

# Report of Working Group 1

## Nitrogen flows at the regional level: policy implications of the Water Framework Directive

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Which measures are best suited to achieve the ultimate Water Framework Directive (WFD) goal: to assure that all water bodies are in good ecological status by 2015? This is the issue that agricultural and environmental research must address. How much have we progressed on the road to providing answers, and what should further research be focussed on?

The working group meeting was structured around the steps we consider essential in the process of identifying the most effective measures for achieving the WFD goals:

- (a) regional assessment of current water quality and nitrogen(N)-load;
- (b) assessment of desired quality and corresponding load;
- (c) inventory of potential measures; and
- (d) evaluation of impact.

Participants were asked to ponder about setting the research agenda for the next few years, to fulfil our obligations as research community in the light of the WFD. Several speakers gave introductory presentations to start off the discussions on the respective aspects listed. Based on submitted abstracts, there appears to be a strong emphasis now on Step (a). Is there a need to shift emphasis? Which elements are missing? Do we need to reconsider methodologies? Do we really need to know processes in such detail? These were the issues discussed; the results are outlined below.

As stated, research so far appears to be largely focussed on the regional assessment of current water quality and N-load. Also, there is quite some activity in modelling to draw up potential measures (c) and to make ex-ante assessments of their expected impact (d). It need not surprise that the material available at this stage regarding measures and their impact, is largely from modelling studies and that experimental or monitoring results are scarce. Afterall, the WFD has been announced recently. Legislative measures may be costly for stakeholders, and so must be taken with greatest care. Next, because many actors may be involved, they must pass the political process which is time consuming. Lastly, once in place, measures may perhaps take effect only slowly and the impact on target variables will show in the course of years.

Apart from the observation that data material on the impact of measures is still very limited, it was felt that there is insufficient attention, at the moment, for defining the desired water quality, at least within the community represented at the meeting. Some researchers argued that there is a large gap between the 'agro-world' and the 'water-world'. Workers in the water-world do give much attention to defining the desired quality, but they seem to be little connected with those working on mitigating diffuse emissions from agriculture. Another contrast identified is that between scales. Much work seems to be conducted at the farm scale, little work at the regional scale. Some of the modelling studies were focussed at the regional scale, and these were highlighted in the meeting. An exemplary study was presented by Merete Styczen from Denmark (see contribution in this book), where entire catchments were modelled including the impact on the water quality in the downstream Odense and

Ringkober fjords. In the subsequent discussions, this served as a frame to highlight various viewpoints by the scientists present. Key points are summarised here:

- The design of monitoring programs must fulfil the requirement that results will expose the impact of policy.
- Models are very effective tools in 'cleaning up' data sets; all data sets from monitoring contain errors and some of the most obvious can be identified with the help of models; models are also considered indispensable in the interpretation of monitoring results.
- Surface water systems are interconnected and form one widespread continuous system. Systems analysis and geohydrological modelling ('particle tracking') are key tools to relate observed water quality to the sources associated; without models this is hardly possible unless monitoring density is very high..
- This also helps to implement measures only where they matter most, thus alleviating pressure on the larger farming community; efforts must be targetted at sensitive zones, usually zones with little natural capacity to eliminate undesired pollutants such as areas where water flows directly to surface waters without passing the redox cline.
- We should be aware of non-agricultural (often point) sources; now there is little attention for their relative importance.
- As for nitrogen, more attention must be given to organic N-species. These turn out to represent an important fraction of N found in surface waters.

As for the WFD, ecological objectives for surface water quality will likely be more restrictive than nitrate emissions via groundwater. In addition, phosphorus is highly relevant for surface water whereas it received limited attention so far, when research was more concerned with groundwater and, hence, nitrogen.

As for farming, there will be an increased public pressure to produce with lower emissions. Research must facilitate the development of more efficient techniques and sustainable systems. This is the well known track of current work. Within this domain, the question was raised why livestock-systems seem to respond more directly to a reduction of inputs than arable systems. Pools of organic N and their turnover must be better understood, including the role of tillage.

It was recognised that the nature of crop and animal growth comes with inherent inefficiencies which cannot be overcome unless we switch to systems now regarded as very or too innovative, that is, using entirely different organisms to generate our food.

Keeping with the same crops and animals, it is not obvious beforehand that 'extensive systems' are more nutrient-efficient. They are, for sure, not more land-efficient as they require more surface area per unit produce. Rather than just aiming to reduce nutrient use in agriculture, we should be more aware of options available to achieve the same goals at catchment scale by segregation of agriculture and 'nature'. This requires (rules for) land use planning, allowing rather intensive agriculture in some parts, at the expense of permissible activities in other parts.

In areas where we will, indeed, continue to farm in a way roughly comparable to current ways, only better optimised within the natural limitations of the production species, better use must be made of options to reduce nutrient loads via retention in surface water systems ('effect-measures'). Examples are buffer zones, zones with specialised catch crops, riparian purification zones. There is a need for systematic comparison and classification of wetland bodies, with respect to their potential for water purification. A typology must be set up for this purpose. Then, given the characteristics of specific areas, options for water management must be explored, and the impact of measures on ecology specified.

In specific cases, as the Dutch peat district, it is obvious that only drastic changes in hydrology management can stem the release of nutrients from the original parent materials. Drained peat releases nutrients irrespective of agricultural land use, and (partial) flooding might prove, in the end, the only solution to reduce nutrient loads substantially.