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1. See: http://ec.europa.eu/environment/water/water-nitrates/index_en.html
2. WISER (Water bodies in Europe: Integrative Systems to assess Ecological status and Recovery) is supported by the European Commission under the Seventh Framework Programme. See: www.wiser.eu

European Commission

Science for Environment Policy

Nitrogen pollution measures need tailoring to specific areas to ensure cost-effective results

New research has shown that policy measures in Denmark have successfully reduced total nitrogen loading to 10 estuaries by 39% in recent decades. However, to fully meet the targets of the EU Nitrates Directive and comply with the EU Water Framework Directive in a cost-effective manner, further mitigation measures must be tailored and focused to particular areas.

Increased use of nitrogen in agriculture throughout Europe between 1940 and 1980 caused serious declines in drinking water quality as well as ecological problems such as eutrophication, prompting the adoption of the Nitrates Directive[1] in 1991. In 2000 the Water Framework Directive (WFD) was established. The key objective of the WFD is to achieve good status for all water bodies by 2015. This comprises the objectives of good ecological and chemical status for surface waters and good quantitative and chemical status for groundwater. In response, Member States have implemented a variety of policy measures to combat nitrogen pollution. Assessing the effectiveness of such measures is vital to developing future plans.

The Danish study, partly conducted under the EU WISER project[2], assessed how levels of nitrogen in the water supply have changed in response to policy measures. Focusing on 10 river catchments and their receiving estuaries, which cover 35% of Denmark's land area, the researchers provided long-term measured data on nitrogen concentrations in streams and the estuaries into which they feed, using data from 1989-2009. They also estimated the nitrogen 'surplus' (i.e. the difference between the amount of nitrogen entering the soil and the nitrogen amount removed with crops grown). Furthermore, the development in the efficiency of nitrogen use in manure was calculated.

The results reveal that measures implemented in Denmark over the past 25 years have been successful in reducing nitrogen pollution. Total nitrogen loads from land-based sources to the 10 estuaries decreased by 39% between 1990 and 2009, leading to significantly lower nitrogen concentrations in freshwater inputs (18-55%) and reduced nitrogen concentrations (24-62%) in upper and middle estuarine reaches.

This was mainly the result of reductions in 'diffuse' sources, such as agricultural run-off and leaching, which led to a 28% decrease in the land-based total nitrogen load to the estuaries. Reductions in 'point' sources, such as industrial waste or public sewage, constituted the remaining 11% decrease. The results also demonstrated reductions of 40-53% of the nitrogen surplus in catchment areas and increases in the efficiency of nitrogen use in manure from 40-45% to 75-80%.

Regionally, the effects of the reduced nitrogen surplus on nitrogen loads varied. Eight of the 10 catchments showed clear reductions in diffuse nitrogen loads within five years. However, two catchments showed almost no response, possibly because their nitrate-rich ground waters led to decade-long time lags. Despite good progress, the study concludes that the objectives set under the WFD have not yet been met, and good ecological quality can only be reached by further reducing current total nitrogen loads between 48 and 55% from the 2001-2005 levels.

The costs of achieving reductions in diffuse nitrogen loads also varied substantially between catchments, ranging from €40 to €189 per kilogram of nitrogen. The study suggests that strong regional differences in geology, surface and groundwater explain the pronounced differences in costs, and policy measures therefore need to be tailored and focused to particular areas to ensure cost-effective results.