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The importance of validated ecological indicators for manure regulations in the Netherlands

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ABSTRACT

The termination of the EU milk quota system on April 1, 2015 is leading to an increase in manure production in the Netherlands. Rather than focus on the quality of water and nature, of which at least the water quality has strongly improved during the last decades, discussions appear to center on strengthening proxy measures that are already being used and which are only remotely related to the quality issue. The quality of water and nature is determined for ground- and surface water by first measuring their N and P content and for nature areas the N deposition. When these values are higher than threshold values determined by ecologists, quality is inadequate and measures are needed. When values are lower, quality is adequate. Three basic problems need to be addressed: (i) threshold values are in practice considered to be permanent while they should be dynamic reflecting a learning process when comparing measurements of N and P values on the one hand and a simultaneous ecological characterization on the other. This requires more cooperation between soil scientists, hydrologists and ecologists. Dynamic characterization may well lead to locally different threshold values. (ii) many measurements of water quality are being made but hardly any measurements of N deposition on nature areas. Such measurements are needed to allow judgements as to the effect of agricultural practices on nature quality. (iii) The necessary further improvement in water and nature quality, as far as it is affected by agricultural practices, can only be achieved when farmers are fully committed and engaged. The current top-down regulations with a "command-and-control" character, while effective in the 1990s, cannot serve this purpose in the information age, the more so since farmers are increasingly well educated and ask too many questions that are not being answered. The suggestion is made to change the generic character of the legislation ("one size fits all") to a system where "tailor made" management systems are designed for individual farms,considering environmental conditions in the area where the farm occurs. Researchers and farmers can work together in a joint-learning mode to develop such designs that can be recognized by certificates with a legal status. In any case, the proportionality principle needs to be considered assuring that the severity of measures taken are in balance with societal effects.

1. Introduction

Environmental policy in the Netherlands, part of which is being guided by the Nitrate (ND) and Water Framework (WFD) directives of the European Commission, has been successful in reducing the impact of agricultural fertilization practices on groundwater quality. Average nitrate contents in groundwater in sandy soils were 190 mg/l in 1991 which was well above the critical threshold of 50 mg/l. After introduction of the ND in 1991, contents have gradually decreased and in 2012 the average content for the country corresponded with the threshold. However, contents in sandy soils were lower in the Northern part of the country and are still higher than the threshold in the southern part. Nitrate contents in clay soils were still 80 mg/l in 1998 but decreased to 20 mg/l in 2012, while contents in peat soils were always lower than the threshold. Loess soils in the southern tip of the country had higher contents than 50 mg/l in 2012 but these soils only occupy a small area and their very deep water tables create quite different conditions (www.rivm.landelijk_meetnet_effecten_mestbeleid).

The quality of surface waters also improved but still approximately 75% of the water has higher N and P contents than the critical thresholds, defined by ecologists and embedded in the

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regulations. Regional differences are quite large and this is not expressed because the entire country of the Netherlands is considered as a vulnerable zone as defined by EC (1991). Nature quality can, in principle, be negatively affected by nutrient-rich surface waters and, particularly, deposition of N, originating from emission of ammonia from agricultural practices followed by N deposition in nature areas, which may cause eutrophication and acidification (De Vries, 2008). Computer simulations of deposition rates suggest negative effects of N depositions on nature quality but measurements to validate these calculations are missing.

The termination of the EU milk-quota system on April 1, 2015 has created new and unsettling conditions because the number of cows has increased and so has the production of manure. This paper will analyze the reaction of the science and policy arenas to these developments. They have so far considered the need to introduce “animal rights”, restricting the number of cows or to introduce measures restricting the P content of animal food or a reduction of the amount of manure that can be applied to the land. The ND “proxy” allows now 170 kg N/ha from manure and derogation rules allow 250 kg N/ha under certain conditions. Derogation rules illustrate the flexible character of the ND which allows exceptions to general rules when adequate documentation is provided by national governments.

As the number of cows increases, the “manure ceiling” can be exceeded and this could mean that the derogation would be recalled so as to allow total manure applications to remain below the “ceiling”.

Rather surprisingly, emphasis thus far appears to be only on measures that have been defined in the past with the intent to reach environmental quality goals. These measures take the form of “proxies” (e.g. Bouma, 2011). But of primary relevance are N and P contents of the water and N depositions on nature, which can define this quality when compared with critical thresholds values for N and P in ground- and surface water and for N deposition in nature areas, defined by ecologists. N and P measurements, as such, serve no purpose by themselves. Their significance arises only after comparison with critical thresholds.

Why are there no initiatives to go back to the principles of the legislation with a focus on water and nature quality, exploring innovative ways to cope with the expected problems rather than follow a business-as-usual scenario based on continuing the application of already established procedures? And, perhaps more importantly, why is there no questioning of the top-down, “command-and-control” procedures that have been followed so far nationwide when applying environmental manure legislation? Changing to an interactive approach engaging farmers in a bottom-up manner, taking advantage of their expertise, could be more effective in solving the problems compared with what would be the continuation of a rather confrontational approach. There was no internet in 1991. Now farmers have access to an overwhelming amount of data on internet and scientists have increasingly the task to guide users through the data forest rather than provide new information (e.g. Bouma, 2015). Without the active and engaged participation of farmers it will be very difficult if not impossible to achieve improvement of future environmental conditions. The “low fruit” has been picked by now and picking the remaining “high fruit” will be difficult. Interestingly, current EU environmental legislation emphasizes the importance of a clear strategy of implementation, involving farmers in a modern learning-mode approach, including exploration of innovations such as, for example, manure processing (http://ec.europa.eu/environment/pubs/pdf/factsheets/nitrates.pdf). Somehow, such opportunities are not eagerly embraced at national level, perhaps out of a fear for loss of control?

The objective of this issue paper is to: (i) review current environmental conditions of air and water in the Netherlands, as affected by agriculture; (ii) discuss the quality assessment process by comparing threshold values with measured N and P contents; (iii) discuss challenges to existing policies following external developments such as the cancellation of the EU milk quota system and (iii) explore new ways in which farmers can be truly engaged in policy issues.

2. The ecological quality of water and nature: comparing measurements with thresholds

As mentioned, when discussing implications of the unexpected increase in manure production, scientists, agricultural journalists and policy makers appear to focus on more strongly enforcing current policies and measures, rather than on the key issue at stake which is the quality of ground- and surface water and nature. So why not start with the latter and next consider appropriate measures to improve this quality when it turns out to be inadequate?

Effects of agricultural practices on the quality of water and nature focus on N and P. Contents of Nitrate in groundwater, N-total and P-total in surface water and N deposition rates in nature areas are measured and compared with critical threshold values defined by ecologists. When measured values are higher than the thresholds, there is a problem and corrective measures have to be taken. If values are lower, there is no problem in a formal sense. The critical threshold for groundwater is the well known 50 mg nitrate/l. As mentioned above, groundwater quality, as measured in more than 700 monitoring sites, was adequate in 2012 in major areas of the country. Only sandy soils in the Southern part of the Netherlands still had nitrate values above the threshold. Progress there is still needed. The relation between agricultural practices and groundwater quality is quite direct and clear as water with nutrients moves down the soil toward the groundwater. The relation with surface water quality is more indirect because other sources may contribute to water quality, even though attempts are made to only measure at points where the impact of other sources appears to be minimal. The relation between agricultural practices and nature quality is still more complex, as will be explored later.

For surface water, thresholds have been defined for 17 types of surface waters by Heinis and Evers (2007) considering four ecological quality parameters: fytoplankton (chlorofyl-a), Macrofytes and Fytobenthos, Macrofauna and Fishes. Different parameters were used for the different types of surface water and no thresholds were defined for ditches and canals, a major outlet for agricultural chemicals. In 2012, 50% of the waters had N-total contents higher than the current threshold. The corresponding value for P-total was 68%. Only 25% of the waters had both N-total and P-total values below the two current thresholds. Regional differences were significant with major problems in the western part of the country (Klein et al., 2012). According to current criteria, improvement is still needed.

The picture is more complicated for nature areas. Ecologists have defined 29 critical N-deposition thresholds for 75 vegetation types (van Dobben and van Hunsberg, 2008). Existing threshold data were used from UNECE (The Convention of long-range transboundary air pollution of the United Nations Economic Commission for Europe), combined with modeling and empirical sources. This is a legitimate and scientifically sound procedure but subject to a lot of unexplained variation. Dry N-deposition rates are, however, only measured at four and wet depositions at eight locations in the Netherlands. Depositions are therefore estimated by simulation modeling which is very difficult without proper validation. Ammonia in air above nature areas is measured at 22 locations since 2005, which has been extended to 60 locations in 2014. But ammonia concentrations in air are no proxy for N-deposition because ammonia is highly mobile and deposition is a function of varying weather conditions. In studying N dynamics in the Northern Frisian