Document title	Technical review of synopses
Code	2-1-Rev.1
Category	DEC
Agenda Item	2 – Technical review of synopses
Submission date	4.6.2020
Submitted by	Secretariat
Reference	

The document has been revised with the information that answers by Poland have been included in 2-1-Att.1.

Background

To support the selection of new measures and actions for the updated Baltic Sea Action Plan, an invitation to submit synopses on potential new HELCOM actions was put forward in spring 2019 to the Contracting Parties, HELCOM subsidiary bodies, international projects and HELCOM Observers.

AGRI 9-2020 took note of the synopses related to agriculture and the guidance for making a technical review of the synopses, agreed to supply replies utilizing the agreed template to the Secretariat by 28 May 2020, requested the Secretariat to make a compilation of the replies and agreed to discuss them in a dedicated online meeting.

The attached document includes the guidance for making the technical review and the synopses relevant for the Agri group.

The attached Excel document (2-1-Att.1) contains the list of synopses relevant for the group and a compilation of the answers by Denmark, Estonia, Finland, Germany, Latvia, Poland and Sweden.

Action requested

The Meeting is invited to finalize the technical review of synopses relevant for the Agri group.

Review of synopses on potential new actions for the updated BSAP

HELCOM has invited submissions of proposals on new actions for the updated BSAP with closing date at the end of 2019. As a response, HELCOM subsidiary bodies, HELCOM observers, and HELCOM and BONUS projects have submitted synopses of about 80 potential new actions. According to the BSAP work plan, HELCOM Working Groups will carry out a first review of the synopses at their regular meetings in spring 2020. Such review round aims to provide a preliminary (qualitative) evaluation focusing on the technical aspects and substance of the proposals. The review should, in this first step, be carried out from a scientific point of view and focus on technical feasibility of the measures, not legal or other aspects of feasibility.

At the BSAP UP workshops in May 2020, further deliberation and evaluation of the proposals will continue based on a set of criteria agreed by the Gear Group, also taking into account the results of the ongoing analysis of sufficiency of measures. The outcome of the Working Group Meetings will be used as a basis for the BSAP UP workshops.

The Working Groups are asked to consider the proposals in their field of expertise and to give feedback on the following aspects/questions:

1) to suggest whether a submitted proposal is best categorized as a measure, research need, or monitoring/data need. All types of proposals will be considered in the BSAP update process but only those that can contribute directly to the reduction of pressures or improvement of the state of the environment will be considered when analysing of sufficiency of measures in the updated BSAP. Proposals related to research needs will be considered for the HELCOM Science Agenda that is under development.
2) to consider whether a proposal is a new measure or is already entirely/partly covered by an existing HELCOM action. In the latter case, identify if the proposal should be, or already is, taken into account in the review and revision of existing HELCOM actions.
3) to evaluate if the proposal is sufficiently substantiated, i.e. if appropriate supporting references and evidence of effect have been provided. This step could make use of a scale low-medium-high.
4) if the proposed action concerns a technical measure, evaluate if it is technically feasible to implement the proposed measure, e.g. is the proposed technique sufficiently developed and tested to be considered for practical implementation. This step could make use of a scale low-medium-high.
5) to identify potential gaps in the proposed new action; it could be that a measure/action has to be implemented first (before the proposed action) or some steps are missing in the proposal.
6) consider gaps and overlaps for the set of synopses: are there any central issues for HELCOM work that are not represented in the set of existing actions or synopses (activities, pressures, state components highlighted in HELCOM strategies, Ministerial Declarations). If yes, identify how the gap could be resolved, e.g. for a lead country to prepare additional synopses. Are there overlaps? If overlaps exist, suggest merging of proposals.

Note that no proposals will be excluded at this stage; the aim is to identify how the proposal is placed in the framework of existing HELCOM actions and make a qualitative evaluation of the technical soundness of the synopses.

RESPONSE TEMPLATE:

Proposed measure: XX		
Question	Response option	Comments/suggestions
1. Is the submitted proposal best categorized as a measure, research need, or monitoring/data need	Measure / research need / monitoring or data need	…
2. Is it a new measure or entirely/partly covered by an existing HELCOM action	New measure / Partly covered by existing action/Covered by existing action	[Clarify the potential overlap]
3. Is the proposal sufficiently substantiated	Low-medium-high	…
4. Is it technically feasible to implement the proposed measure	Low-medium-high (or Not applicable)	…
5 Potential gaps in the proposed new action	Yes/No	[Clarify the potential gap. The submitters could be asked to complement the synopsis]

Consideration of the set synopses		
6a. Potential gap in the set of proposed new actions	Yes/No	[Clarify the potential gap and propose how it could be resolved]
6b. Potential overlap between proposed new actions	Yes/No	[Clarify the potential overlap]

Overview of proposals

An overview of proposals relevant for the AGRI Group are set out in the table below. The full text of each proposal is available further below and can be reached by clicking the titles in the table. Some of the synopses also fall under the mandate of other HELCOM Working Groups.

Title	**Submitted by**	**Considered also by Working group**
Adapted buffer zones to reduce phosphorus losses from agricultural land, for example on parts of fields where surface runoff and erosion occurs, along ditches or at surface water inlets	Sweden	Pressure
Adapted fertilization rate and precision fertilization in order to increase nitrogen efficiency and reduce nitrogen losses	Sweden	Pressure
Allow coordination of abatement measures among HELCOM countries to ensure cost-effective nutrient abatement at the basin and Baltic scales	TOOLS2SEA (BONUS project)	Pressure
Annual field-level fertilization planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region	SuMaNu	Pressure
Cost effectiveness should be the guiding principle for designing nutrient abatement plans	TOOLS2SEA (BONUS project)	Pressure

Title	Submitted by	Considered also by Working group
Definition of "New Hot Spots" of nutrient input into the Baltic and subsequent targeted measures to reduce the source	CCB	Pressure
Develop Best Available Techniques (BAT) lists for reducing ammonia and GHG emissions from livestock housing, manure storage and spreading	SuMaNu	Pressure
Develop national strategy and consequent measures to secure sustainable use of recyclable nutrients with potential inclusion of simultaneous bio-fuel production	SuMaNu	Pressure
Develop recommendations to support national strategies for manure management in the BSR specifically from horses, sheep, goats, and fur farming	CCB	Pressure
Facilitating the selection of cost-effective measures by creating national catalogues of abatement measures and their unit abatement costs	TOOLS2SEA (BONUS project)	Pressure
Improve knowledge transfer between farmers, authorities and decision makers	SuMaNu	Pressure
Improve soil structure and aggregate stability on clay soils to reduce phosphorus losses from agricultural lands, for example by using soil structure lime or gypsum	Sweden	Pressure
Incentives to support the use and the production of manure based recycled nutrients	SuMaNu	Pressure
Increase organic farming to reduce the inputs of nutrients and hazardous substances to the Baltic Sea	DE expert contribution	Pressure
Levy on mineral phosphorus in animal fodder and on mineral fertilizer P	TOOLS2SEA (BONUS project)	Pressure
Levy on nitrogen in mineral fertilizer	TOOLS2SEA (BONUS project)	Pressure
Mutual learning among farmers on best practices and innovative technologies	TOOLS2SEA (BONUS project)	Pressure
Nutrient-balanced fertilization to control nutrient surplus on farmland	CCB	Pressure
Prohibition of post-harvest application of manure and other organic fertilizers	TOOLS2SEA (BONUS project)	Pressure
Promote regenerative farming practises for multiple benefits	BSAG	Pressure
Recycling of nutrients and carbon in agricultural residues by use of anaerobic digestion	RETURN (Bonus project)	Pressure

Title	Submitted by	Considered also by Working group
Reducing livestock densities and coupling livestock to the area of available farmland	DE expert contribution	Pressure
Reporting estimates on the effects of agri-environmental measures on the main phosphorus (P) fractions	Shared Waters project	Pressure
Safe manure nutrient recycling	SuMaNu	Pressure
Use of gypsum to reduce phosphorus loads from agricultural land	SAVE (Finnish project)	Pressure

Title: Adapted buffer zones to reduce phosphorus losses from agricultural land, for example on parts of fields where surface runoff and erosion occurs, along ditches or at surface water inlets

Submitted by:

Sweden
Contact: Swedish Board of Agriculture

Description of measure

A perennial crop (such as grass) that can reduce erosion is established and maintained on parts of the agricultural land where erosion och surface runoff frequenly occur. It can, for example, be on erosion-prone parts of a field, along ditches, streams and lakes or at surface water inlets to the drainage system.

Activity:

Agriculture

Pressure:

Input of phosphorous

State:

Nutrients

Extent of impact:

Effectiveness of measure

The effectiveness depends on where the zones are placed. If they are located where surface runoff and erosion occur, they can significantly reduce erosion. They also reduce the risk of P losses caused by soil tillage close to ditches and watercourses and fertilizers being unintentionally spread outside the field or directly into the water. Site-specific information is needed to be able to place the zones where they reduce erosion.

Cost, cost-effectiveness of measure:

The adapted buffer zones take land out of production and it also takes extra time for a farmer to manage a field with buffer zones within the field. The measure has been assessed to have high cost-effectiveness in a Swedish evaluation (Gyllström et al., 2016).

Feasibility:

Follow-up of measure:

Background material:

References

- Helena Aronsson, Kerstin Berglund, Faruk Djodjic, Ararso Etana, Pia Geranmayeh, Holger Johnsson and Ingrid Wesström (2019) Effekter av åtgärder mot fosforförluster från jordbruksmark och åtgärdsutrymme, Ekohydrologi 160
- Djodic, F. and Markensten, H. 2018. From single fields to river basins: Identification of critical source areas for erosion and phosphorus losses at high resolution. Ambio 48:1129–1142
- Mikael Gyllström, Martin Larsson, Jens Mentzer, Jan F. Petersson, Mathias Cramér, Peo Boholm and Ernst Witter (2016) Åtgärder mot övergödning för att nå god ekologiskt status - underlag till vattenmyndigheternas åtgärdsprogram. Länsstyrelsens rapportserie, Rapport 2016:19

Title: Adapted fertilization rate and precision fertilization in order to increase nitrogen efficiency and reduce nitrogen losses

Submitted by:
Sweden
Contact: Swedish Board of Agriculture

Description of measure
The amount of nitrogen fertilizer applied and the distribution of fertilizer within fields are adapted to the need of the crop and to the nitrogen delivery from the soil. The conditions at the specific site and in the specific year are considered. All nitrogen fertilizer is not applied at once. Techniques such as unfertilized plots, N-sensors and satellite photos can be used to asses how much nitrogen to apply during the season, and to adapt the application rate within different parts of a field. Nitrogen losses can be reduced by increased nitrogen use efficiency and reduced over-fertilization.

Activity:
Agriculture

Pressure:

Input of nitrogen

State:
Nutrients

Extent of impact:
So far this measure is used to different extent in the countries around the Baltic Sea and there is potential for wider use. It is mostly used in winter wheat but it is also suitable in other crops.

Effectiveness of measure
The effectiveness of the measure depends greatly on how efficiently nitrogen is currently used, i.e. how much it can be improved.

Cost, cost-effectiveness of measure:
The farmer can save money on fertilizers. Initial investments can be needed, depending on the chosen technique.

Feasibility:

Follow-up of measure:

Background material:

References

- S. Delin and M. Stenberg (2014) Effect of nitrogen fertilization on nitrate leaching in relation to grain yield response on loamy sand in Sweden, European Journal of Agronomy, Vol 52
- Simmelsgaard & Djurhuus (1998) An empirical model for estimating nitrate leaching as affected by crop type and the long-term N fertilizer rate, Soil Use and Management, Vol 44

Title: Allow coordination of abatement measures among HELCOM countries to ensure cost-effective nutrient abatement at the basin and Baltic scales.

Submitted by:

BONUS TOOLS2SEA; https://projects.au.dk/bonus-tools2sea/; msa@envs.au.dk (Mikael Skou ANDERSEN)

Description of measure

Rules specifying how nutrient abatement targets can be achieved have a substantial impact on total costs. The current Baltic Sea Action Plan (BSAP) sets rigid national abatement targets, rather than basin specific targets. If each country must reduce nutrient emissions by a certain amount to a certain basin, costs will be unconditionally higher than necessary. If more flexible abatement strategies were allowed, i.e., if BSR countries could cooperate to find the least-costly abatement measures for a particular basin, the same overall reduction could be achieved at substantially lower cost than implied by the current BSAP.

Activity:

Agriculture

Pressure:

Input of phosphorous
Input of nitrogen

State:

Nutrients

Extent of impact:

Coastal waters/sub basins/Baltic scale.

Effectiveness of measure

Flexibility in choices of abatement measures is fundamental for achiving cost-effective solutions according to environmental policy theory. The greater the potential choice of measures the greater the potential reduction in costs to achieve a specific target. Allowing BSR countries the flexibility to cooperate in the choice and spatial allocation of abatement measures among countries would considerably increase flexibility, and hence potential to reduce the costs of achieving abatement targets. In this way, nutrient abatement measures could be allocated to those places where they have the greatest effect for the lowest cost. In the absence of this flexibility individual countries may be forced to implement extremely costly meausures, when a neighbour could have achieved the same abatement at lower cost.

Cost, cost-effectiveness of measure:

Balitic-scale cost-effectiveness studies show that as much as 500 million Euros can be saved annually if the BSAP set basin scale nutrient abatement targets and allowed flexibility among countries for achieving the targets, through cooperation.

Feasibility:

Since cost-effective abatement would significantly lower the costs of achieving Baltic Sea abatement targets compared to the current BSAP, which is based on national targets, it should be more feasible than the current BSAP.

Follow-up of measure:
The measure would promote implementation of known abatement measures at a scale far greater than is likely under the current BSAP, because the costs of implementing the current plan are substantially higher than necessary.

Background material:
Elofsson, K. 2010b. Cost-effectiveness of the Baltic Sea Action Plan. Marine Policy, 34, 1043-1050.

References
Gren, I.-M. 2008b. Costs and benefits from nutrient reductions to the Baltic Sea. Report 5877. Stockholm: Swedish Environmental Protection Agency.
Wulff et al. (2014) Reduction of Baltic Sea Nutrient Inputs and Allocation of Abatement Costs Within the Baltic Sea Catchment. AMBIO, 43, 11-25.

Title: Annual field-level fertilization planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region
Submitted by: SuMaNu project platform
Description of measure To optimise nutrient use efficiency on farms and to enhance nutrient recycling, annual field-level fertilization planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region. Norms or guidelines for economically optimal N and P fertilisation rates that farmers can adjust for local conditions and expected yields should be developed for all relevant crops and updated regularly at a national level. To have a full picture of the soil nutrient supply capacity, soil analysis data and field cultivation history, including crop rotation, should be taken into account. Farm-gate nutrient balancing should be done annually after harvest to be able to follow the nutrient use efficiency on the farm
Activity: Agriculture
Pressure: *Input of phosphorous* *Input of nitrogen*
State: Nutrients
Extent of impact:
Effectiveness of measure Planning the fertilization annually and following up the nutrient use with farm-gate nutrient balances is essential in avoiding overfertilization that can lead to nutrient loading.
Cost, cost-effectiveness of measure: Following up the fertilization and improving resource efficiency is also beneficial for the farmer.
Feasibility:
Follow-up of measure:
Background material:
References

Title: Cost effectiveness should be the guiding principle for designing nutrient abatement plans.
Submitted by: BONUS TOOLS2SEA; https://projects.au.dk/bonus-tools2sea/; msa@envs.au.dk (Mikael Skou ANDERSEN)

Description of measure
A nutrient abatement plan is cost effective when it promises the greatest possible reduction in emissions for the lowest possible cost to society. Cost-effectiveness should be the guiding principle for guiding pollution policy, because society's resources are limited while abatement measures are costly to farmers. Failure to consider cost effectiveness not only implies less abatement is achieved than is possible given available budgets, but ultimately reduces the political attractiveness of implementing measures, since the higher the costs the greater the political barriers to implementing measures.

Activity:
Agriculture

Pressure:
Input of phosphorous
Input of nitrogen

State:
Nutrients

Extent of impact:
Coastal waters/sub basins/Baltic scale

Effectiveness of measure
The cost-effectiveness criteria implies effectiveness by definition. It adds the condition that a measure should not only be effective, but also minimize the costs of reducing nutrient emissions when different measure are available.

Cost, cost-effectiveness of measure:
Balitic-scale cost-effectiveness studies show that as much as 500 million Euros can be saved annually if cost-effectiveness was the guiding principle for designing the BSAP.

Feasibility:
Cost-effective measures would likely imply higher costs for particular farmers compared to current schemes, which reduces their feasibility. This is because current schemes are normally based on uniform payments per unit area of a measure rather than the amount of pollution abatement. Meausres will therefore be located where they are least costly for the farmer and not for nutrient abatment. To make it feasible for farmers to locate measures where they have greater affect but are also more costly to the farmer it is necessary that payments for measures can be differentiated, such that farmers who reduce more pollution can receive higher payments.

Follow-up of measure:

Background material:
Elofsson, K. 2010b. Cost-effectiveness of the Baltic Sea Action Plan. Marine Policy, 34, 1043-1050.
Wulff et al. (2014) Reduction of Baltic Sea Nutrient Inputs and Allocation of Abatement Costs Within the Baltic Sea Catchment. AMBIO, 43, 11-25.

References
Sidemo-Holm, W., H. G. Smith and M. V. Brady (2018). "Improving agricultural pollution abatement through result-based payment schemes." Land Use Policy, 77: 209-219.

Title: Definition of "New Hot Spots" of nutrient input into the Baltic and subsequent targeted measures to reduce the source

Submitted by:
Coalition Clean Baltic (Observer)

Description of measure
Using existing monitoring and reporting schemes (e.g. PLC), this measure aims at finding current Hot Spots of nitrogen and phosphorous input into the Baltic Sea. Building up on the measure of the last BSAP where Hot Spots of intensive rearing of cattle, poultry and pigs that were not fulfilling the requirements in the revised Annex III of the Convention were identified, this new measure would identify any current source, thus making it possible to tackle the sources of high nutrient input. Especially for phosphorous as an ending resource an efficient strategy for recycling instead of net loss into the Baltic has to be developed.

Activity:
Waste waters (urban, industrial, and industrial animal farms)
Aquaculture – marine, including infrastructure
Aquaculture – land
Agriculture

Pressure:
Input of organic matter — diffuse sources and point sources
Input of nitrogen
Input of phosphorous

State:
Nutrients

Extent of impact:
The measure would be put in place for the whole basin of the Baltic Sea.

Effectiveness of measure
By identifying Hot Spots and consequently using the results to specifically reducing those identified sources, such as industrial animal farming, phophosgypsum waste sites or lacking wastewater treatment, the reduction of the overall nutrient input into the Baltic would be greatly reduced. Especially for phosphorous as an ending resource an efficient strategy for recycling instead of net loss into the Baltic has to be developed.

Cost, cost-effectiveness of measure:

Feasibility:
The „list of hot spots" is an established mechanism in HELCOM that has proven efficient in the past. Based on the latest Pollution Load Compilation data it should be already possible to identify hotspots with high inputs of nitrogen and phosphorus. Criteria for defining such hotpots need to be further developed. Lastly, there are financing mechanisms already in place (e.g. EUSBSR, Nordic Council) or are under development (fund for the implementation of the new BSAP). These could be used to finance the remediation of the identified hotspots.

Follow-up of measure:
There is already an established follow-up system and reporting mechanism for the deletion of hot spots.

Background material:

References

Title: Develop Best Available Techniques (BAT) lists for reducing ammonia and GHG emissions from livestock housing, manure storage and spreading

Submitted by:
SuMaNu project platform

Description of measure
Best Available Techniques (BAT) lists for reducing ammonia and GHG emissions from livestock housing, manure storage and spreading should be jointly developed for the Baltic Sea Region and adopted by each country for all livestock producers. Currently, on the EU level, only industrial-sized poultry and pig farms are obliged to follow the BAT reference documents published by the Joint Research Center according to the Industrial Emissions Directive. Cattle and dairy farms are excluded from the regulation regardless of their size. Considering the difficulties in significantly reducing the negative impacts of agriculture on the environment and climate, it is time to require all livestock operations to abide by BATs.

Activity:
Agriculture

Pressure:
Input of phosphorous
Input of nitrogen

State:
Nutrients

Extent of impact:

Effectiveness of measure
With best available technology the emissions can be significantly reduced. Different techniques, e.g. slurry acidification, have been tested in regional projects and the results showed a large emission reduction potential.

Cost, cost-effectiveness of measure:
Since testing new technologies is expensive and time consuming, it would make most sense to jointly within the Baltic Sea Region (BSR) establish evaluation criteria and protocols for approval of new BATs as well as minimum performance levels for reducing ammonia and GHG emissions to be included on the list. A jointly approved and developed BAT list would not only be more resource effective than each country evaluating and developing its own list, but it would also speed the assimilation of new innovative techniques into practice across the BSR.

Feasibility:

Follow-up of measure:

Background material:

References
http://balticslurry.eu/
https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/best-available-techniques-bat-reference-document-intensive-rearing-poultry-or-pigs

Title: Develop national strategy and consequent measures to secure sustainable use of recyclable nutrients with potential inclusion of simultaneous bio-fuel production

Submitted by:
SuMaNu project platform

Description of measure
To reduce emissions from manure, enhanced manure management and use is the key. This includes increasing the use of best available methods on the farms in animal feeding (avoidance of unnecessary nutrient excretion to manure) and in technologies used for animal housing, manure storage and manure spreading (minimizing losses into the environment).

Furthermore, additional benefits may be gained with manure processing including production of renewable energy. If the solutions are linked to bio-fuel production, emission reduction may become even more effective especially with regard to greenhouse gases.

An overarching strategy on the national level to support sustainable nutrient recycling with simultaneous transition towards renewable transportation would assist in aligning different sector policies (the environment, climate, energy, transport, land use), address their multiple objectives, ensure a broad commitment to the change and plan effective steering mechanisms. Such longer-term strategies may give sufficient security for businesses to invest in novel technologies and services in nutrient recycling.

Activity:
Agriculture

Pressure:
Input of phosphorous
Input of nitrogen

State:
Nutrients

Extent of impact:

Effectiveness of measure
Strategies may make the field of manure processing and nutrient recycling clearer to all stakeholders involved. It enables better division of responsibilities and improved dialogue between sector policies deciding on potential measures to support the actions desired. The targets of the society become clearer to the businesses which may then feel more secure to invest and push the actions forward, relying more on their services and products to be needed in the future. The strategy is also a means to facilitate dialogue between the stakeholders and to raise awareness amongst the society on the reasons behind the actions desired, thus potentially making the transition to new practices smoother. Thus, cross-sectoral national strategy on nutrient recycling, in possible connection to transition to bio-fuels, may push the overall practical change forward effectively.

Cost, cost-effectiveness of measure:
Working groups on different issues in the society are a usual practice to find roadmaps towards any goal desired. Their cost is low, but their impact may be high depending on the commitment of the working group members, and more importantly the society to support the measures towards to goal set. For the policies, the commitment should be made in longer-term, especially in cases of such systemic change as transition to enhanced nutrient recycling and bio-based transportation system.

Feasibility:

Follow-up of measure:

Background material: http://urn.fi/URN:ISBN:978-952-327-482-2
References

Title: Develop recommendations to support national strategies for manure management in the BSR specifically from horses, sheep, goats, and fur farming

Submitted by:
Coalition Clean Baltic

Description of measure
There is no consistent approach to manure management for animal health or nutrient reduction from horses, sheep, goats, and fur farming across the BSR. The measure is to bring these manure sources into full consideration and integration with the ongoing HELCOM process to develop national strategies for manure management, in collection, storage, and in land use to better capture nutrients that cannot be collected from grazing areas or paddocks. Such strategies should also have a clear intention for relevant useage of the nutrients, as well as a timeline for implementation. CCB suggests that this HELCOM action be developed and agreed by 2022.

Activity:
Urban uses (land use) Waste waters (urban, industrial, and industrial animal farms)

Pressure:
Input of nitrogen Input of phosphorous

State:
Nutrients Nitrogen and Phosphorous. The measure contributes to reducing the amount and concentration of these nutrients that may leak into the Baltic.

Extent of impact:
The impact is Baltic-wide, by capturing a widely distributed source of nutrient input.

Effectiveness of measure
The existing direction on manure handling across the BSR for horses, sheep, goats, and in fur farming is patchy and inconsistent, frequently based on voluntary guidelines. Manure is also a source of nutrients flowing into Baltic region rivers, lakes, streams and the Baltic Sea. Given the widely distributed nature of how these animals are kept, either in an agricultural setting or frequently as a hobby or recreation activity, introducing new practices and encouraging more awareness is complex. Developing recommendations in HELCOM to support the ongoing HELCOM processes to develop national stragegies for manure management can help curb nutrient flows to the Baltic from this wide range of animal inputs.

Cost, cost-effectiveness of measure:
Cost of time and person hours to integrate these manure sources into ongoing HELCOM processes.

Feasibility:
Relevant for meeting reduction targets

Follow-up of measure:
Feedback and development of national manure management strategies for the noted manure sources, based on the developed recommendations.

Background material:
Research on manure use in agriculture
Nutrients from horse manure in Sweden
Effective measures against eutrophication

References
Draft report on manure management submitted to AGRI 8-2019
"How to make the most of manure?" by the Manure Standards Project
Draft HELCOM Recommendation on the use of national manure standards
Overview of national manure standards in the Baltic Sea region
Activities in the Manure Standards project in 2019

Title: Facilitating the selection of cost-effective measures by creating national catalogues of abatement measures and their unit abatement costs.

Submitted by:
BONUS TOOLS2SEA; https://projects.au.dk/bonus-tools2sea/; msa@envs.au.dk (Mikael Skou ANDERSEN)

Description of measure
All Baltic Sea Region (BSR) countries should develop national catalogues of measures and their unit abatement costs, comparable to the 'virkemiddel-katalog' that exists in Denmark. Being able to identify cost-effective nutrient abatement measures is crucial for restoring the Baltic Sea to good health, because society's resources to finance abatement measures are limited while implementing measures is costly for farmers. Since the effectiveness and cost of a particular measure will vary with local biophysical and climatic conditions (the problem of spatial heterogeneity), it is crucial that information about the effectiveness of different measures in different locations is available for farmers and policymakers.

Activity:
Agriculture

Pressure:
Input of nitrogen
Input of phosphorous

State:
Nutrients

Extent of impact:
Coastal waters/sub basins/country scale

Effectiveness of measure
An abatement measure is cost effective if it generates an aditional unit of abatement at a lower cost than any other measure. Currently most BSR farmers have poor information about the effectiveness and costs of different measures relevant to their farms. Compiling national catalogues of measures and costs that are relevant to the particular conditions faced by farmers in a particular country would therefor greatly increase the potential for achieving cost-effective nutrient abatement.

Cost, cost-effectiveness of measure:
Balitic-scale cost-effectiveness studies show that as much as 500 million Euros can be saved annually if cost-effectiveness was the guiding principle for designing the BSAP.

Feasibility:
A Swedish study (Nordin and Höjgård, 2017) shows that helping farmers to improve nutrient management practices not only reduces nutrient emissions, but can also increase farmers' profits, which would greatly increase the feasibility of nutrient abatement measures.

Follow-up of measure:

Background material:
Eriksen, J., P. N. Jensen and B. H. Jacobsen (eds.) (2018). VIRKEMIDLER TIL REALISERING AF 2. GENERATIONS VANDPLANER OG MÅLRETTET AREALREGULERING, Aarhus, Denmark: DCA - Nationalt Center for Fødevarer og Jordbrug.

References
Nordin, M. and S. Höjgård (2017). "An evaluation of extension services in Sweden." *Agricultural Economics*, 48(1): 51-60.

Title: Improve knowledge transfer between farmers, authorities and decision makers

Submitted by:
SuMaNu project platform

Description of measure

Policies and support mechanisms should foster knowledge transfer from research to practical actions; both in national and international context. Often language used for communicating messages is too official and poorly understandable for the potential target groups. Direct contact methods are the most efficient means of knowledge transfer and they should be supported. These are meetings, discussions and training on field and on farm, opening the communication and knowledge transfer to and between farmers. Direct contacts should also be promoted for direct communication between scientists, policymakers and farmers. Evaluation and analysis of the efficiency of agricultural and environmental advisory system in the Baltic Sea countries is needed. The aim would be to learn from the strengths of the other countries and to adjust the national advisory system accordingly.

Activity:
Agriculture

Pressure:
Input of phosphorous
Input of nitrogen

State:

Extent of impact:

Effectiveness of measure

Cost, cost-effectiveness of measure:

Feasibility:

Follow-up of measure:

Background material:

References

Project Green Agri implemented several studies to obtain targeted and comprehensive information for direct communication with two main agricultural sector target groups –farmers and policymakers.
http://zemniekusaeima.lv/projects/greenagri/

Title: Improve soil structure and aggregate stability on clay soils to reduce phosphorus losses from agricultural lands, for example by using soil structure lime or gypsum

Submitted by:
Sweden
Contact: Swedish Board of Agriculture

Description of measure
A large proportion of phosphorus losses from clay soils are in particulate form and measures that improve soil structure and increase aggregate stability have potential to reduce phosphorus losses from these soils. So far, structural lime has mostly been used in Sweden and gypsum has mostly been used in Finland.

Activity:
Agriculture

Pressure:
Input of phosphorous

State:
Nutrients

Extent of impact:
This measure is relevant on agricultural clay soils, where it has potential to reduce phosphorus losses. Gypsum contains sulphur and should not be used in areas where it may have negative effects on lakes, while soil structure lime does not add sulphur. Soil structure lime has a longer lasting effect than gypsum.

Effectiveness of measure
Studies on structural liming show 0-60% reduction of phosphorus losses from clay soils.

Cost, cost-effectiveness of measure:
Cost-effectiveness is relatively high, especially in cases where the measure also increase crop yields. It is important for the effectiveness to apply and incorporate structural lime under the right conditions.

Feasibility:
This measure does not take land out of production and improved soil structure has several benefits. For example, it can also increase infiltration capacity and improve conditions for the crop.

Follow-up of measure:

Background material:

References

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Title: Incentives to support the use and the production of manure based recycled nutrients

Submitted by:
SuMaNu project platform

Description of measure
Direct support to the use of recycled nutrients is recommended to make them a viable alternative to mineral fertilizers from the perspective of an individual farmer. Investment support to farm structures, such as storages and machinery, enabling the use of recycled nutrients may also be important for the market of recycled nutrients to develop. Support to businesses in contracting services specialized to recycled nutrients should also be considered.

"Regional nutrient redistribution centres" may be needed to process manure effectively into recycled fertilizer products to ensure transport and use on regions in need of the nutrients. Investment subsidy for such manure processing plants should be set. Notably, detailed conditions to meet the objective of regional nutrient reallocation should be included to secure the overall sustainability of nutrient use on different territorial scales, of the processing chain (e.g. preferably positive energy balance) and in the use of the possible by- and end-products. Investments in manure processing could be also deployed to support smaller-scale solutions enabling regional nutrient reallocation and simultaneous locally enhanced nutrient use. To support manure being directed to regional processing plants reallocating the nutrients, incentives may also be needed to compensate for logistic costs from the farms to the plants and/or the recycled nutrients from the plants to farms.

Activity:
Agriculture

Pressure:
Input of phosphorous
Input of nitrogen

State:

Extent of impact:

Effectiveness of measure

Not all farms have sufficient field area for the sustainable use of the manure nutrients. They may need to relocate some of the nutrients to other farms and/or to (partially) separate nitrogen and phosphorus into different fractions to change their usability as fertilizers.

The need for relocation may also apply to a larger region, such as a certain area in a country. In regions of intensive animal production, there may be an excess of manure nutrients for the need of the crop production on that particular region (supply). On other regions, there may simultaneously be too few manure nutrients available and a clear need for fertilizers (demand). Manure processing into transportable recycled fertilizer products could solve this regional conflict in nutrient supply and demand.

Reducing nutrient surpluses on farms and regions will reduce the risk of nutrient loading into the environment due to improved efficiency of using nutrients already cycling in the food system. The more precise nutrient use on the fields of animal farms and replacing mineral fertilizers with manure-based recycled fertilizer products on crop farms and in other regions in deficit of nutrients will reduce the overall fertilization over the country. This will lead to reduced risk of nutrient runoff to waterways and also reduced emissions into the atmosphere, if the processing chain and management of the fertilizer products uses bet available technologies.

Cost, cost-effectiveness of measure:

There are costs to manure processing (investments, operation and maintenance, logistics) but there could also be economic benefits.

The goals and objectives of the regional manure reallocation could, in addition to reducing environmental pressures in/from a given region, be linked to broader and more general objectives to boost bioeconomy, to reduce dependency on imported mineral fertilizers (circular economy, better self-sufficiency) or to support R&D, business innovations and pilots based on scientific expertise or industrial activity deriving from a given region.

Feasibility:

Technologies for manure processing are already available and being developed further, and good practices for the processing chain and the use of the products are increasingly known and still produced. However, to create a new market and services for the supply and use of manure-based recycled fertilizer products support from the society will be at least temporarily needed.

Follow-up of measure:

Background material:

References

Title: Increase organic farming to reduce the inputs of nutrients and hazardous substances to the Baltic Sea

Submitted by:

Expert contribution from DE

Note: DE encourages the HELCOM process to compile a pool of innovative ideas as a basis for HELCOM bodies to develop and agree proposed new regional measures. To aid this process, the proposal submitted is based on individual expert opinions. It does not reflect a national position and does not prejudice Germany's position on the proposal.

Description of measure

Conventional farming leads to the loss of nutrients and hazardous substances and thereby contributes to the eutrophication of the Baltic Sea and to pollution. The main difference between organic and conventional farming systems are significant restrictions for the use of fertilizer and pesticides on organic farms. Additionally, import of fertilizers, fodder, manure, pharmaceuticals, cleansing agents and stocking densities are limited. Therefore, organic farming has a high potential to contribute to the protection of the Baltic Sea. It reduces the emissions of nutrients, pesticide and veterinary medical products, thereby protecting surface and groundwaters and the Baltic Sea (Kusche et al. 2019).

While this is not the focus of the BSAP it is important to consider that organic farming has numerous other benefits on land. Organic farming is an important strategy for the conservation of biodiversity in cultivated landscapes (Stein-Bachinger et al. 2019). It maintains soil fertility, which is central to climate change adaptation, as fertile, humus-rich and well-structured soils contribute significantly to erosion and flood protection as well as other regulatory ecosystem services (Jung & Schmidtke 2019). Lastly, organic farming also has a positive impact on human health, e.g. due to the reduced use of pesticides in farming and antibiotics in animal husbandry.

HELCOM Contracting Parties should commit by 2023 to a country-specific percentage increase of organic farming (including animal husbandry) in the Baltic Sea catchment area. Such a commitment caters for the different starting conditions (current percentage of organic farming) in the countries around the Baltic Sea. It is envisioned to achieve at least an increase of 50% in organic farming. For example, in Germany organic farming currently has a share of only 8.21% (FiBL Statistics 2019) and the sustainability strategy of the German Government currently foresees an extension to 20% in 2030.

The increase should be predominantly achieved by converting conventional agriculture into organic farming rather than by additional agricultural areas / ploughing up of grassland. An important instrument to achieve an extension of organic farming could be to ensure a consistent funding for conversion to and maintenance of organic farming to give farmers some planning reliability. In addition, funding for research on organic farming techniques should be increased. The processing and marketing of products from organic farming also needs to be strengthened and organic farming could be accounted for in approval procedures. Options to more tightly linking it to the Common Agricultural Policy (CAP) subsidies also need to be explored.

Activity:

Agriculture

Pressure:

Input of nitrogen
Input of phosphorous
Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) — diffuse sources, point sources, atmospheric deposition, acute events
Input of organic matter — diffuse sources and point sources
Choose an item.

State:

Nutrients
- in particular nitrogen and phosphorous

Hazardous substances
- pesticides / biocides
- pharmaceuticals (e.g. antibiotics)

Extent of impact:

Baltic-wide, with the strongest impacts in estuaries and coastal waters.

Effectiveness of measure

Agriculture is one of the major contributors to eutrophication of the Baltic Sea (e.g. Germany: 78 % of total nitrogen input and 51 % of total phosphorous input in 2012–2014) and contributes substantially to the input of contaminants. Increasing the amount of organic farming in the Baltic Sea catchment area will therefore lead to reductions in the input of nutrients and contaminants.

Conventional farming emits on average 27.3 kg N/ha, while organic farming emits only 17 kg N/ha (Kusche et al. 2019). This is achieved by following certain EU regulation and by cultivating and animal husbandry practices (e.g. crop rotation, limiting the amount of livestock per area etc.) (Haas 2010). Organic farming also reduces phosphorus losses through a reduction in erosion. In organic farming erosion is reduced by 26% compared to conventional farming (Cooper et al. 2018, Möller et al. 2018). There are currently no studies that have quantified the reduction in phosphorus inputs that can be achieved by organic farming. This is still an area of research (Kusche et al. 2019).

Due to a prohibition of the use of chemical-synthetical pesticides in organic farming their input is reduced to zero (Alföldi et al. 2002). There are, however, inputs of copper and biological pesticide. Due to the choice of robust animal breeds and the prohibition of a preventive use of veterinary medicines there is a substantially reduced use of veterinary medicines including antibiotics in organic farming, which reduces their emissions to the environment.

An older study showed that organic farming was not very important in reducing nutrient and pesticide loads into the drainage basin of the Baltic Sea (2.3% N, 1.8% P, 0.8% herbicides, 0.3% insecticides, 0.6% plant growth regulators) (Paulsen et al. 2002). But when the share of organic farming is increased by replacing conventional farming it can be expected that these percentages will increase substantially. The expected effects will be largest for HELCOM Contracting Parties that have large amounts of arable land in the Baltic Sea catchment area and for countries which have currently high inputs of fertilisers and pesticides.

Cost, cost-effectiveness of measure:

[*Free text: indicate any known or likely sources of cost and/or effectiveness data of the measure*]
Organic farming has higher costs compared to conventional farming due to more effort (labour) needed and due to reduced yields.
Cost estimate: 80–200 € /ha (mean 170 €/ha) (Osterburg & Runge 2007)
Cost effectiveness estimate: 0.7–6.7 €/kg N (mean 2.8 €/kg N) (Osterburg & Runge 2007)
For a full consideration of costs and benefits it is important to also factor in the societal costs of conventional farming (cost of environmental degradation (e.g. drinking water purification) and cost of a loss in use value of the nature (e.g. reduction in pollinating insects) (Sanders & Heß 2019). Many benefits of organic farming cannot be quantified yet, which renders any cost-benefit analysis challenging.

Feasibility:

The measure has a high feasibility. Organic farming already exists in all HELCOM Contracting parties and only needs to be extended. Consumer demand is increasing considerably in most countries around the Baltic Sea. Funding options exist. Adaption of the CAP is principally possible. The knowledge and expertise for organic farming already exists. Nevertheless, more research on organic farming techniques is necessary. The development of organic farming principally proceeds along six steps: establishment of an organic farming community; establishment of political recognition; establishment of financial support; establishment of non-competitive relationships between the organic sector and general agricultural institutions; establishment of an organic food market; and development of a discussion and coordination arena. Higher governmental engagement in all of these steps is needed to promote organic farming and to reduce the institutional barriers (Larsson et al. 2013).

Follow-up of measure:

Possible indicators:
- inputs of nutrients and hazardous substances
- emissions and deposition of nitrogen compounds and hazardous substances
- trends in nutrient surpluses in agriculture
- proportion of organic farming in relation to conventional farming

Possible monitoring programmes:
- monitoring of nutrients and contaminants

Background material:

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Title: Levy on mineral phosphorus in animal fodder and on mineral fertilizer P

Submitted by:

BONUS TOOLS2SEA; https://projects.au.dk/bonus-tools2sea/; msa@envs.au.dk (Mikael Skou ANDERSEN)

Description of measure

Up to 90% of fodder-P is excreted by animals and needs to be disposed of as organic fertilizer. Phosphorus uptake in pork and poultry can be increased by adding enzymes ('fytase') at the wholesale level. By introducing a levy there will be an incentive to make better use of phosphorus available in manure and other organic fertilizers, thus reducing mineral fertilizer use and phosphorus leaching to the Baltic Sea. Levy base is the phosphorus contents in commercial production and/or import of animal fodders and in mineral fertilizers for use by agriculture.
Levy revenues can be used to finance the costs of transport and spreading of organic fertilizers and manure and/or to reduce other farmland taxes. Levy can create more flexibility for farmers in choosing measures, so that command-and-control efforts can be scaled down.
It will help curb excess 'insurance' fertilization and prospective increases in mineral fertilizers.

Activity:

Agriculture

Pressure:

Input of phosphorous

State:

Nutrients

Extent of impact:

Coastal waters/sub basins/Baltic scale

Effectiveness of measure

Based on the experience with Denmark's levy on phosphorus in animal fodder at a rate of DKK 4 or €0.54 per kg P, a demand elasticity of minus 0.6 can be estimated.
It secured a reduction in fodder-P of about 2,000 tonnes annually. The annual leaching rates are variable and depend on local circumstances, but assuming a 5% rate the short term annual reduction in leaching amounted to 100 tonnes P for Denmark.
Denmark accounts for about half the annual phosphorus manure from pork and poultry in BSR countries, so reintroducing and extending the levy to other countries would yield an estimated short term annual reduction of about 200 tonnes P.
Extending the levy to P in mineral fertiliser could amplify this effect, as annually 235,000 tonnes of P in mineral fertilizers are applied to farmlands in BSR countries, with a gross nutrient balance of 34,000 tonnes P in surplus. Assuming a 5% annual loss rate a short-term annual leaching of 1,700 tonnes from agricultural land can be estimated.
A levy of €0.5 per kg P would increase the price of mineral phosphorus fertilisers with 33 per cent. Assuming the same price elasticity as for nitrogen fertiliser (minus -0.4) this should lead to a reduction in the application of P with 13.5 per cent or 32,000 tonnes, whereby the gross nutrient balance surplus of phosphorus at basin scale would be practically eliminated. This assessment is for Danish price levels, see proposed rate adjustments below.

Cost, cost-effectiveness of measure:

At the present cost of about €1.5 per kg of mineral phosphorus in animal feed, the levy will increase feed costs by 33%, while fytase could be added at a cost of €0.25 per kg P.

Feasibility:
With full recycling of revenues back to farmers to support better use of manure and organic fertilizers and to lower other taxes (e.g. farm land taxes) the measure should be entirely feasible.
Levy needs implementation in national law, but HELCOM could provide a standardized framework and guidance on levy rates for countries to adopt.
Levy rate to be subject to adjustment with the EU correction coefficients for differences in price levels (purchasing power parities), whereby it would be lower in Poland and the Baltics and higher in Nordic countries (e.g. PL: €0.23; LT: €0.27; LV: €0.28; EE: €0.34; DE: €0.40; SE: €0.44; FI: €0.48; DK: €0.54).

Follow-up of measure:
Phosphorus levy would complement other and targeted measures for improving local water quality.

Background material:
The animal feed mineral phosphorus tax in Denmark (Study for European Commission)
https://ieep.eu/uploads/articles/attachments/ccbf12fc-48fa-4ddf-8d6d-4413357ae01e/DK%20Phosphorus%20Tax%20final.pdf?v=63680923242

References
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Title: Levy on nitrogen in mineral fertilizer

Submitted by:
BONUS TOOLS2SEA; https://projects.au.dk/bonus-tools2sea/; msa@envs.au.dk (Mikael Skou ANDERSEN)

Description of measure
By introducing a levy there will be an incentive to make better use of nitrogen available in manure and other organic fertilizers, thus reducing mineral fertilizer use and nitrogen leaching to the Baltic Sea.
It will also help curb excess ‘insurance’ fertilization and prospective increases in mineral fertilizers.
Levy revenues can be used to finance the costs of transport and spreading of organic fertilizers and manure and/or to reduce other farmland taxes.
Levy can create more flexibility for farmers in choosing measures, so that command-and-control efforts can be scaled down. Levy base is the production and/or import of nitrogen in mineral fertilizers for use by agriculture.

Activity:
Agriculture

Pressure:
Input of nitrogen

State:
Nutrients

Extent of impact:
Coastal waters/sub basins/Baltic scale

Effectiveness of measure
According to previous estimates from Sweden’s National Board of Agriculture, a levy will lower the optimal fertilizer dose for various crops, e.g. by 10 kgN/ha for wheat.
Sweden’s National Institute of Economic Research (NIER) has identified a long run demand elasticity of minus 0.4 for mineral fertilizer N (Konjunkturinstitutet, 2014).

With a levy rate at SEK 1.80 (EUR 0.18) per kg N, it was shown in Sweden to lead to an annual reduction of 10,000 tonnes of mineral fertilizer nitrogen use, amounting to 6% less total use.
As it might represent excess use, assuming an average retention rate of 67-80% is probably too pessimistic, but it would translate into a reduction in short-term annual leaching by Sweden of 2,000-3,333 tonnes of N.
At basin scale a similar 6% reduction in the 2 million tonnes of fertilizer N applied in BSR countries corresponds to a reduction in mineral fertilizer use of 120,000 tonnes N, which on the same terms can be predicted to yield a reduction in short-term annual leaching of 24,000-40,000 tonnes N.

Cost, cost-effectiveness of measure:

For a levy rate of €0.18 per kgN the NIER analysis finds that abatement costs per kg of N would be as low as €0.09 per kg N and competitive with most other measures. For higher abatement levels, the analysis shows that unit costs will increase but remain relatively low (up to €0.6 per kg N).

Feasibility:

With full recycling of revenues back to farmers to support better use of manure and organic fertilizers and to lower other taxes (e.g. farm land taxes) the measure should be entirely feasible.
Levy needs implementation in national law, but HELCOM could provide a standardized framework and guidance on levy rates for countries to adopt.
Levy rate to be subject to adjustment with the EU correction coefficients for differences in price levels (purchasing power parities), whereby it would be lower in Poland and the Baltics and higher in Nordic countries (e.g. PL: €0.10; LT: €0.12; LV: €0.13; EE: €0.15; DE: €0.18; SE: €0.20; FI: €0.21; DK: €0.24)
For comparison the current market price for CO_2 allowances of €25/tCO_2 translates into a cost of €0.10 per kg mineral fertilizer-N, as the ratio of GHG:N is 5:1 (for CAN/AN fertilizers) (Hasler et al 2017). Still, most mineral fertilizers are imported from non-EU countries.
Monetary benefits to local recreation and property owners were found to be in the range of €2.5-32 per kg N reduced leaching, corresponding to €0.5-10 per kg N in reduced rootzone loss for eight coastal water bodies to the Baltic Sea(Andersen et al, 2019).

Follow-up of measure:

Nitrogen levy would complement other and targeted measures for improving local water quality.

Background material:

Agrifood Economics Centre, 2015. Skatt på handelsgödsel – ett billigt sätt att minska övergödningen? Policy Brief no 6. http://www.agrifood.se/Files/AgriFood_PB20156.pdf
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Title: Mutual learning among farmers on best practices and innovative technologies

Submitted by:

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Description of measure

We find that targeted action is needed to address particular policy instruments and farmer conditions that might bring about the nutrient abatement targets in most effective ways.
In this regard transfer of technological innovations and mutual learning among farmers across several BSR countries could be one of the effective and relatively cost efficient measures that could help to disseminate and adopt nutrient abatement sensitive technologies for less price and at the same time save spending in other cost categories.
For example establishing cross country farmer mutual learning groups, cross visits, demonstration activities, collaboration with researchers, advisors and technology companies in disseminating and introducing new technologies (e.g. injection manure spreading) may be an effective approach.

Activity:

Agriculture

Pressure:

Input of phosphorous
Input of nitrogen

State:

Nutrients

Extent of impact:

Will help reduce the gross nutrient balance of nitrogen and phosphorus, i.e. the difference between input and output of nutrients

Effectiveness of measure

Many farmers continue to rely on fertilizers companies for advice on use and application. Information, advice and mutual learning can help shift farmers to more efficient use, saving money on mineral fertilizers and making better use of nutrients in manure and organic fertilizers.
Capacity building is potentially an effective and flexible instrument; as it is farm and farmer specific and often implemented to complement other instruments it is difficult to attribute a specific effect to capacity building as such (Aronsson & Johnsson, 2017). According to (Pihlajamäki & Tynkkynen, 2011) lacking awareness of eutrophication and different national aspirations vary across the BSR. Traditionally DK, SE and FI have been regarded as ‘forerunners’ when it comes to combating eutrophication, whereas the Eastern parts of the region have been less active. Although this gap seems to have narrowed, it persists in some of the new EU-MS and RU with regards to awareness (Drangert et al., 2017).
Capacity building is an important foundation for a successful implementation of a long range of policy measures. However, assessing the impact of such educational interventions is often challenging because effects may be slow to materialize and difficult to attribute to the specific intervention (Taylor et al., 2012). Based on case studies in DE, LV, PL, EE and NO, Fammler et al. (2018) argue that a hindrance to policy acceptance is that most farmers within the BSR are unaware of the need to fulfil water protection requirements, as they do not always know the effects of the policies, their practices and reasons behind.
Nordin and Höjgård (2017) find that extension service positively influence nutrient utilization due to better land management practices thereby decreasing the nutrient surplus.
The SE “greppa näringen” programme (catch the nutrients) provides free advice to farmers, and experiences suggest an effect of 1,9 kg N/ha. However, effects are likely higher for countries with more inefficient nutrient management practices.

Cost, cost-effectiveness of measure:

The SE “greppa näringen” programme costs the government around 440 million SEK per year (Smith, 2016).

Feasibility:

-

Follow-up of measure:
-

Background material:
-

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Title: Nutrient-balanced fertilization to control nutrient surplus on farmland

Submitted by:
Coalition Clean Baltic

Description of measure
The main nutrient leakage source from agriculture is overfertilization practices. The Annex III Part 2: Prevention of Pollution from Agriculture, point 7-Application rates of nutrients, says "The application of nutrients in agricultural land shall be limited, based on a balance between the foreseeable nutrient requirements of the crops and the nutrient supply to the crops from the soil and the nutrients with a view to minimise eutrophication". Existing HELCOM regulations cannot secure balanced fertilization with a low nutrient surplus. More detailed requirements are necessary with the following amendments in Annex III, Part 2, para 7:

- Introduce annual nutrient accounting practices at farm level and calculation of total nutrient surplus (incl. manure and mineral fertilizer) (as kg N/ha and kg P/ha) for each crop, at farms bigger than 20 ha or with more than 10 Animal Units (AU)
- Introduce national tolerable nutrient surplus levels for nitrogen and phosphorus (kg N/ha; kg P/ha) at farm/field level, to reduce nutrient surplus in fertilization practices to reach nutrient balanced fertilization, especially in areas with risk for nutrient leakage
- Phosphorus surplus as kg/ha, from farm/field nutrient surplus calculations, shall be set to zero or almost zero, to avoid surplus storage of phosphorus in soils
- the full content of nutrients in manure will be forwarded as input to the nutrient accounting at farm/field level
- manure should not be spread in autumn, because plants will utilize such nutrients only for a limited period

Activity:
Agriculture

Pressure:
Input of nitrogen
Input of phosphorous

State:
Nutrients. Nitrogen and phosphorous. Proposed measures contribute to reducing the amount and concentrations of nutrients to Baltic Sea.
Nutrients

Extent of impact:
Nutrients leakage from agricultural land in the BSR contributes with 50 % of the total nutrient load to the Baltic Sea. Farmland nutrients is a key point source for nutrient input.

Effectiveness of measure

Nutrient Use Efficiency in agriculture is low. Overfertilization drives the nutrient leakage from farmland. The source of origin, the farmers application of fertilizer on farmland, is the most important and effective way to control and limit future diffuse nutrient leakage. Overfertilization will build up nutrient reserve/deposit in farmland soils which gradually will leak the coming decades. Overfertilization with phosphorus on farmland has for the last 50 years created a huge P-deposit, becoming the main source for diffuse leakage to the Baltic Sea. To control nutrient leakage in the future, the most effective measure is to limit soil nutrient reserves, via control and limitation of overfertilization.

Germany has for more than 10 years applied a system nutrient-balanced fertilization with limits for tolerable nutrient surplus. By applying limits for Tolerable nutrient surplus, nitrogen surplus per ha has almost been halved. Germany has also introduced requirements for zero P-surplus on farmland from fertilization practices. These practices have been an important instrument to reduce nutrient levels in rivers. Denmark, having another system for allowable fertilization levels on farmland, has limited its nutrient leakage from farmland considerably. Germany and Denmark has clearly showed the effectiveness of reduction of nutrient farmland leakages via control of overfertilization.
2013 HELCOM Ministerial Declaration agreed on various para for reaching nutrient-balanced fertilization practices incl. tolerable nutrient surplus approach for BSR countries.
The single biggest source of emissions of dinitrogen oxide gas (DNO) is agriculture sector, and the use of nitrogen fertilizers is the underlying reason. One kg of DNO corresponds to 298 kg of carbon dioxide. Limitation of nitrogen fertilizer application will limit the emissions of DNO.

Cost, cost-effectiveness of measure:

Farmers produce on an annual basis Fertilization plans at field level for separate crops, ”Economical optimal fertilization plan for the farmer”. Such plans include commonly overfertilization practices, as this usually is profitable for the farmer. A nutrient-balanced fertilization plan calculate the overfertilization as nutrient surplus, and minimizing the surplus gives economic savings and reduce the nutrient pollution with a view to minimize eutrophication. The extra work for farmers to calculate nutrient surplus will easily pay-off with savings of reduced fertilizer input.

Phosphorus is listed as a Critical Raw Material for the EU. High-quality phosphorus rock is a limited global resource, that will be spent within 50-100 years. Phosphorus is an irreplaceable nutrient for food production, and its Nutrient-use-efficiency is necessary to strengthen substantially.

Follow-up of measure:

When HELCOM regulations for mandatory systems to calculate nutrient surplus on farmland is in place, HELCOM countries should coordinate their system for calculation of nutrient surplus.

Background material:

2013 HELCOM Copenhagen Ministerial Declaration
-page 5-6: WE AIM at improved farm nutrient management, especially manure nutrient recycling, including calculation of nutrient surplus in fertilization practices, and nutrient accounting at the farm level;
-Para 7(N) . 8(N) and 10(N)

https://www.su.se/ostersjocentrum/english/communication/policy-briefs/policy-brief-phosphorus-in-the-catchment-actions-taken-today-create-tomorrow-s-legacy-1.436141

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Michelle L. McCrackin, Bärbel Muller-Karulis, Bo G. Gustafsson, Robert W. Howarth, Christoph Humborg Annika Svanbäck, Dennis P. Swaney, 2018 “A Century of Legacy Phosphorus Dynamics in a Large Drainage Basin”

Title: Prohibition of post harvest application of manure and other organic fertilizers

Submitted by:

BONUS TOOLS2SEA; https://projects.au.dk/bonus-tools2sea/; msa@envs.au.dk (Mikael Skou ANDERSEN)

Description of measure

Timing of manure use is one of the most important aspects for ensuring a high utilization effect of manure and field trials document that leaching risk is highest for manures that are applied in autumn (Liu et al., 2018). All littoral states to the Baltic sea (except RU) have a ban on manure application during winter beginning about November 1st and opening again in the beginning of the growing season. However, field trials document high leaching from manure applied in autumn. Hence, a ban on post harvest application of manures will ensure that manures are stored and increasingly applied prior to the growing season of the main crop, which implies a higher utilization effect of N in the manure. Furthermore, a ban on post-harvest application will provide incentives for farmers to construct sufficient storage capacity for manure to ensure distribution when utilization is highest.

Activity:

Agriculture

Pressure:

Input of phosphorous
Input of nitrogen

State:

Nutrients

Extent of impact:

Coastal waters/sub basins/Baltic scale

Effectiveness of measure

Reducing the post harvest application of manure is an effective way of addressing nutrient loss as most nutrient leaching occurs during wither, when soils are frozen, water saturated and plant growth is minimal (Liu, 2018). Manure application in September is assessed to increase the leaching with 10 % of total N from the manure compared with the period January-August (Cuttle and Bourne, 1993; Beckwith et al. 1998; Smith et al. 2002; Eriksen, Nordemann Jensen, & Jacobsen, 2014).

According to national legislation in place storage capacity should be at least 6 months for liquid manure on farms larger than 10 LSU in all littoral states to the Baltic sea, except RU. However, stricter standards apply in countries like DE (7 m), DK (6-9 m), SE (6-10 m) and FI (12 m). Given the 6 month storage capacity in PL, LT, LV and EE, manure storage need to be emptied in the fall to ensure sufficient capacity for winter storage. Assuming that the 10 % increasing leaching is consistent across the region and that 40 % of manures are distributed post harvest it implies that a total ban on post harvest application will prevent leaching to the root zone and an increased nutrient use efficiency of 51.660 tN for DE, 20.578 tN for PL, 2.688 tN for LT, , 1.496 tN for LV and 922 tN EE corresponding to 4 % of total manure N production in these regions. However, modeling results suggest that investments in storage technology in combination with improved spreading technology could reduce nitrogen surpluses in agriculture by 18% and nitrogen concentrations in the Baltic Sea by 1 to 9% depending on the basin (Jansson et al., 2019).

Cost, cost-effectiveness of measure:

Limitations on the application of manure in the fall will in some cases imply the need for increased storage capacity for manure. Assessing this cost is challenging as accurate estimates of the cost-effectiveness require farm-specific data, as implementation costs and the operational costs depend on farm type, farm size, and hydrological situation.

Costs of the measure primarily relate to increasing storage capacity. Estimates from DK suggest that increasing storage capacity represents an annual costs of €2-2,6 per. m^3 liquid manure and €0,3-0,4 per m^3 solid manure, corresponding to €1,6 per kg N in reduced rootzone loss. However, some farmers may be able to solve this by manure exchange and or storage agreements and in that case costs will be lower (Eriksen, Nordemann Jensen, & Jacobsen, 2014).

Feasibility:

Farmers benefit directly from improving nutrient use efficiency by reducing the need to purchase mineral nitrogen fertiliser or through increased crop yields when extra nitrogen is not applied. However, a ban on post harvest application of manure would imply investments in storage capacity that could be partly available with funds from the Rural Development Programme to ease implementation. An alternative to a ban on post haverst application of manure would be to set requirements for an increase of the storage capacity, however, in itself this will not ensure that manures are distributed in spring.

Follow-up of measure:

Background material:

See: Eriksen, J., Jensen, P., & Jacobsen, B. H. (2014). Virkemidler til realisering af 2. generations vandplaner og målrettet arealregulering. Tjele, DK: DCA - Nationalt Center for Fødevarer og Jordbrug.

Jansson, T., Andersen, H. E., Hasler, B., Höglind, L., & Gustafsson, B. G. (2019). Can investments in manure technology reduce nutrient leakage to the Baltic Sea? Ambio, 48(11), 1264-1277. doi:10.1007/s13280-019-01251-5

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Cuttle, S.P. & Bourne, P.C. 1993. Uptake and leaching of nitrogen from artificial urine applied to grass-land on different dates during the growing season. Plant and Soil 150, 77-86.

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Smith, K.A., Beckwith, C.P. Chalmers, A.G., Jackson, D.R. 2002. Nitrate leaching following autumn and winter application of animal manures to grassland. Soil Use and Management 18, 428-434.

Title: Promote regenerative farming practises for multiple benefits

Submitted by:

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Contact: Kaj Granholm, Project manager, t. +358 46 85 09 208, kaj.granholm@bsag.fi

Description of measure

The key cultivation practises in regenerative climate-smart farming are:

- diverse crop rotation cycles, which include deep-rooted plants
- minimal tillage; leaving residual biomass in the fields
- winter time green cover by using cover crops and catch crops

In addition, soil health and carbon sequestration potential can be enhanced by

- use of organic soil improvers
- well-functioning drainage as a baseline pre-requisite

Balanced fertilization with minimal input of mineral fertilizers, nutrient recycling and mechanical-biological pest control are also elements of climate-smart regenerative farming.

1. To be included as a best practice (for crop farming, for ruminant livestock farming, for agriculture in general) in Annex III Part II.
    - Regardless of whether this proposed measure is adopted for the revision or not, it is proposed to change the term 'humus' in Annex III Part II to 'soil organic matter, SOM'. SOM is more comprehensive encompassing all organic matter which is beneficial for soil health, such as plant residues and manure. Furthermore, this change should be accompanied by the understanding that SOM alone does not guarantee soil health or good structure, but this is only achieved through optimal interaction with the soil mineral matter.

2. To be referred to as a 'best practice' climate adaptation and climate change mitigation measure. In this context, special additional measures for cultivated peatlands (organic soils) should be listed, such as raising ground water level, rewetting for paludiculture and conversion to ley.

3. To be supported with associated research topics in the HELCOM SCIENCE AGENDA (e.g. long term studies of nutrient runoff and carbon sequestration, mechanisms of permanent carbon in agricultural soils, accounting and valuation of multiple benefits, implementation and governance)

4. To be reflected in the Nutrient recycling strategy, as this proposed action is in line with nutrient recycling measures 'PROMOTING THE USE OF ORGANIC FERTILISERS' and 'RECYCLING ORGANIC RESIDUES AS SOIL IMPROVERS'.

Activity:

Agriculture

Pressure:
Input of nitrogen

Also:
Input of phosphorus
Loss of natural biological communities due to plant cultivation
Input of organic matter

State:

Nutrients

Extent of impact:

For simplicity, and to support the Stakeholder Conference proposal 'BAT for crop farming', this proposal primarily proposes regenerative farming for crop farming. However, these practises are adaptable to ruminant livestock farming alike, with the added emphasis on grazing practises and ley management.

Measure is theoretically applicable to the entire arable land area in the Baltic Sea Region. The measure is particularly suited to diversified agricultural systems with existing crop rotation, but will have most value added if implemented as an alternative management approach in present monoculture systems.

Effectiveness of measure

In regenerative farming, the farmer kicks the soil biology into action by maintaining and adding organic material. Regenerative farming brings multiple benefits in soil health and fertility, climate resilience, reduced fossil dependency, carbon sequestration and reduced nutrient runoff.

Regenerative farming relies on and supports soil health. Active soil microbiology maintains good soil structure by stabilizing soil particles which reduces the erosion risk. In addition, good structure helps to maintain good drainage. High organic matter content is also a great buffer for droughts as it can withhold water up to twice its dry weight.

In short, preparing for the progressing climate change and extreme weather events, and to reduce the risk of increasing SOM and nutrient runoff from the fields, we need to put attention to soil structure. And measures that help us do that, also, according to state-of-the-art science, help to sequester carbon.

If we want to survive we really have no alternative but to restore carbon to the soil. [T] this can be done through biology, using a method that has worked for millions of years" (Kittredge 2015).

Cost, cost-effectiveness of measure:

There is no estimate on the cost, as this measure concerns standard farm practice. For the farmer, adopting these practises requires a bit more working hours spent on the field as well as in planning cropping cycles, fertilization and recycling of organic matter. The savings for the farmer come i.a. in reduced mineral fertilizers, reduced need for heavy tillage and machinery in addition to direct gains over time in improved soil fertility. The market situation determines the range of returns for the farmer, but due to improved resilience and greater diversity, the farmer is better off in any market situation and with carefull planning and choice of crops can aim at maximum gains. For the society, implementation of regenerative farming may require investments in advisory and extension services, but there will be considerable societal gains in terms of environment and climate benefits, both locally and globally.

Feasibility:

The measure is low cost, but relatively knowledge intensive. Multi-benefit farming methods should be based on the latest science and supported by ongoing mutual science-practice learning. Capacity of AKIS must be increased and scaled in order to implement the measure more widely. Positive image of agriculture, viability and attractiveness of the profession to the younger and emerging generations are a prerequisite and incentives rewarding for long term land management and stewardship would be a welcome boost. Due to long-term international cooperation over the recent decades, the agricultural advisory systems and networks are capable of adopting and transferring the required knowledge across the region. This topic should be included in any agri-environmental knowledge tranfer activity among the HELCOM CS' in the future.

Follow-up of measure:

Existing agri-environment indicators can be used to monitor the measure:

- input of mineral fertilizers
- input of chemical pesticides
- modelled and monitored nutrient, solid matter and organic carbon losses from farmland
- extent of associated measures applied, such as winter time green cover, crop rotation and catch crops

Background material:

As regenerative farming lacks a universally adopted definition and consists of a set of practises which all aim to restore and maintain soil health and natural biological fertility in harmony with the surrounding farm environment, there is limited amount of scientific literature on the measure and the effects as a whole. Many of the cultivation practises are centuries old and were mainstream before the industrial fossil and synthetic input driven agriculture gained dominance in the post-world war era. Globally detected trends of loss of soil carbon, loss of soil micronutrients, and loss of farmland biodiversity and pollinators are signs that agricultural systems driven by external inputs are not sustainable.

The chosen references all support the key cultivation practises presented above and serve as gateways to practical and research work in the topic ongoing in Europe and globally.

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Heinonsalo, J. toim. (2020): Hiiliopas – katsaus maaperän hiileen ja hiiliviljelyn perusteisiin.
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www.amazincarbon.org
www.carbonaction.org

Title: Recycling of nutrients and carbon in agricultural residues by use of anaerobic digestions

Submitted by:
BONUS RETURN -project

Description of measure
Recycling of agricultural residues (horse manure, set-a side grass and grass from buffer zones) by use of centralised anaerobic digestion which produces biogas, and liquid and solid digestate phases. The digestates are concentrated sources of nutrients, such as N and P, that can be applied back to fields as organic fertilizers.
The key are the substances that are not utilised today (manure, set a side grass, etc.)

Activity:
Agriculture

Pressure:
Input of phosphorous Input of nitrogen
Input of organic matter — diffuse sources and point sources

State:
Nutrients
Decreasing nutrient loading and concentrations
Circular use of nutrients, reducing the net use of mineral fertilizers

Extent of impact:
The measure is applicable in areas with agriculture, especially with animal husbandry. The impact depends on the extent of application of the measures. The measures reduce pressure from agricultural land in catchment areas.

Effectiveness of measure
Based on a systems analysis study comparing different approaches to manage and recycle agricultural wastes in the Vantaanjoki catchment area – an approach with anaerobic digestion would recycle almost 100 % of nitrogen and phosphorus, and this recycling will replace the same amount of mineral fertilisers and on long term also reduce the fluxes of nitrogen and phosphorus to the Baltic sea. Another deliverable of the system is biogas.

Based on model simulations with SWAT model, the increased application of organic material to the fields will change the soil parameters in the field (changes based on expert judgement) in a way that both erosion and nutrient loading will decrease. However, the amount agricultural residues in Vantaanjoki catchment were not that significant that it would result in significant loading reductions to the Baltic sea. The situation could be different in intensive areas of animal husbandry, with excessive production of manure.

Cost, cost-effectiveness of measure:
Cost-benefit analysis shows that the benefits exceeds the costs and a scenario with anaerobic digestion provides a net present value of 67.mio € for the catchment area

Feasibility:

Requires lot of logistics in centralised treatment. The transport of substrates are 73 000 tonnes to the biogas fascility and more or less the same amount back to field. This amount is comparable with food waste from 73 000 persons. However, decentralised option has less transport, but less synergies with other systems (like district heating, operation and maintenance), increasing the cost.

There may be some obstacles in regulation in implementing the production in large scale. In Finland, the dairy company Valio has had a project for setting up a facility for handling manure, but there were problems with getting the environmental permit due to point source loading from waste waters of the production, even though the benefits in catchment scale would positive.

Follow-up of measure:

Indicator: Number of anaerobic digestion plants mainly agricultural residues
We had a multicriteria analysis including 10 sustainability criteria, that can be used as indicators.

Background material:

Literature review and data collection from scientific and gray literature MCA and CBA assessment Systematic evidence maps Systematic evidence review

References

Johannesdottir, S. et al. 2019. D.3.3 – Report from the multi-criteria analysis from workshop 2 with comparisons of the different alternatives in each case study and selection of eco-technologies for further use in WP5. Deliverable report in BONUS RETURN project. https://www.bonusreturn.eu/wp-content/uploads/2019/05/BONUSRETURN_D3.3_REPORT_FROM_THE_MULTICRITERIA_ANALYSIS.pdf

Haddaway NR, Piniewski M, Macura B. What evidence exists relating to effectiveness of ecotechnologies in agriculture for the recovery and reuse of carbon and nutrients in the Baltic and boreo-temperate regions? A systematic map protocol. Environ Evid. 2019; 8:5.

Macura, B., Johannesdottir, S.L., Piniewski, M. et al. Effectiveness of ecotechnologies for recovery of nitrogen and phosphorus from anaerobic digestate and effectiveness of the recovery products as fertilisers: a systematic review protocol. Environ Evid 8, 29 (2019) doi:10.1186/s13750-019-0173-3

López, J.M. 2020. Assessment of costs and benefits for selected eco-technologies. CBA analysis of selected eco-technologies in the BSR, Deliverable report in BONUS RETURN project (D.3.5). In print.

Title: Reducing livestock densities and coupling livestock to the area of available farmland

Submitted by:

Expert contribution from DE

Note: DE encourages the HELCOM process to compile a pool of innovative ideas as a basis for HELCOM bodies to develop and agree proposed new regional measures. To aid this process, the proposal submitted is based on individual expert opinions. It does not reflect a national position and does not prejudice Germany's position on the proposal.

Description of measure

Concerning agriculture in the Baltic Sea catchment area some regions are more dominated by livestock production, while others are more focused on crop production. The crop-livestock separation is an important driving force for nutrient imbalances in agriculture (Nesme et al., 2015; Schipanski and Bennett, 2012). Areas focussing on crop production often depend on imported mineral fertilizer to a large extent. Areas focussing on livestock production import a large proportion of feed for animals (Wang et al., 2018), while the manure usually is applied on fields close to the farm, often in excess of crop needs. Therefore, in areas with high livestock densities excessive nutrient inputs to surface waters are occurring. Transporting the manure to other regions would be a possible solution, but it is costly and therefore hardly practiced. A more sustainable solution would be to reduce livestock densities and couple them more closely to the area of available farmland, so that sustainable fertilisation practices can be achieved.

The aim of the measure is that HELCOM Contracting Parties commit to a reduction of livestock densities in particular in areas with high livestock densities that are sensitive to nutrient losses. Current livestock densities vary between HELCOM Contracting Parties Baltic Sea catchment area (0.26 to 1.17 LSU/ha according to Svanbäck et al. 2019). Therefore, an overall upper quantitative target of a certain LSU/ha is not feasible and the measure should aim for individual commitments from HELCOM Contracting Parties.

Reductions in livestock densities can be achieved by a number of instruments:

- Integration of respective limit values for livestock densities (LU/ha) as objectives in spatial plans.
- Accounting for livestock density in approval procedures: approval of new buildings for livestock only in regions where the respective limit values for livestock densities are not exceeded. Alternatively, approval could be coupled to requirements regarding own feed production. Both may require adaptations in national legislation (regulative law, planning / building law).
- Efforts (jointly by HELCOM CP's / at HELCOM-level) for a better alignment of the EU CAP with the needs of protecting the marine environment, in particular coupling direct payments to site-specific limits of fertilization (organic fertilizer and manure).

Activity:

Agriculture

Pressure:

Input of phosphorous
Input of nitrogen

State:

Nutrients

Extent of impact:

Baltic wide. The strongest impact can be expected from areas that currently have high livestock densities and are sensitive to nutrient losses.

Effectiveness of measure

Agriculture is one of the major contributors to eutrophication of the Baltic Sea (e.g. Germany: 78 % of total nitrogen input and 51 % of total phosphorous input in 2012–2014). Organic (liquid) manure accrues in excess particularly in regions with high densities of livestock. It is commonly spread on the fields, and parts of the excess nutrients are washed or drained into the rivers and transported to the sea, or evaporated to the atmosphere and (in part) deposited onto the sea, contributing to excessive nutrient inputs.
Nutrient input from excess liquid manure usually cannot be reduced sufficiently by export of manure to other regions (KLU 2019). Suitable means for the reduction of nutrient input originating from liquid manure are therefore the reduction of animal stocks particularly in regions with currently high densities and the establishment of a sustainable link between livestock production and available farmland (WBA 2015, Gutser & Matthus 2001). The farmland should take up the manure produced by the livestock and should provide fodder in order to reduce inputs of fodder and mineral fertiliser, thereby closing the nutrient loop.

N and P surpluses have been shown to decrease with decreasing livestock density (Wang et al. 2018) and in the Baltic Sea catchment area a clear relationship between livestock densities and nutrient surpluses has been demonstrated (Svanbäck et al. 2019). Reduction of livestock densities are therefore expected to result in a reduction of nutrient inputs to the Baltic Sea via riverine and atmospheric pathways.

Cost, cost-effectiveness of measure:

[*Free text: indicate any known or likely sources of cost and/or effectiveness data of the measure*]
No estimates found in the literature.

Feasibility:

Adaptations of national legislation (regulative, planning, building law) may be necessary with regard to spatial planning and approval procedures (WD 2017). Since this measure requires a re-distribution or reduction of livestock densities it is not easy to achieve. There could be synergies with the HELCOM nutrient recycling strategy that is currently in preparation and the measure also contributes to the implementation of the revised Annex III of the Helsinki Convention, in particular to the part on nutrient recycling that is currently drafted. The current CAP-reform will lead to more flexibility for the distribution of subsidies for individual EU countries, which could be used to implement this measure. The measure can be coupled with the measure on the increase of organic farming, since organic farms are characterised by reduced livestock densities.

Follow-up of measure:

Possible indicators:
- nutrient inputs
- atmospheric emissions and deposition of ammonia
-trend in nutrient surpluses
- trend in livestock densities (in LU/ha)

Possible monitoring programms:
- MSFD monitoring of nutrients

Background material:

References

Gutser R, Matthus U (2001) Wunsch und Wirklichkeit. In: Neuer Rahmen für den Ackerbau. DLG-Mitteilungen 3/2001, 13–14.

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WD (2017) Besatzobergrenzen in der Tierhaltung: Rechtliche Steuerungsmöglichkeiten des Bundes. WD 7–3000–066/17. Deutscher Bundestag (Ed.). 12 pp. Available at https://www.bundestag.de/resource/blob/514878/9e842ffb5b18b1dd1eee7efbba565db4/wd-7-066-17-pdf-data.pdf

Title: Reporting estimates on the effects of agri-environmental measures on the main phosphorus (P) fractions

Submitted by:
Shared Waters project (contact antti.iho@luke.fi)

Description of measure
Currently, BSAP targets are given as a sum of all species of P. P losses from agriculture mainly comprise of particulate P (PP) and dissolved P (DP). Problematic for agriculture is 1) measures that decrease erosion and PP increase the loading of DP (Dodd and Sharpley 2016) and 2) for eutrophication, DP is more potent than PP (Baker et al 2014). Estimates on the long-term bioavailability of PP range between 20% and 60% (Uusitalo et al 2003). There is a risk that further efforts to reduce TP result in decreases in PP but increases in DP. This accelerates the eutrophying potential of P loading, as found in several sites in the USA (Jarvie et al 2017). For BSAP, we should define the effects of currently used and proposed measures on PP and DP loading. The final aim is to encourage the HELCOM countries to include P fractions in their load monitoring programmes and to base load reduction measures on cost-effectiveness analysis accounting for P bioavailability.

Activity:
Agriculture (mainly)

Pressure:
Input of phosphorous

State:
Nutrients

Extent of impact:
The measure would impact the fundaments of policy design and follow up. Mitigating climate change and improving soil health increases the pressure to increase vegetation cover in arable land. We must identify, quantify and manage the risk of the ensuing DP loading. The measure has potential to be applied to other loading sources, too, in addition to agriculture. It is possible that entailing P bioavailability in the Baltic Sea protection context would fundamentally change some of the prevailing water protection measures and speed up meeting the environmental targets

Effectiveness of measure

The measure is at the core of the concept of efficiency. A simple calculation to exemplify. The set up:
1) P loading from an agricultural field must be cut by 10%. Initial PP 1.8 kg/ha, DP 0.2kg/ha -> TP 2 kg/ha
2) Measure ALPHA found to be cost-effective. It decreases PP to 1.4 kg/ha/y and increases DP to 0.4. Final TP 1.8kg/ha/y; reduction 10%; cost of the measure 10 €; **unit abatement cost: 50€/kg**
3) Alternative measure BETA would decrease DP by 0.1kg/ha, not affect PP; cost 100€; **unit abatement costs: 1000€/kg**. BETA is 20 times more expensive than ALPHA.

Now assume we take into account (and know) the long-term bioavailability of PP. Define the abatement costs in terms of eutrophying P = DP+bioavailability*PP. Typical range of hundreds of estimates in literature between 20% and 60% at the edge of field. Define the unit costs for 20%, 40% and 60% PP bioavailability.

60%: Initial loading of eutrophying P: 0.6*1.8+0.2=1.28 kg/ha/y. Loading after measure ALPHA: 0.6*1.4+0.4=1.24kg/ha/y. Reduction 0.04kg/ha/y. **Unit Abatement cost ALPHA 250€/kg/y**. Eutrophying P Loading after measure BETA: 1.18kg/ha/y. **Unit Abatement cost BETA 1000€/kg/y** (not affected by PP bioavailability.

PP bioavailability 40%: Initial loading of eutrophying P: 0.92 kg/ha/y. Measure ALPHA *increases the loading of eutrophying P by 0.04 kg/ha. Abatement costs would be infinite and the cost-effective choice would be BETA.*

To sum up: Efficiency of P abatment from agriculture hinges upon 1) the relative effects of measures' effects on DP and PP loading (this information will be collected in the measure) 2) long-term bioavailability of PP (comprehensive information on this will be provided by the Shared Waters project].

Cost, cost-effectiveness of measure:

We propose starting with a pilot country/basin. Low cost measure, effects on future policies unknown.

Feasibility:

Desktop exercise, full feasibility

Follow-up of measure:

Reporting from member states, implications on eutrophying P loading calculated

Background material:

Shared Waters project page: http://www.samassavedessa.fi/en-US, Similar activitites in the Chesapeake Bay protection area: https://www.chesapeake.org/stac/events/assessing-the-environment-in-outcome-units-aeiou-using-eutrophying-units-for-management/

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Title: Safe manure nutrient recycling

Submitted by:
SuMaNu project platform

Description of measure
Unnecessary addition of trace elements (e.g. copper, zinc, arsenic) in animal feed and use of pharmaceuticals, such as antibiotics, in animal rearing needs to be avoided to minimize their excretion to manure. When manure is used as a fertilizer, these harmful compounds end up in agricultural soils, and potentially to food chain and waterways, causing a risk for both the environment and human health.

Furthermore, the hygienic quality of manure needs to be secured, especially when processing manures from several farms and/or with additional feedstocks. The processing should include proper hygienization and prevention of recontamination via precautions taken during processing, storage and logistics.

As the risks related to e.g. trace elements, organic contaminants and hygiene are typically higher in sewage sludge than in manure, their co-processing is not advisable.

Activity:
Agriculture

Pressure:
Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) — diffuse sources, point sources, atmospheric deposition, acute events

State:
Hazardous substances

Extent of impact:

Effectiveness of measure
Trace element concentrations are commonly low in manures, but their annual input to field soils can be higher than from mineral fertilizers depending on the application rate. Some trace elements are used as feed additives and therefore high manure application may pose a threat to trace elements accumulating in soils.

Among pharmaceuticals, e.g. antibiotics and their metabolites can enter to the food chain from pasture or after manure application on agricultural fields. Antibiotics may pose a risk for the development and spread of antibiotic resistant microbes.

Different processing technologies have various effects on contaminants and pathogens that can originate from manure and/or co-feedstocks entering the process / processing chain. When manure from several farms is processed in the same processing plant with or without other feedstocks, there is a risk of spreading pathogens, plant diseases and invasive species from farm to farm and to the environment.

Solution:
Avoiding unnecessary use of trace elements and pharmaceuticals in animal rearing will decrease their possible risks for the environment and human health.

Hygienization and proper cautionary measures during processing and the storage, logistics and use of the end-products (recycled fertilizer products) should be applied to minimize the risks related to contaminants and hygiene.

Cost, cost-effectiveness of measure:

Feasibility:

Follow-up of measure:

Background material:

References

BONUS PROMISE project https://www.bonusportal.org/files/5700/BONUS_PROMISE_final_report.pdf
Bloem et al. (2017): https://doi.org/10.1016/j.scitotenv.2017.06.274

Title: Use of gypsum to reduce phosphorus loads from agricultural land

Submitted by:
Finnish large-scale gypsum pilot project SAVE 'Improving the quality of the Archipelago Sea by applying gypsum to agricultural fields'
Contact persons: Markku Ollikainen, University of Helsinki, Petri Ekholm, Finnish Environment Institute

Description of measure
Gypsum ($CaSO_4 \cdot 2H_2O$) application to the surface of soil provides a new measure that can effectively reduce phosphorus runoff from agricultural fields. Gypsum application increases the ionic strength of soil pore water. It creates larger aggregates of soil particles, calcium bridges and affects phosphorus binding, which reduces erosion and phosphorus losses to waterways. Importantly, phosphorus remains fully available to plants. A vital additional benefit is reduction in the loss of dissolved organic carbon. These beneficial effects occur immediately after the dissolution of gypsum, last for about five years and are achieved without any loss of crop yields or taking land out of cultivation.

Activity:
Agriculture

Pressure:
Input of phosphorous

State:
Nutrients

Extent of impact:
Local to Baltic wide scale

Effectiveness of measure
Previous research, and the recent large-scale gypsum pilot in the River Savijoki catchment in southwestern Finland, have demonstrated that gypsum amendment of fields reduces phosphorus loads from fields by around 50%. A vital additional benefit is reduction in the loss of dissolved organic carbon. These effects take place immediately after the dissolution of gypsum and are assumed to last about five years according to a catchment study performed on a clayey area in southern Finland (Ekholm et al., personal communication). The results have been quantified by tests on laboratory, field and catchment scales (Ekholm et al. 2012, Uusitalo et al. 2012). In the Finnish gypsum pilot in the River Savijoki catchment, the applied amount was 4 tonnes per field hectare.
Gypsum contains sulfate, which is gradually flushed away from soil to nearby waterways. As sea water naturally contains sulfate, it is safe to use gypsum in arable fields along waterways running into the sea. Using multiple indicators of aquatic biota, environmental research in the River Savijoki gypsum pilot area shows that sulfate losses do not cause any harm to biota in rivers. This research showed that sulfate concentrations, even at markedly higher levels than those observed in the pilot, do not impact trout (Salmon trutta), the thick-shelled river mussel (Unio crassus, a red-listed species) and the common water moss (Fontinalis antipyretica). Also, the mean increase in sulfate levels in the river turned out to be minor and the higher temporary peaks short-lived.

Gypsum has no effect on the suitability of soil phosphorus for plants, and no changes were observed in phosphorus concentrations in crops. Sulfate in gypsum has been found to impair the absorption of selenium by plants during the first year after gypsum spreading (TraP project). However, no declines in selenium were observed in the case of the Savijoki river; concentrations were generally low in the region. It has also been suggested that gypsum reduces the absorption of boron, but no support has been found for this claim. The sulfur content of the crop rose in the gypsum-treated plots.

Cost, cost-effectiveness of measure:

The Finnish gypsum pilot suggests that the unit cost for gypsum amendment is about 70 €/ kg P reduced. This figure is based on measured phosphorus reduction assumed to last for five years and the actual gypsum amendment costs (gypsum, its transportation and spreading) of 220 €/ha.
Because gypsum amendment does not reduce yields or the arable area, it does not result in loss of income for farmers. In addition, no equipment investments are required, since gypsum can be spread using existing equipment.
The costs of gypsum amendment have been ascertained in the Savijoki river pilot and earlier projects, all of which involved the use of Siilinjärvi gypsum. Transportation from Siilinjärvi (in central Finland) to the farms accounted for about 60% of the cost. The remainder was divided between the material and the costs incurred at the farm.

Feasibility:

In the Finnish large-scale gypsum pilot, farmers perceived gypsum amendment of fields very positively. Gypsum spreading after harvest was easily incorporated into ordinary farming activities. Farmers did not observe negative effects on crops or fields.
Gypsum is well-suited to clay soils and all crops. Gypsum can be easily spread by ordinary lime- or manure-spreading machinery. The best time for spreading is after the harvest. Gypsum can safely be used with conservation tillage and no-till and land ploughed with mouldboards. In the case of no-till it is recommended not to spread gypsum at the same season as planting. Gypsum includes sulfur, which is beneficial for crops.
Farmers valued the fact that using gypsum neither requires any changes in land use nor changes in cultivated crops. The number of farmers who originally had doubts about that gypsum would reduce yields and lead to soil crust was reduced after their experiences spreading and the first harvest. Most farmers were keen to repeat the gypsum amendment in the future and to recommend the gypsum amendment to other farmers.

Follow-up of measure:

The SAVE project's monitoring and research in the gypsum pilot area will now continue in the SAVE2 project until the end of 2020. The duration of the effect of gypsum is assessed by continuing to monitor the water quality in the Savijoki river. Samples of well water, soil and crops will also be taken in the future. In addition, the practical questions related to the spreading of gypsum and its effects will be investigated in the project – especially the winter spreading of gypsum via a snow spreading test conducted in a laboratory.
The SAVE2 project also aims to model the impact of large-scale gypsum-spreading on the nutrient concentration and algal biomass of coastal waters and promote research collaboration on this novel water protection measure for agriculture with the coastal states of the Baltic Sea. The effects of gypsum on the microbial activity in soil will be studied. In addition, the aim is to gain a more detailed understanding of the effect of gypsum on the cation balance of the soil.

Background material:

Information package explains the implementation and impact of gypsum amendment, in the light of research and practical experiences: https://blogs.helsinki.fi/save-kipsihanke/files/2019/02/SAVE-Infopackage-of-Gypsum-Amendment.pdf
More background material on SAVE project page: https://blogs.helsinki.fi/save-kipsihanke/materials/?lang=en

References

Ekholm et al. (2011) – The effect of gypsum on phosphorus losses at the catchment scale

Uusitalo et al. (2012) – The effects of gypsum on the transfer of phosphorus and other nutrients through clay soil monoliths
Ekholm et al. (2012) – Gypsum amendment of soils reduces phosphorus losses in an agricultural catchment
Jaakkola et al. (2012) – Simulated effects of gypsum amendment on phosphorus losses from agricultural soils
Iho & Laukkanen (2012) – Gypsum amendment as a means to reduce agricultural phosphorus loading: an economic appraisal