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Farmer driven national monitoring of nitrogen concentrations in drainage water in Denmark

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Field drains are often considered to short circuit the hydrological cycle in agricultural catchments and lead to an increased risk of nitrogen loss to the environment. Because of increased regulation of agricultural practices due to catchment management plans, resulting from the implementation of the water frame directive, Danish farmers pushed for a large scale monitoring of nitrogen loss from field drains. Therefore, the knowledge centre for agriculture, Denmark, organized a three year campaign where farmers and local agricultural advisory centres collected water samples from field drains three to five times during the winter season. Samples were analysed for nitrate and total nitrogen. Combined, more than 600 drains were monitored over the three years.

During the first two years of monitoring, average winter concentrations of total nitrogen ranged from 0.1 mg N L^{-1} to 31.1 mg N L^{-1}, and the fraction of total nitrogen present as nitrate ranged from 0% to 100%. This variation is much larger than what is observed in the Danish national monitoring and assessment programme, which monitors only a few drains in selected catchments. Statistical analysis revealed that drainage water nitrogen concentrations were significantly correlated to the cropping system and the landscape type (high ground/lowlands/raised seabed) in which the monitored fields were situated. The average total nitrogen concentration was more than 2 mg N L^{-1} lower on raised seabed than on high ground, and the average fraction of total nitrogen present as nitrate was more than 20% lower. This indicates that substantial nitrate reduction occurs at or above the drain depth on raised sea flats, in particular in the north of Denmark. This inherent nitrogen retention on raised seabed is not taken into account in the current environmental regulation, nor in the first generation catchment management plans.

The monitoring program demonstrated large variation in nitrogen concentrations in drainage water, in addition to demonstrating that nitrogen retention around the drain depth occurs under certain geological conditions. In order to make management plans for individual catchments areas, this new information must be taken into account. In addition, there is a need to improve on the data presented here by measuring drain flow in order to quantify total nitrogen loss from drains. Both drain flow measurements and methods to include the evident variability in drainage water nitrogen concentrations are under way in other projects within the framework of the DNmark research alliance.