schr-poznan.com/images/stories/Do_pobrania_goscie/Publikacja_OSChR_Poznan.pdf
[39] http://www.oschr-gorzow.pl/index.php/d-a-o-r/artykuly/monitoring-azotu-mineralnego-w-glebie

## 2.8 Russia

Vladislav Minin, Institute for Engineering and Environmental Problems in Agricultural Production
5 September 2016

*Legislation, policies or strategies to enhance the recycling of nutrients*

The main sources of nutrient inputs into waterbodies from agriculture are manure and waste water from livestock/poultry premises. In Russia, waste management, including livestock, is regulated by the Federal Law of 24.06.1998 number 89-FZ "On Production and Consumption Waste"[40]. The law requires the owner of the waste to ensure the prevention of harmful effects on human health and the environment, as well as the involvement of waste into economic circulation as additional sources of raw materials. Cattle manure is assigned to the fourth level of danger, and pig manure and poultry litter - to third level. Therefore, the companies and farmers with livestock and poultry have special requirements of environmentally sound waste management.

Currently, pursuant to Art. 17 of the Federal Law of December 27, 2002 N 184-FZ "On Technical Regulation"[41], each agricultural enterprise should develop “Enterprise Standard. Technological Regulations for Environmentally Sound Animal and Poultry Manure Processing and Fertilizing Application”. The objectives of the introduction of the regulation is to increase the level of safety of life and health of citizens, improve environmental safety, animal and plant life and health safety; improvement of production and product quality assurance. Regulations is a document, which describes the conditions and sequence of the Technological process of animal/poultry manure processing into an organic fertilizer, resulting in environmentally safe product with the quality indices, which comply with the requirements of approved standards or technical specifications.

Documents governing the treatment of livestock waste on which regulations are based are the following:

- RD-APC 1.10.15.02-08 “Guidelines for the Technological design of removal systems and preparation for the use of manure"[42];
- Veterinary and sanitary rules for the preparation to be used as organic fertilizers manure, poultry litter and waste water in infectious and parasitic diseases of livestock and poultry[43].

Thus, the result of the creation and implementation of the “Enterprise Standard. Technological Regulations ….”, is to solve problems of safe disposal of manure, manure runoff, bird droppings and compost, eliminating their negative effects on human health and the environment.

[40] Федеральный закон от 24.06.1998 № 89-ФЗ "Об отходах производства и потребления" (the Federal Law of 24.06.1998 number 89-FZ "On Production and Consumption Waste"(in Russian);
[41] Федеральный закон от 27 декабря 2002 г. N 184-ФЗ «О техническом регулировании» (Federal law of December 27, 2002 N 184-FZ "On Technical Regulation""(in Russian);
[42] РД-АПК 1.10.15.02-08. Методические рекомендации по технологическому проектированию систем удаления и подготовки к использованию навоза и помета (Management Directive for Agro-Industrial Complex (РД-АПК) 1.10.15.02-08 «Recommended Practice for Engineering Designing of Animal and Poultry Manure Removal Systems and the Systems of Animal and Poultry Manure Preparation for Application»). Moscow, 2008, 93 p. (in Russian);
[43] «Ветеринарно-санитарные правила подготовки к использованию в качестве органических удобрений навоза, помета и стоков при инфекционных и инвазионных болезнях животных и птицы», Утверждены Заместителем Начальника Департамента ветеринарии Минсельхозпрода России В.В.СЕЛИВЕРСТОВЫМ 4 августа 1997 г. N 13-7-2/1027 (Veterinary and sanitary rules for the preparation to be used as organic fertilizers manure, poultry litter and waste water in infectious and parasitic diseases of livestock and poultry,approved by the Deputy Head of Veterinary Department Russian Agriculture Ministry on August 4th, 1997 N 13-7-2 / 1027(in Russian);

The introduction of Technological regulations of the agricultural enterprise provides:

- Environmental Fees reduction and elimination of penalties for negative impact on the environment;
- Transition to a waste-free farming technology;
- Improvement of the environmental safety of the enterprise and obtaining additional profit (increase in yield, increase soil fertility).

To date, more than 50% of agricultural enterprises of various forms of property in the region have the technological regulations on preparation and use of manure and poultry dung as organic fertilizer.

Control over the impact of agricultural enterprises on the environment is carried out by:

- Federal Service for Veterinary and Phytosanitary Supervision;
- Federal Service for Supervision of Natural Resources.

In particular, the nitrate content in soil, nitrate and ammonium and phosphates concentration in the waste water going onto water sources are monitored (Table 2.).

Enterprises, including livestock, discharging their wastewater into water sources, must ensure that the content of controlled substances are below the MPC.

*Table 2. MPC of mineral nitrogen and phosphorus compounds in soil and water*

| **Index** | **Chemical form** | **MPC, mg/kg** | **Note** |
|---|---|---|---|
| Soil | | | |
| Nitrate | $NO_3$ | 130 | |
| Fishery waters | | | |
| Ammonium ions and $NH_4$ | $NH_4$ | 0,5 | |
| Nitrate | $NO_3$ | 40 | |
| Nitrite | $NO_2$ | 0,08 | |
| sodium and calcium and potassium phosphates, mono-, di- and tri-substituted | $PO_4$ | 0,05 | oligotrophic waters |
| | | 0,15 | mesotrophic |
| | | 0,2 | eutrophic |
| Water bodies of water drinking and cultural and community water use | | | |
| Ammonium ions and $NH_4$ | $NH_4$ | 1,9 | |
| Nitrate | $NO_3$ | 45 | |
| Nitrite | $NO_2$ | 3,3 | |

It should be noted that the integral indicator of the degree of use of nutrients in agriculture is a balance of nutrients for agricultural enterprises, district and region. Currently, the Institute for Engineering and Environmental Problems in Agricultural Production "(IEEP) develops such balances in the region.

*National financing programmes and other tools to enhance nutrient recycling*

The State programme of development of agriculture and regulation of agricultural products, raw materials and foodstuffs for 2013 - 2020[44] provides financial assistance to agricultural enterprises in the construction of new or reconstruction of old livestock buildings, including facilities for handling manure. Also, grants are issued to new farmers, in part can be used for the development of instruments for the management of manure/litter.

*Phosphorus sensitive areas*

Regional maps of mobile phosphorus content in agricultural soils are not currently available. Meanwhile, the soil of agricultural enterprises and farms are examined regularly and the content of mobile phosphorus is determined. A special project to collect the analytical data and to generate the map is needed.

[44] http://mcx.ru/

## 2.9 Sweden

Carina Carlsson-Ross, Swedish Board of Agriculture
Anna Maria Sundin, Swedish Environmental Protection Agency
31 May 2017

*Legislation, policies or strategies to enhance the recycling of nutrients*

The basis in Sweden, when it comes to enhancing the recirculation of nutrients, was the implementation in July 2001 of the directive 99/31/EG. According to the law that was passed, organic untreated waste cannot (since 2005) be used for landfills. The biological reuse of food waste in Sweden is increasing and in 2014, about 38 % of the food waste was biological treated (composted or used for biogas) to take care of the nutrients. One of the environmental quality objectives[45] states that by 2018, at least 50 % of the food waste should be sorted and treated biologically in order to reuse the nutrients[46]. The responsible authority is the Environmental protection agency in Sweden.

When it comes to nutrient recycling in agriculture, there are no direct legislation or policies that regulates this. There is a limitation on how much phosphorus from animal manure that can be used per hectare of farm land. This is indirect a way of enhancing a sustainable recycling of nutrients by making sure the production of animal manure is not larger than the plant demand on the farm. This is regulated in the rules on environmental concerns in agriculture and states that livestock manure or other organic fertilizers may, for five years, not be applied in quantities greater than the equivalent of 22 kg total phosphorus per hectare of application area per year[47]. The application of nitrogen in animal manure is regulated in accordance with the nitrate directive. The responsible authority is the Swedish Board of Agriculture.

For sewage sludge there are rules regulating the quality of the sewage sludge that can be used on agricultural land, how it can be spread and for which crops it can be used. The rules are set in order to protect human health and the environment.

No other hazardous substances than heavy metals are regulated in todays' legislation. However, in 2013 the Swedish Environmental protection agency presented a commission from the Swedish government concerning sustainable recycling of phosphorus. In this commission a proposal of a new ordinance was presented. The new, suggested regulation is in progress at the ministry and has not been decided upon.

In the proposed ordinance limit values of some organic substances are included, see table 3. The suggested limit values are based on a risk assessment.

Approximately 200 000 tones dry solids of sewage sludge is produced in Sweden per year. In 2014, 25% was used in agriculture, 29% for soil production and 24% for final coverage of landfill. There is a ban to deposit organic material, but composted sewage sludge is excluded from this ban. However, the amount of sludge which is deposited is limited. Only 1% of the sludge was combusted. There is no full scale application of recovery of phosphorus in ashes used in Sweden. There are some methods under development, but in a pilot scale.

[45] The environmental quality objectives describe the quality of the environment that Sweden wish to achieve by 2020. There are 16 of them, covering different areas – from unpolluted air and lakes free from eutrophication and acidification, to functioning forest and farmland ecosystems. The objectives have been adopted by the Swedish Parliament.
[46] www.miljomal.se
[47] SJVFS 2015:21: The Swedish Board of Agriculture rules and general guidance (SJVFS 2004:62) on environmental concerns in agriculture as regards plant nutrients.

*Table 3. Suggested limit values in the commission on sustainable phosphorus recovery (Swedish EPA 2013) and quality of sludge used on farmland 2015*

| Metals | Current limit mg/kg TS | Suggested limit 2015 mg/kg TS | Suggested limit 2023 mg/kg TS | Suggested limit 2030 mg/kg TS | Quality of Swedish sludge used in agriculture 2015* |
|---|---|---|---|---|---|
| Cadmium (Cd) | 2 | 1 | 0,9 | 0,8 | 0,75 |
| Copper (Cu) | 600 | 600 | 550 | 475 | 341 |
| Mercury (Hg) | 2,5 | 1 | 0,8 | 0,6 | 0,52 |
| Chromium (Cr) | 100 | 60 | 45 | 35 | 22 |
| Nickel (Ni) | 50 | 40 | 35 | 30 | 16 |
| Lead (Pb) | 100 | 35 | 30 | 25 | 18 |
| Zink (Zn) | 800 | 800 | 750 | 700 | 544 |
| Silver (Ag) | | 5 | 4 | 3 | |
| **Organic contaminants** | | | | | |
| Dioxin | | 20 | 15 | 10 | |
| PFOS | | 0,07 | 0,05 | 0,02 | |
| Klorparaffiner | | 4 | 3 | 2 | |
| PCB7 | | 0,06 | 0,05 | 0,04 | |
| BDE-209 | | 0,7 | 0,5 | 0,5 | |

*As reported in the Implementation questionnaire 2014 on soil and sewage

### *National financing programmes and other tools to enhance nutrient recycling*

In the project ”Focus on nutrients” the farmer is in focus. The goal of the project is to increase nutrient management efficiency by increasing awareness and knowledge. Therefore the core of the project is education and individual on-farm advisory visits which are free of charge for the farmer[48].

Financial support for the production of biogas from animal manure is available. The project is financed nationally and runs from 2014 to 2023. Small-scale producers can receive support for the energy produced. The producer is paid for the environmental benefit of producing the gas from animal manure.

The Swedish Water & Wastewater Association, representing the water industry, has established a quality assurance certification system, REVAQ, which enables wastewater treatment plants to obtain certification of their sludge. Nearly half of all wastewater in Sweden is now treated in REVAQ certified wastewater treatment plants. The treatment plants are designed to remove nutrients from the water and bind these in the sludge, but current treatment methods are not in place to remove environmental pollutants. Therefore the upstream work is crucial to improve the sludge quality. To become certified according to REVAQ the WWTP needs to carry out active and structured upstream work.

[48] www.greppa.nu

*Phosphorus sensitive areas*

There are no such maps produced for Sweden. The water classification according to the water framework directive can be used as an indication of where phosphorus application should be limited and recycling improved.


www.helcom.fi