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Horizon EU project NORDBALT-ECOSAFE: Reviews European, Nordic and Baltic regulations and policy measures for devising fit for purpose regulations and incentives. Supports river basin managers, stakeholders, and policy makers to apply a systemic approach to preventing nitrogen and phosphorus pollution across economic sectors to meet the requirements of the Water Framework Directive.

Towards efficient and just policies for mitigating agricultural nutrient emissions in the Nordic-Baltic region

Nitrogen (N) and Phosphorus (P) emissions cause eutrophication and the deterioration of surface waters. Agricultural fields are fertilized by chemical N and P fertilizers and manure, and runoff from the fields to waters is the most important form of nutrient pollution globally. Farmers are interested in water protection, but they need clear rules and support.

European regulations and policies to curb agricultural nutrient emissions

There are several European level regulations and policies as well as national rules and plans to guide the management of agricultural emissions to protect aquatic environments. The EU Water Framework Directive (2000/60/EC; WFD) regulates the ecological condition of rivers, lakes, transitional waters, coastal waters and groundwater. EU member states have a duty to make River Basin Management Plans for each river basin and apply ecosystem-based management to achieve the target of the Directive, a good ecological status of all waters. The Nitrates Directive (91/676/EEC) is also central. Under the Directive, member states must make National Action Plans to lower the emissions. No general European phosphorus regulation yet exists, but some countries regulate agricultural phosphorus use by national legislation.

The EU Common Agricultural Policy (CAP) and the National Strategic Plans promote environmental and water protection and set environmental standards and measures that the farmer must fulfill to receive subsidies. The implementation of the Nitrates Directive is connected to the subsidy rules or CAP (the so-called cross-compliance mechanism).

(Nutrient) emissions can also be regulated indirectly. Environmental criteria can be set in public procurement decisions: states and cities can (and should) favor products and services with low nutrient footprints. The new EU Taxonomy with its Delegated Acts and screening criteria defines environmentally sustainable economic activities and sets reporting rules for investors. Investors can (and should) be interested in farming and food with a benign water impact.

Table 1 summarizes the European regulations and policy areas mentioned. Each EU member state implements the EU rules at the national level, and Norway has its own rules.

Table 1. EU level regulations and policies with an impact on N and P emissions to EU waters

Regulations and policies with an impact on N and P emissions to EU waters	
The name of regulation or policy	The aim of regulation or policy
Water Framework Directive 2000/60/EC & national river basin management plans	Prevent deterioration and enhance status of aquatic ecosystems
Nitrates Directive 91/676/EEC & national action plans	Protect water quality and promote good farming practices
Common Agricultural Policy & national strategic plans	Promote food security, sustainable use of natural resources and rural livelihoods
Public Procurement Directive 2014/24/EU & national public procurement law and policy	Increase transparency, fairness, environmental protection, societal welfare through procurement decisions
Taxonomy Regulation 2020/852/EU & upcoming Delegated act on water and pollution	Facilitate investments to environmentally sustainable economic activities

Stakeholder experiences and opinions in six Northern European countries

NORDBALT-ECOSAFE organized six stakeholder workshops in six river basins in six Northern European countries to discuss nature-based solutions and mitigation measures against nutrient pollution specifically in agriculture as well as regulations and policy measures that mandate or incentivize the uptake of such solutions and measures. As discussed above, EU member states implement the WFD, the Nitrates Directive, and the environmental measures of the CAP through their national plans. National rules exist for farmers on fertilization, manure storage and dissemination, buffer strips, catch crops, collector plants, soil properties and tillage, mulching requirements, minimum winter plant cover, hydrotechnical measures, rewetting peat soils and the promotion of circular economy.

In the workshops, we received several experiences, opinions and suggestions for improving national regulations and policies. The stakeholders believe regulations and policies should be clear, fair, and effective.

Finland has a new national regulation on the use of P fertilizers and manure (64/2023). Stakeholders welcome the application of the same rules to all farms. Farmers at our workshop said no farmer uses the maximum allowed amount of fertilizers but instead the amount the plants need. The 1 m buffer strip requirement along main drainage systems as a requirement for CAP subsidies was removed in 2023, the sensibility of which raised doubts among farmers as they considered the requirement acceptable. Finnish authorities (ELY Centre) highlighted the need for long-term target-setting, follow-up, and continuity in measures and policies as improving water quality is a lengthy process. Everyone agreed.

Swedish farmers described how knowledge about nutrient balances also benefits farm economy and how farmers learn from each other. Farmers understand the value of wetlands for water protection and also for recreation and landscape. For some subsidies, bureaucracy is heavier than the reward, but for example subsidies for the renovation of drainage systems had more applicants than there was funding.

The Swedish authorities saw it as a drawback that they cannot reward measures under the CAP, i.e., they cannot pay more in subsidies than the measure costs, not even in areas where the measure is highly effective. To enhance knowledge-based decision-making, monitoring the impacts of environmental mitigation measures needs resources. Scientists called for decision-making that takes food security, climate, biodiversity, water, soil, and landscape all into account. It is not only about mitigating the impacts of cultivating different crops, but about which crops should be cultivated in the first place (growing more grass would have many environmental benefits).

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n Latvia, the nitrogen surplus in agricultural lands has increased since the early 2000s, which is a non-desirable development. Agricultural subsidies based on animal numbers and production volumes favours the intensification of agricultural practices. The OECD recommends subsidies based on grass hectares instead (OECD 2019).

The riverine nutrient loads in Latvia are heavily influenced not only by Latvian agriculture but also by transboundary loads from upstream countries. Nutrient loads from Belarusian agriculture are not fully known, but they are likely to be significant (HELCOM 2018). Collaboration on water quality issues between Latvia and Belarus at a river basin level would be desirable but is severely challenged by the war in Europe.



Source: Syke's image bank

Denmark is one of the most intensively farmed countries in the world with 61% of total land area cultivated. In the past, Danish farmers have struggled with and even protested fertilization standards getting stricter. Catch crop schemes are in place and supported by regulations and policies (see below). Constructed wetlands are employed, but stakeholders see the administrative processes with them as very lengthy and complicated.

New measures and policies demand resources both from farmers and authorities, with all the application forms and IT work. Scientists call for strict and mandatory rules. The 36 % reduction in N losses from Danish agriculture from 1990 to 2004 was a world record, and that was because of the long list of mandatory measures. Environmental NGOs support stricter rules as they are not pleased with no downward trend of nutrient emissions or concentrations for the past 15 years.

In Poland, a difference between young and old farmers can be observed: younger farmers may be more eager to try new things. Information on the impacts of different ways to manage land is needed, and incentives for the application of nature-based solutions and mitigation measures are important. Authorities and scientists see that embedding nature-based solutions and agricultural mitigation measures in broader, strategic policies is key. This means strategies on climate change mitigation and adaptation, green infrastructure and biodiversity, all based on an ecosystem approach. Specialists in water resource management and water ecosystems need a more prominent, if not a dominant voice.

Restructuring of rural areas, especially agro-tourism, should be supported under EU and national programs and funds, investments should be channelled to infrastructure for environmental protection, and environmental content should be introduced in educational programs. Farmers should be compensated for their activities that enhance the ecosystem services for everyone.

Norway is not part of the EU but has implemented the EU WFD in Norwegian law. However, the country is not implementing CAP, but has its own regulations and policies to ensure uptake of environmental mitigation measures. The opinions of Norwegian farmers on mitigation measures have recently been studied by Skaalsveen et al. (2022) and Blankenberg and Skarbøvik (2020). Farmers are motivated by the measurable impacts of actions to protect the waters and to preserve the soil. Good information and knowledge on the measures and on the economic incentives is deemed important and can be improved. Practice has shown that farmers who have already tried out measures tend to protest less against the measures. To protect vulnerable water bodies, more regulations are now being implemented in some regions (e.g., environment-friendly ploughing routines and more buffer zones), whereas a regulation to restrict the allowable number of animals per farm field area is still being discussed. Given that only 3 % of the country is agricultural land, there is a potential conflict between environmental measures and the need to produce more food to improve self-sufficiency. Scientists see that operators need assistance in planning and implementing nature-based solutions and that the application process should not be a maze.

Danish example: catch crop regulations

Denmark, as other countries with large-scale animal farming, has a major challenge and target in significantly lowering its nutrient emissions. Catch crops are one option. Since 1999, introduced as part of the Danish implementation of the EU Nitrates Directive, catch crops on a certain percentage of farmed areas have been mandatory in Denmark.

Today, four different catch crop regulations are introduced the major ones being agricultural catch crops and targeted catch crop regulations. The main aim of catch crops is to reduce the leaching of nitrate -N from agricultural fields. They are sown in the late summer after harvest and ploughed down in the winter or early spring, the allowed date being dependent on soil type. The total Danish agricultural area with catch crops has increased from 138.000 ha in 2005/06 to 513.000 ha in 2021/22 (Blicher-Mathiesen et al. 2023). The effect of catch crops in Denmark has been measured in controlled plot experiments and reported in Eriksen et al., 2020, Table 2, which presents the annual reduced leaching of nitrate-N from agricultural fields following implementation of catch crops on two main soil types and two farming systems that have different production quantities of animal manure.

Today, the animal catch crop regulations apply to animal farms that have more than 10 ha field, produce more than 30 kg N/ha in animal manure, and are located in a vulnerable coastal catchment (NATURA 2000) or catchment with increases in animal production and having demands for N-reductions under the WFD. Each year a map is produced by the state showing the percentage of catch crops needed under animal catch crop regulation.

The NORDBALT-ECOSAFE consortium will develop and demonstrate innovative methods and establish best practices to improve current river basin management and governance by reaching the following major aims: i) setting ecologically safe nutrient boundaries in different types of water bodies; ii) improving monitoring of nutrient concentrations by comparing benefits of novel high-frequency online sensors with traditional monitoring; iii) establishing nutrient loading tipping points for carbon sequestration and emissions in water bodies; iv) establishing a harmonised river basin modelling tool for precise estimation of nutrient sources, pathways and transport; v) demonstrating novel Nature Based Solutions (NBSs) and Mitigation Measures (MMs) for reaching the required nutrient load reductions; and vi) developing advanced solutions supporting regional governance structures to implement the most suitable measures to meet the ecological nutrient boundaries. A conceptual diagramme is showing the links between different parts of the project and a ma shows our working platform consisting of six river basins and riverine monitoring points under HELCOM and OSPAR.

<https://projects.au.dk/nordbalt-ecosafe>

Table 2: Effect of catch crops in Danish animal farms

	<80 kg N/ha in manure		>80 kg N/ha in manure	
	Clay soil	Sandy soil	Clay soil	Sandy soil
Catch crop effect	12 kg N/ha yr	32 kg N/ha yr	24 kg N/ha yr	45 kg N/ha yr

The targeted catch crop regulation was introduced in 2017, and every year a new map is introduced for the percentage need for catch crops in Danish coastal river basins. Farmers can then in the first phase every year voluntarily apply for growing catch crops in the coastal catchments. If the yearly target for catch crops in each catchment is not met through the first, voluntary round, a second round with mandatory catch crop demands in the catchment will be introduced to farmers. During the voluntary round, farmers will be compensated for establishing catch crops, but no support is given in the second mandatory round.

Instead of targeted catch crops, farmers can choose among several alternative nature-based solutions or mitigation measures. These include in-between crops, energy crops, early seeding of winter cereals, set-aside land, buffer strips along streams and lakes, precision farming, reduction in farm N quota, or the use of unused N quota from previous year. Each alternative measure has its exchange rate with catch crops. The system thus provides farmers flexibility and as such is presumably cost-efficient as farmers can choose and combine measures that they consider reasonable and affordable.



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Conclusions and recommendations

In Nordbalt-Ecosafe WP6, we study the regulations and policies that impact N and P loads in Northern European waters. In 2023, the project organized workshops in six river basins in six countries and compared N and P mitigation measures as well as regulations and policies that mandate or support the uptake of such measures.

To conclude:

- Reaching a **safe nutrient** concentration and load in the Nordic-Baltic region requires coastal river basin level management, national efforts, and local action.
- Currently applied **mitigation measures** to curb agricultural nutrient emissions in the EU are mainly based on the WFD, the Nitrates Directive, and CAP, which are implemented differently in each country.
- **Farmers** are interested in soil nutrient balances and motivated to protect waters. They want clear rules and sufficient financial support for measures that are sensible.
- **Regional authorities** emphasize evidence-based decision-making, policy coherence, and long-term target-setting. They want to reward the most effective actions in the most suitable locations.
- **Scientists** recommend the consideration of all environmental and social impacts of the food system at the same time and the application of systemic approaches for restructuring the ways of production and consumption.
- The **Danish catch crop example** shows how national target-setting, planning, and regulation can support the application of nature-based solutions and mitigation measures in the agricultural sector in a way that is effective and predictable while also offering flexibility for farmers.

Each country should set water quality targets including nutrient concentration targets based on the WFD and national laws, determine possible solutions and measures based on newest science, and uptake binding regulation and/or sufficient financial incentives in addition to accessible information to reach the environmental targets. Reforming food systems and protecting waters are best done in co-creative and continuous multi-stakeholder processes. Running a comprehensive program is challenging but necessary. When planning food system regulations and policies, societies should consider how all actors including agricultural input suppliers, farmers, food companies, food traders, consumers, and specifically investors can be targeted with regulations and incentives.

References

- Blankenberg, AG.B. & Skarbøvik, E. (2020) Phosphorus retention, erosion protection and farmers' perceptions of riparian buffer zones with grass and natural vegetation: Case studies from South-Eastern Norway. *Ambio* 49, 1838–1849 (2020). <https://doi.org/10.1007/s13280-020-01361-5>.
- Blicher-Mathiesen, G., Thorsen, M., Houlborg, T., et al. (2023) Landovervågningsoplande 2021 (Land surveillance catchment areas 2021, in Danish). NOVANA. Aarhus Universitet, DCE – Nationalt center for Miljø og Energi, 284 s. Videnskabelig rapport nr. 526. <http://dce2.au.dk/pub/SR526.pdf>.
- Eriksen, J., Thomsen, I. K., Hoffmann, C. C., Hasler, B. & Jacobsen, B. H. (2020) Virkemidler til reduktion af kvælstofbelastningen af vandmiljøet. Aarhus Universitet. DCA – Nationalt Center for Fødevarer og Jordbrug. 452 s. – DCA rapport nr. 174. <https://dcau.au.dk/djfpdf/DCArapport174.pdf>.
- HELCOM (2018) Sources and pathways of nutrients to the Baltic Sea. *Baltic Sea Environment Proceedings* No. 153. <https://www.helcom.fi/wp-content/uploads/2019/08/BSEP153.pdf>.
- OECD (2019) OECD Environmental Performance Reviews: Latvia 2019. https://www.oecd-ilibrary.org/environment/oecd-environmental-performance-reviews-latvia-2019_2cb03cdd-en.
- Skaalsveen et al. (2022). Barrierer og muligheter for gjennomføring av vannmiljøtiltak (Barriers and possibilities to implement mitigation measures to improve the water environment, in Norwegian). NIBIO-rapport 8(38). <https://nibio.brage.unit.no/nibio-xmlui/handle/11250/298386>.

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