Science for Environment Policy
DG Environment News Alert Service
SPECIAL ISSUE

Water

Issue 7 July 2008

Editorial

Improving water quality in Europe's rivers

The European Water Framework Directive (WFD) urges policy implementation managers to respond to poor ecological, chemical and quantitative status of the water system caused by negative pressures from different drivers. This issue discusses recent experiences with regard to different stages of river basin management strategy, to help us understand how we can safeguard water, an indispensible resource.

Monitoring levels of contaminants in river water accurately remains an ongoing challenge and various methods are available. One recent study has proposed monitoring living organisms, such as plankton, in water, as these show clear signs of harm caused by pollution (see 'Using micro-organisms to measure river health'). Elsewhere, researchers have compared the merits of continuous monitoring devices with spot check devices (see 'Combined approaches to measuring metal concentrations in water').

A strong relationship between science and policy is pivotal in ensuring best practice. Recently, researchers have designed a new concept for integrating science into every stage of water policy development, as detailed in 'Science-policy interface: A route to implementing the WFD'. 'Challenges in agricultural pollution policy' looks at scientific developments in our understanding of agricultural pollution in rivers, which can help inform policy changes. Meanwhile, scientists in Denmark show that policy can have a genuine impact by reducing nitrogen levels in river water (see 'Action plans for reducing nitrogen pollution').

The public are very concerned about water quality and it is important that the diverse views of citizens are incorporated into river management strategies. 'Social learning in river basin management' emphasises the need for collaborative decision-making, which involves different cultural groups.

In line with the above, I would like to conclude by drawing your attention to the WISE[1] information system, designed to facilitate exchange of up-to-date information related to the implementation of the WFD. In the WISE-RTD branch (www.wise-rtd.info), information can be found on results of Research and Technology Developments in the form of projects, tools, methodologies, experiences and guidance. This information is technology-oriented as well as related to the policy implementation process.

Willem J. de Lange
Deltares - Enabling Delta Life
The Netherlands

[1] WISE: Water Information System for Europe, http://water.europa.eu/content/view/20/36/lang,en/

Contents

Page

EUROPEAN COMMISSION
environment

Using micro-organisms to measure river health

Contact: juliette.tison@bordeaux.cemagref.fr
Theme(s): Water

Monitoring changes in microscopic organisms called diatoms can assist in evaluating the quality of water over an entire river watershed. Researchers from France have developed a new index that could help Member States fulfill the EU's Water Framework Directive 2000 (WFD)[1]. The WFD aims to achieve good ecological and chemical status in surface water bodies by the year 2015.

"[The method] enables an entire river basin to be monitored, which is a distinct natural geographical and hydrological unit, rather than taking administrative or political boundaries as a starting point."

Diatoms are a type of phytoplankton - microscopic organisms that serve as the basis of the aquatic food web. They exist in the lower levels of rivers, including the sediment, and their community structures change noticeably in the presence of pollution or other human-induced impacts. Studying the health and abundance of their communities can provide an accurate method of monitoring environmental conditions and determining water quality.

There are many diatom species, so the researchers classified them according to pollution sensitivity levels, on a scale of 1-5 according to whether they showed maximum sensitivity to pollution (1) or maximum tolerance to pollution (5). The researchers then measured the abundance of diatom communities with different degrees of sensitivity to pollution at various points along the river. These samples were compared against a 'reference community' of organisms of the highest, least-disturbed quality taken where the water is purest, usually at the headwaters of a river.

The resulting Ecological Distance Index (EDI) reveals the ecological damage to the species compared with the reference community as they travel along a river gradient. The researchers tested the index using samples collected during the summer low flow period from 31 sites on five rivers that form the Adour-Garonne river basin in South West France.

One advantage of the method is that EDI values are directly comparable across different geographical and climatic regions. It also enables an entire river basin to be monitored, which is a distinct natural geographical and hydrological unit, rather than taking administrative or political boundaries as a starting point. The WFD encourages cross-border cooperation in river basin management. The EDI method is able to be incorporated into other water quality indices that use a variety of different measures. It can also be applied to other species, such as macro-invertebrates (e.g. insects and crustaceans) and fish, in the same way by finding typical reference communities for each river type and then ranking the species by pollution sensitivity values.

The authors comment that the EDI is therefore more adapted to fulfilling the requirements of the WFD than traditional water quality measures, although they point out that the pollution sensitivity values used as a basis for the index are valid only for the French river system and would need to be revised for other geographical areas.

Source: Tison, J. Giraudel, J.-L. and Coste, M. (2008). Evaluating the ecological status of rivers using an index of ecological distance: An application to diatom communities. *Ecological Indicators.* 8(3): 285-291.

1 EU's Water Framework Directive 2000 (WFD) http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm and http://ec.europa.eu/environment/water/water-framework/index_en.html

Combined approaches to measuring metal concentrations in water

Contact: ian.allan@niva.no
Theme(s): Water

EU Member States are required to monitor concentrations of metals in surface water in order to comply with regulations laid out under the Water Framework Directive[1]. Current sampling methods may produce uncertain estimates of pollutant levels. A new study provides evidence that combining different sampling techniques can produce more reliable estimates.

"A major problem with spot sampling is that it does not take account of variations in pollutant concentrations that occur in the periods between samples."

In 2006, the European Commission issued a list of environmental quality standards for concentrations of chemicals in surface water. These standards relate to chemical pollutants identified as 'priority substances' under the European Water Framework Directive. Priority substances pose risks to ecosystems and human health, often because they accumulate in food chains. They include the trace metals cadmium, nickel and lead.

Monitoring programmes which ensure compliance with these standards generally use spot sampling techniques to measure levels of trace metals. But in a recent study, scientists recommend combining spot sampling with data taken from devices that remain in the water for a number of weeks. Researchers from France, Norway, Sweden and the UK tested trace metal concentrations in the River Meuse in the Netherlands using two different sampling devices and compared the results to those obtained from spot samples.

A major problem with spot sampling is that it does not take account of variations in pollutant concentrations that occur in the periods between samples. Estimates of metal concentrations can be improved by sampling more often, but this can prove time consuming and expensive. The new research shows that monitoring devices that accumulate metal over longer periods can provide useful estimates of metal concentrations, which compare well with data from high frequency spot samples. The two devices tested, Chemcatcher® and the diffuse gradient in thin film (DGT) sampler, both provided reliable estimates of cadmium and nickel concentrations, as well as other metals such as copper and zinc not listed as priority substances. However, the researchers suggest further adjustments need to be made to the devices to improve lead sampling.

The study was carried out using devices that remained in the water for between one and four weeks. Therefore, before widespread use in monitoring programmes can be implemented, more research needs to be carried out to establish optimum exposure times for obtaining accurate data. A question also remains over the effects of the specific characteristics of a body of water on the devices. The River Meuse, for example, is a "hard water" source – it contains high levels of calcium carbonate. Further studies should address the impact of different conditions on the accuracy of sample data.

Provided these further studies yield favourable results, combined sampling techniques could help EU member states to comply with quality standards by providing reliable water monitoring data without the need for costly high frequency sampling.

Source: Allan, I.J. Knutsson, J. Guigues, N. *et al.* (2008). Chemcatcher® and DGT passive sampling devices for regulatory monitoring of trace metals in surface water. *Journal of Environmental Monitoring*. 10: 821-829.

[1] EU's Water Framework Directive 2000 (WFD) http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm

Science-policy interface: a route to implementing the WFD

Under the Water Framework Directive[1] (WFD), all water in Europe should be of good quality, ensuring the sustainable use of water in the future for Member States. Researchers suggest water policies can be successfully implemented through a science-policy interface, where scientific research is integrated at all stages of policy developments. A concept has been developed to provide the necessary technical support for such an interface.

Contact: Wim.deLange@deltares.nl
Theme(s): Water

"A strong science-policy interface would enable the bi-directional linking of policy and science. Expert information to support water policy design, development, implementation and review would be available to policy makers."

Research and Technology Development (RTD) projects within the 5th and 6th Framework programmes of the European Community (and under LIFE and INTERREG III[2] initiatives) are considering more policy requirements, an important issue if the milestones set under WFD are to be met. For example, under the framework of the Harmoni-CA[3] project, modelling tools and methods are being harmonised for the integrated management of water at the river basin scale.

A strong science-policy interface would enable the bi-directional linking of policy and science. Expert information to support water policy design, development, implementation and review would be available to policy makers, while scientists and other experts would be better informed of the requirements of policy makers. Water-related policies and associated policy implementation tasks would be connected with:

- guidance on the application of RTD projects and tools used to implement water policies
- results of case studies which have implemented water policies (experiences)
- actual RTD results and tools

Researchers have outlined the mechanism (a science-policy interfacing instrument) by which links can be made between the strategic areas of policy and science. Progress towards this interfacing instrument has been made within the framework of the Harmoni-CA project.

Access to information through the interfacing instrument would be via 'keywords' which cover activities, such as 'monitoring', and water-related items, such as 'water body status'. An activity is located within the correct context by combining an activity related keyword with context-related (water-related) keywords. For example, the combination of the activity keyword 'identification' with the water-related keyword 'driving force or pressure' would define the more specific activity of dealing with the identification of pressures. Policy implementation tasks, guidance, experiences and tools could therefore be linked to one or more activities through the combination of keywords.

By applying filters to the interface instrument only the most relevant information would be made available to specific users, thus supporting the requirements of a broad range of stakeholders. In addition, a Web Portal[4] (WISE-RTD) is under development, where the science-policy interface could be accessed. At the time of writing the paper, further research was needed to validate the concept and particularly to evaluate the user entries of the system.

Source: Willems, P., de Lange, W.J. (2007). Concept of technical support to science-policy interfacing with respect to the implementation of the European water framework directive. *Environmental Science & Policy* 10: 464-473.

1 EU's Water Framework Directive 2000 (WFD) http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm

2. See: http://ec.europa.eu/environment/life/index.htm for information of LIFE and http://ec.europa.eu/regional_policy/interreg3/index_en.htm for information on INTERREG III.

3 See: www.harmoni-ca.info

4 See: http://www.wise-rtd.info/wpis/mywise.cgi .

Challenges in agricultural pollution policy

Concerns about the impact of agricultural pollution on the environment have led to national and international efforts to limit water pollution, such as the EU Water Framework Directive (WFD). New UK research highlights a number of key issues for policy makers in this area relating to monitoring and modelling pollution levels.

Contact: Adrian.Collins@adas.co.uk
Theme(s): Agriculture, Water

"Policy makers should be aware that modelling studies that look at preventing pollution during key ecological windows might be more beneficial than models that only assess the annual prevention of pollution."

Much improvement has been made in water protection in Europe, in both individual Member States and at European level. However, there is still progress to make and this need is expressed by both the scientific community and other experts and, to an increasing extent, by the public and environmental organisations.

The WFD[1] will increasingly coordinate EU water policy. It aims to prevent water resources deteriorating further, promote sustainable water use and enhance aquatic environments. The WFD includes economic analyses and public participation to develop plans for river basin management.

One key issue in river basin management is that while scientists' current understanding of pollution levels is good, it is difficult to link pollution data with ecological impacts. However, a number of new monitoring tools are becoming available, including biological early warning systems and chemical water quality monitoring systems.

Modelling and decision support tools have been used to inform policy about diffuse pollution from agriculture. Policy makers should be aware that modelling studies that look at preventing pollution during key ecological windows (for instance when salmon are spawning in rivers) might be more beneficial than models that only assess the annual prevention of pollution.

Mitigation programmes must consider multiple pollutants and the risk of 'pollution swapping,' where intervention to address one pollutant has a negative effect on another. Efforts to mitigate diffuse agricultural pollution must be sustainable and also address the wider needs of society. Stakeholder engagement in the decisions about mitigation strategies is important, the study says.

The authors also point out that the WFD does not address climate change, which is a potential weakness. For example, recent UK research suggests that climate change will cause wetter winters with more storms, which means that more contaminants in sediment could be washed into aquatic ecosystems as a result.

Efforts to target mitigation methods appropriate for the type of landscape or agriculture practiced continue to come under scrutiny, particularly in the context of additional environmental pressures like climate change. Sediment must be given a higher profile in pollution policy because it plays a key role in transferring nutrients and contaminants with a negative impact on habitats.

The researchers call for a more holistic approach to understanding and managing the pressures and impacts of pollution from alternative sectors, and stakeholder engagement.

Source: Collins, A.L. and McGonigle, D.F. (2008). Monitoring and modelling diffuse pollution from agriculture for policy support: UK and European experience. *Environmental Science & Policy*. 11(2): 97-101.

1 EU's Water Framework Directive 2000 (WFD) http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm

Additional information: The recently published LIFE Focus brochure, "LIFE on the farm: Supporting environmentally sustainable agriculture in Europe", highlights innovative LIFE projects that succeeded in contributing to the WFD objectives. These include a project contributing to the implementation of the WFD in Denmark, the Optimizagua project, which is developing an optimised irrigation system to rationalise water use, and the Agri-Peron project, which promotes best agricultural practice in reducing nitrate pollution.

Action plans for reducing nitrogen pollution

European policy directives set ambitious targets for controlling nitrogen pollution. Effects of policy measures implemented in Denmark suggest that substantial improvements to water quality are possible through changes in farm management practices, without negative impacts on agricultural performance.

Contact: bkr@dmu.dk
Theme(s): Agriculture, Water

"Between 1989 and 2004, nitrogen concentrations in streams dropped by around a third, as did nitrogen levels leached from agricultural land."

Nitrogen pollution of water systems poses a significant problem in Western Europe. Despite widespread implementation of monitoring networks and action plans in EU Member States, recent statistics show that nitrogen levels in water vary greatly and continue to rise in many areas. Intensely farmed regions are more susceptible to nitrogen pollution as the fertilisers used in agriculture are a major source of nitrates.

In 1991, the Nitrates Directive was imposed with the aim of reducing concentrations of nitrogen in water systems. The later European Water Framework Directive (WFD)[1], imposed in 2000, introduced new targets for maintaining water quality at levels close to those which would be seen under natural conditions, without human impacts. Innovative measures are needed to achieve these goals.

One country that has seen dramatic improvements in water quality in recent years is Denmark. A new study highlights the success of seven national action plans in reducing nitrogen concentrations in Danish waters. Between 1989 and 2004, nitrogen concentrations in streams dropped by around a third, as did nitrogen levels leached from agricultural land. The researchers say this has been achieved during a period of intense agricultural activity and growth. They claim therefore, that it is possible for Denmark and other nations with strong farming industries to reach the targets set by the WFD without negatives impacts on agriculture.

The seven policy measures introduced in Denmark focus on controlling the amount of manure and fertiliser used in agriculture, as well as on establishing wetlands, which play an important role in nitrogen cycling and removing harmful nitrates from the environment. All measures were developed following discussions with researchers and farmer groups, in line with WFD requirements for public consultation. Future policy changes will be implemented with the aim of integrating measures designed to reduce nitrogen pollution with other aspects of water and land management.

A key finding of the study, say the researchers, is that there may be a long lag between implementation of a new policy and decreases in nitrogen levels. They concede that original targets for halving nitrogen levels in water within five years were unrealistic. Policy makers are often keen to see fast results, but it inevitably takes time for farmers to adopt new farming methods and for reductions in nitrogen levels used in agriculture to transfer to water systems.

Source: Kronvang, B., Andersen, H. E., Børgesen, C. *et al.* (2008). Effects of policy measures implemented in Denmark on nitrogen pollution of the aquatic environment. *Environmental Science & Policy*. 11(2): 144-152.

[1] EU's Water Framework Directive 2000 (WFD) http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm

Social learning in river basin management

Contact: pahl@usf.uni-osnabrueck.de
Theme(s): Water

Water resources management generally follows a model in which problems and their causes are scientifically identified, and technical solutions are devised. However, contrary to the terms of the European Water Framework Directive (2000)[1], this process does not take into account the social beliefs, behaviours and attitudes of other interest groups. A recent study discusses how diverse interests can collaborate in decision-making processes.

"The researchers identified various ways in which different groups base their opinions about the environment, for instance, whether they are interested in protecting nature, their country or economic security."

National populations consist of many cultural groups, each with their own stake in a nation's resources. Since river basin watersheds often cross political borders, international cultural practices also need to be considered. The researchers, from the EU HarmoniCOP[2] project, identified various ways in which different groups base their opinions about the environment, for instance whether they are interested in protecting nature, their country or economic security. Each approach has very different attitudes towards nature and risk, and to different expectations for management strategies. Social learning requires dialogue between each type of understanding, instead of just allowing 'experts' to define both the problem and the solution.

Climate change is expected to increase the pressure on water resources, and cultures must adapt to this rapid environmental change. Each culture must be very responsive to managing resources.

The extent to which the unwritten 'rules' of local behaviour influence the practice of formal institutions (such as laws and regulatory organisations), in the management and provision of water resources, is a good indicator of how responsive governance is to water management. Active public involvement creates wider ownership of the decision-making process, promotes greater cooperation and commitment to the eventual decision, and contributes to a stronger society in the face of rapid change.

As an example, development of the National Water Plan in Spain was characterised (in national press coverage) by a gradually increasing focus on sustainability. This has been interpreted as a social learning process in which a cultural change occurred, which lead to changes in the more unpopular parts of national policy.

However, the study reports that across Europe, the standard 'command and control' approach still dominates water governance. Integrated resource management does not often occur, nor are collaborative and responsive management processes in place. Mechanisms are urgently needed both to promote dialogue between different interest groups and cultures, and to translate these discussions into political action.

Compared with more liberal societies, social participation will be more difficult to establish in heavily regulated societies, with widespread inequalities in power and wealth and strong emphasis on individual rights. However, social learning is intended to encourage more open models of decision making, and resolving environmental and social conflict is a natural part of the process.

Source: Pahl-Wostl, C. Tabara, D., Bouwen, R. *et al.* (2008). The importance of social learning and culture for sustainable water management. *Ecological Economics*. 64(3): 484-495.

1 EU's Water Framework Directive 2000 (WFD) http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm

2 The HarmoniCOP project was supported by the European Commission's fifth framework programme for Research and Development: http://www.harmonicop.uos.de/index.php

Issue 7 July 2008

A selection of articles on Water from the *Science for Environment Policy* News Alert

Determining the good status of groundwater (20/6/08)

Groundwater standards in Member States are to be established by the end of 2008, according to the European Union's new Groundwater Directive. Recent research has developed a new method to determine the chemical status of groundwater which is applicable across the EU. This procedure has been assessed by testing the quality of the groundwater of the Upper Rhine Valley in Germany, Switzerland and France.

Measuring diffuse pollution in river catchment areas (15/5/08)

In recent decades, discharges of pollutants from waste water treatment plants and industry have been successfully identified and in many cases reduced, but assessing inputs of diffuse pollution from land, and the degree of retention of pollutants, such as nitrogen and phosphorus, within surface water systems is harder to achieve. A recent study has compared different methods used to estimate diffuse pollution in river catchments.

Mapping pesticide contamination risk (17/4/08)

A new computerised tool helps regulators identify water sources at risk of pesticide contamination. The tool can be used to produce maps indicating water bodies at risk of contamination by taking into account: adjacent land-use, the concentration of pesticides in the environment and biological indicators of contamination.

Putting a price on water quality (21/2/08)

One way to clean-up water pollution is to award 'credits' to facilities that reduce their emissions. These credits can then be traded with other facilities to compensate for pollution outputs. This controls overall pollutions levels, while creating an economic incentive to reduce emissions. Research using models that simulate water quality has been used to establish the value of these credits and analyse how the price of credits might change under various conditions, such as the seasonal changes in a river's ability to deal with pollutants.

Informed farmers keep the healthiest streams (10/1/08)

Information campaigns highlighting simple water management practices to farmers could provide a cost-effective way to restore natural water sources, a recent study concludes. Researchers in New Zealand found that deer farmers who received information packs voluntarily adopted simple practices, such as fencing off livestock from streams, which restored stream health on their farms.

To view any of these articles in full, please visit:
http://ec.europa.eu/environment/integration/research/newsalert/chronological_en.html,
and search according to article publication date.