

**PAPER 17****Water quality response to changes in agricultural measures and practices**

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Since 1985, seven national Action Plans (AP) have been implemented in Denmark to reduce nutrient losses from point sources (sewage treatment plants, fish farms, industrial plants and scattered dwellings) and diffuse sources. The instruments used to reduce nutrient losses from Danish agriculture include a list of nutrient related measures as e.g. mandatory fertilizer plans, livestock densities, mandatory storage capacity for liquid manure, improved utilization of nitrogen in manure, reduced nitrogen (N) norms to crops, tax on fertilizer and fodder, etc. and area-related measures as e.g. reestablishment of wetlands, buffer strips and buffer zones and afforestation programmes. A national monitoring programme was launched in 1988 to monitor regional and national trends in water quality in groundwater, streams, lakes and estuaries as a response to the AP's adopted. Moreover, a Land Monitoring Programme was launched which included a thorough monitoring of five agricultural catchments in groundwater, soil waters, tile drainage water and stream water including an annual interview on farming practices at field scale.

Four national indicators were defined to follow trends in diffuse nutrients losses from agriculture areas: nutrient surplus in agriculture, nutrient leaching from agricultural land and nutrient concentrations and loads in surface waters. Since 1985, the introduction of mitigation programmes has reduced the discharges of BOD<sub>5</sub>, total nitrogen and total phosphorus from point sources by 96%, 81% and 81%, respectively. The use of nitrogen and phosphorus in chemical fertilizer has been reduced by 50% and 65%, nitrogen and phosphorus in animal manure by 3% and 6% and the surplus of nitrogen and phosphorus by 31% and 48%, respectively during the period 1989-2003. The model calculated nitrogen leaching from the root zone has on average been reduced by 33% during the period 1989–2002. Trend analysis of total nitrogen concentrations and loads in 86 streams draining smaller agricultural catchments shows an average reduction of 29 and 32% (1989–2004). No general trends in diffuse phosphorus losses can be observed in the Danish streams draining agricultural catchments during the same period. The reason for this might be due to a combination of effects as: i) an ongoing positive P-surplus in Danish agriculture giving rise to increases in soil P and thus increases in erosional P-losses and P-leaching; ii) unintended side effects of some of the adopted measures for nitrogen giving rise to increases in P losses as restoration of wetlands; iii) climate change showing increases in precipitation and runoff during the last 80 years in Denmark. The instruments and measures adopted in Denmark to regulate nutrient losses from different pressures have, therefore, proven successful for nitrogen from point sources and diffuse sources and for phosphorus from point sources, whereas we still need to tighten regulations of phosphorus losses from diffuse sources.