Protecting waters from pollution caused by nitrates from agricultural sources – Evaluation

7 March 2024, Members and advisors of the Scientific Committee on Nutrient Management Policy (CDM) in the Netherlands

Introduction

Nutrients are essential for plant growth, but excess use of nitrogen (N) and phosphorus (P) negatively affect the environment and reduce biodiversity. Diffuse N and P leaching from agricultural systems deteriorates quality of groundwater and surface water. The Nitrates Directive was implemented in 1992 and aims to protect water quality by preventing leaching of nitrates from agricultural sources to groundwater and surface water and by promoting the use of good farming practices.

The European Commission concluded in the latest Commission Report on the implementation of the Nitrates Directive (data for 2016-2019) that water quality improved overall in the EU in the last 30 years, but nitrates still exceed water quality standards and pollute water. In addition, the European Commission also stated that excessive fertilization remains a problem in many parts of the EU and that action programmes are not sufficiently effective in decreasing nitrate leaching in many regions. The commission also indicated that the impact of climate change on pollution with nitrates has to be better factored in at national level.

We confirm the importance of reducing N and P leaching to groundwater and surface waters in order to improve water quality. However, we conclude that several elements of the Nitrates Directive are not clear and effective. For this consultation, we like to respond on three topics, i.e. i) the targets of the directive, ii) the measures to decrease N and P pollution, and iii) the effect of climate change on water quality.

Clear targets

This Directive has the objective of reducing water pollution caused or induced by nitrates from agricultural sources and preventing further such pollution. Countries have to take measures in action programmes in nitrate vulnerable zones to reduce nitrate leaching. These nitrate vulnerable zones are defined as waters that were identified making use of the following criteria:

- *"whether surface freshwaters, in particular those used or intended for the abstraction of drinking water, contain or could contain, if action pursuant to Article 5 is not taken, more than the concentration of nitrates laid down in accordance with Directive 75/440/EEC;*
- *whether groundwaters contain more than 50 mg/l nitrates or could contain more than 50 mg/l nitrates if action pursuant to Article 5 is not taken;*
- *whether natural freshwater lakes, other freshwater bodies, estuaries, coastal waters and marine waters are found to be eutrophic or in the near future may become euthropic if action pursuant to Article 5 is not taken."*

There is a high spatial and temporal variability in water quality, due to many controlling factors such as weather conditions, farm management, soil characteristics, crop, hydrology etc. It is not clear from the Nitrates Directive at what spatial (e.g. field, farm, region, river basin, groundwater body, soil type,

country) and temporal scale (monthly to averages over several years) the targets for water quality have to be met. We note that a fine spatial and temporal detail may on the one hand be desirable, but on the other hand we signal the challenges to monitor and maintain at such fine levels. There are also large differences between countries in monitoring of water quality and, because of this, in the evaluation of water quality and the spatial scale at which measures have to be taken.

Eutrophication of surface waters is caused by a combination of factors, of which concentrations of N and P are the main components. Member states use different criteria to determine the trophic status of the surface water quality (see e.g. Commission Report on the implementation). The measures of Nitrates Directive focus on decreasing nitrate pollution, but in many surface waters P is equally or more important for the trophic status. The Nitrates Directive forms an integral part of the overarching Water Framework Directive. However, there is no harmonization of the determination of the trophic status in both the Nitrates Directive and the Water Framework Directive.

Recommendations:

- We recommend that the spatial and temporal scale at which the targets on nitrate concentration have to be met are made clear and well-defined in the Nitrates Directive. This must strike a balance between effectiveness and practical feasibility.
- We recommend that a harmonized approach for the determination of the trophic status of surface water is included in the Nitrates Directive. This approach should also include the P concentration in surface water, as P is a main compound that determines the trophic status. It should also be made clear how the targets on surface water quality of the Nitrates Directive link to the chemical and ecological targets of the Water Framework Directive.

Effective measures

The Nitrates Directive contains an Annex with Codes of Good Agricultural Practice (which are obliged in national or regional Action Programmes in Nitrate Vulnerable Zones) and an Annex with compulsory measures that have to be taken in Action Programmes. The most effective and sustainable strategy to reduce nitrate leaching is balanced N fertilization, in which the N application is tuned to the N demand of the crop to increase N use efficiency and minimize the N surplus, in combination with measures that reduce N leaching or runoff, such as catch crops, buffer strips, and closed periods for N application. These measures are already included in the Nitrates Directive, but we recommend to describe in more detail the approach for calculation of balanced N fertilization, because there are large differences between member states how N application standards are calculated. It is thereby important at which spatial scale, soil type and/or crop the N application standards are valid and how the control and enforcement of the N application standards will be organized.

We also recommend to remove the measure of a maximum amount of manure application of 170 kg N per ha from the Nitrates Directive. There is no scientific underpinning that this measure will improve water quality. Moreover, we notice that farmers have to take expensive measures to meet the 170 kg N per ha application standard, by exporting manure from their farm, manure processing, and/or reducing the number in livestock, but that these measures are not necessarily effective in improving water quality. One reason is that reduction in manure application can be partly compensated by mineral N fertilizer. So, a fixed application standard of 170 kg N per ha stimulates the

use of mineral N fertilizer in some situations. Some crops, including grasslands, can take up higher N manure rates input rates than 170 kg N per ha, without exceedance of the 50 mg/l nitrate threshold. However, for other crops, e.g. some vegetables, the nitrate standards will be exceeded at lower manure application rates than 170 kg N per ha. We recommend that the calculation of the amount of manure that can be applied will be part of the balanced N approach, so that there is no general manure application standard in the Nitrates Directive in EU, but that the amount of manure that can be applied will be made dependent on the local/regional conditions including manure management, crop choice and cultivation methods. The latter could be used to define the fertilizer equivalencies for manure N in attaining balanced fertilization. The same will hold for the application rate of mineral fertilizer, processed manure, and biologically fixed N. Such a balanced N approach can differentiate between crop - soil combinations prone to nitrate leaching and not prone to leaching, and that will increase effectivity compared to a generic approach. Additional indicators for N leaching, such as the N surplus or nitrate residue in the soil after harvest could be added in such a balanced N approach. Best Available Techniques (BAT) to mitigate emissions should be applied to decrease gaseous N emissions, including ammonia, and to increase N use efficiency.

Decreasing eutrophication is one of the targets of the Nitrates Directive. Therefore, we recommend that measures to decrease P leaching and runoff will also be included in Action Programmes, such as balance P fertilization. Part of obliged N measures in the Nitrates Directive will also decrease P leaching and runoff, i.e. buffer strips and closed periods for manure application. This will also harmonize the implementation of the Nitrates Directive, as only part of the member states have included measures to decrease P leaching and runoff to surface waters in their Action Programmes.

Recommendations:

- We recommend to describe in more detail a consistent and harmonised approach for calculation of balanced N fertilization because this is the most effective strategy to decrease nitrate leaching (and avoid other N-related losses and emissions).
- We recommend to remove the measure of a maximum amount of manure application of 170 kg N per ha from the Nitrates Directive, because there is no scientific underpinning that this measure will improve water quality in the current situation as compared to 1991. Moreover, it can cause additional costs especially for dairy farmers. We recommend that the calculation of the amount of manure that can be applied will be part of the balanced N approach, so that there is no generic manure application standard in the Nitrates Directive, but that the amount of manure that can be applied will depend on the local/regional conditions (e.g. crop-soil type combination) and manure management and application procedures.
- We recommend to include additional mandatory Best Available Techniques for low emission application of manure. This will also reduce the risk of pollution swapping between nitrate, ammonia and nitrous oxide.
- We recommend that measures to decrease P leaching and runoff will also be included in Action Programmes, such as balanced P fertilization.

Dealing with climate change

Extreme weather events result in rapid changes in water quality. Recent years have shown that cycles of (extreme) dry and wet periods can have a large disruptive effect on nutrient cycling. For example, the nitrate concentration in groundwater and surface water strongly increased after the extremely

dry summer of 2018 in countries in NW Europe. Extreme weather conditions affect the concentration of nitrate via different mechanisms, i.e. i) dilution effect (more rainfall dilutes the nitrate concentration in groundwater) , ii) breakdown of nitrate by denitrifying bacteria under anoxic conditions (less denitrification and high nitrate concentrations under dry weather conditions), iii) increased N mineralisation upon rainfall after a dry period, and iv) lower yields and N uptake by the crop under dry conditions. These factors cannot be influenced by farmers. Most crops are fertilized at the start of the season. A farmer cannot anticipate the weather conditions later that season and for many crops (further) split N application is not possible or only in the first weeks of growth. While the increases in nitrate concentration due to dry periods are a reason of concern, little is known about what these increases mean for effects on the end points that underly the Nitrates Directive; viz. prevention of eutrophication of fresh and marine waters and of drinking water. Often high nitrate concentrations coincide with low nitrate loads (because of lower volumes of water that leach), which could mean on the longer term with alternating dry and wet years, that the nitrate concentrations in finally receiving groundwater and (fresh and marine) surface water bodies are limited.

Recommendations:

- It is recommended to deal with climate change by evaluating long-term trends in water quality in combination with other N indicators of N pressure on water quality, such as the N input, the N surplus and/or nitrate residue in the soil after harvest, so that effective measures to decrease N and P leaching can be taken.
- More research is needed on what increased nitrate concentrations due to dry weather cycles mean for effects on aquatic ecology and drinking water resources

Members and advisors of the Scientific Committee on Nutrient Management Policy (CDM), a committee that advises the Dutch Ministry of Agriculture on scientific underpinning of measures and policies to decrease nitrogen and phosphorus leaching to groundwater and surface waters.

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