32. Introduction

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1. THE RESULTS OF THE SECOND-ROUND QUESTIONNAIRE

The analysis of responses to the first questionnaire[1] produced a set of 31 indicators selected on the basis of the four criteria shown in Figure 32.1: pollution-emitting sectors, pressures in terms of quality and quantity, water quality parameters and types of water resources (surface/underground). The results of the second questionnaire were then used to classify these indicators

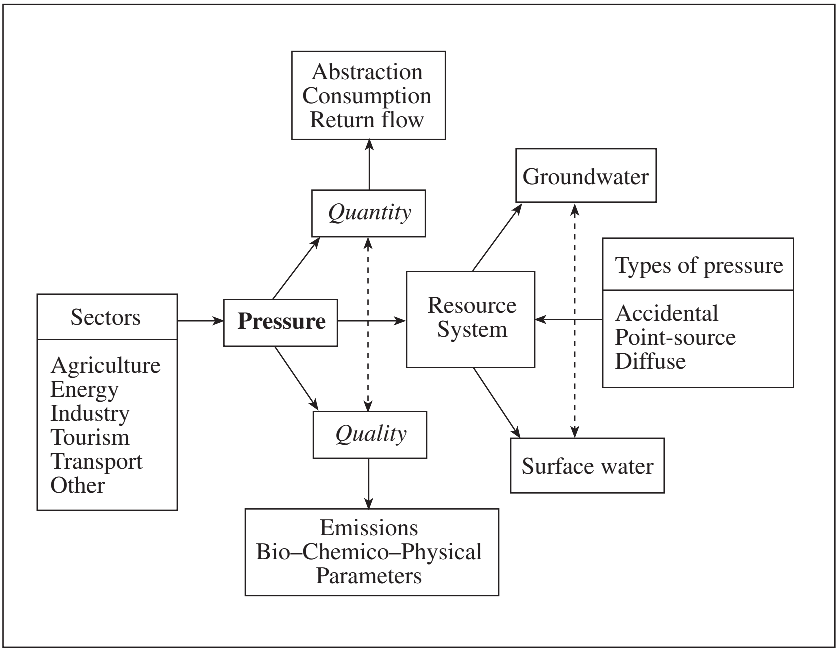

Figure 32.1 Criteria for selection of water pollution and resources indicators

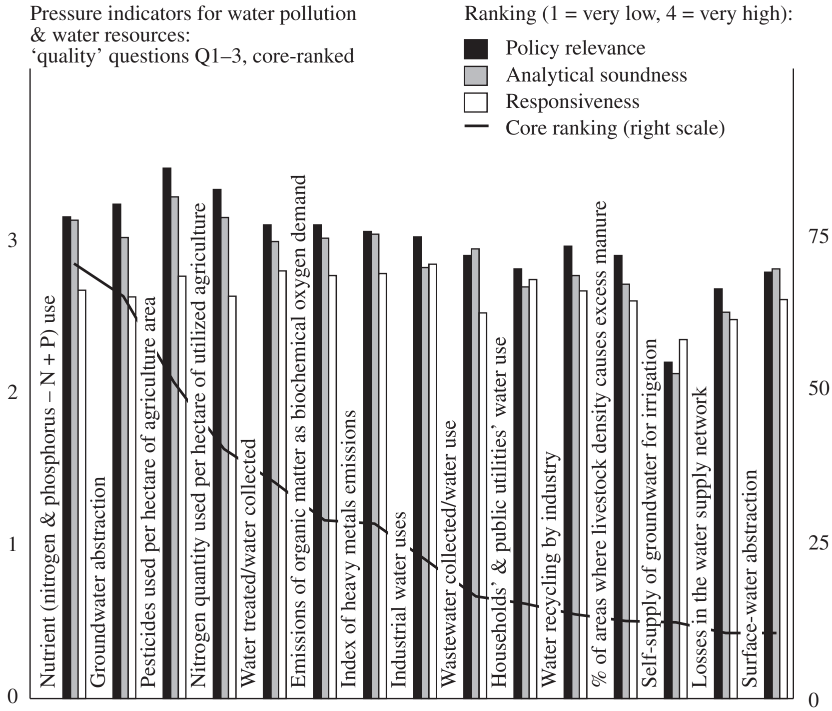

Figure 32.2 *Results of second-round questionnaire for the Water Pollution and Water Resources policy field*

in order of rank on the basis of three qualitative criteria: policy relevance, analytical soundness and responsiveness.

The overall top 15 rankings for the three quality questions and the core rankings are given in Figure 32.2. These indicators cover the different natural areas in Europe, qualitative and quantitative pressures on water resources and their impact, and the different sectors which release polluting substances.

Pressure on Water Quality

Pressures on water quality are caused by the release of pollutants and toxic substances produced by social and economic activity. Agriculture is the main source of nitrogenous pesticide and fertilizer effluent. Agricultural pressures are reflected by two highly ranked indicators: 'pesticides used per hectare of utilized agricultural area' and 'Nitrogen quantity used per hectare of utilized agricultural area'. Indicators associated with public use and urban areas include ‘emissions of organic matter measured as BOD’. Indicators related to industry are represented by ‘Index of heavy metal emissions’. The final indicator in this category – ‘Total nutrient (N + P) use (eutrophication equivalents)’ – cuts across all sectors since the substances released are common to them all.

Quantitative Pressures

Quantitative pressures are those resulting either from excessive withdrawals and use, or from wastewater released into the environment with little or no treatment, which is measured in terms of effluent flows. In the case of pressures due to water abstraction, particular attention is given to underground water resources because of their sensitivity to over-abstraction. The indicator used is ‘groundwater abstraction’. The impact of industry, as the major source of pressure related to water use, is reflected by the indicator on ‘industrial water uses’. The main sources of effluent discharge are industrial and municipal, and pressures in this case are measured by indicators such as wastewater collected/water use.

Representativeness of the Selected Indicators

The indicators selected reflect problems associated with qualitative and quantitative pressures which occur during the different phases of the water cycle (resource systems, use and return flows) in the various natural areas in Europe, as well as the intensity of different social and economic uses of water in these regions (domestic, municipal, industrial and agricultural).

The polluting and toxic substances included in the indicators reflect the main impacts in terms of water quality: eutrophication, toxicity, organic pollution and – indirectly – acidification. In terms of quantity, the main emphasis is on groundwater resources because of their extreme sensitivity to excessive abstraction (resource renewal problems), and also on industrial water uses because of the toxicity problems liable to result from the discharge of industrial wastewater into aquatic ecosystems. Finally, this category also includes the indicators reflecting return flows, such as ‘water treated/ water collected’. Discharges from these sources are largely responsible for the water quality problems mentioned above.

It should be borne in mind that several aspects are not taken into consideration: first, those aspects related to ‘natural’ pressures, with flooding and drought as the major impacts; second, salinization problems characterizing some southern European regions (for example, Spain) as a result of freshwater scarcity and inappropriate irrigation (for example, inadequate or non-existent drainage systems); and third, the problems due to changes in the water regime brought about by hydraulic installations, to changes in aquatic systems through development, or to changing land-use patterns.

2. DELIMITATION OF THE POLICY FIELD FROM OTHER POLICY FIELDS

Water is a non-substitutable resource that is vital both to ecological processes (*in situ* use) and to social and economic activity (*in situ* and *ex situ* uses), but it is the latter category that exerts the greatest pressures on the resource system.

Relevance to the Pressure System

Public utilities and the different economic sectors (agriculture, industry and so on) all use the natural environment to meet their water needs. The quantities of water abstracted therefore provide an indication as to the intensity of the pressures exerted by the different types of use. Once part of the water abstracted has been used and/or consumed, wastewater effluent is discharged into the same environment, which is therefore subject to two forms of pressure, both of which are primarily quantitative in the sense that both abstraction and discharge produce changes in the water regime.

The effluent discharged once the water has been utilized contains many different types of polluting – and sometimes toxic – substances, in concentrations which depend both on the type of activity and on whether or not the effluent is treated after use. Pressures are therefore also exerted on water quality, since the effluent alters the composition of the water resource. Interaction between the qualitative and quantitative aspects of water management also needs to be stressed, in the sense that pollutant emissions tend to limit the quantities of water available for certain uses, while over-abstraction may alter water quality in the environment.

Relevance to the Other PIP Policy Fields

Because water resources interact in so many different ways with social and economic activities in their various forms (through abstraction and wastewater discharges), as well as with other natural habitats and ecosystems (air, soil, vegetation, other natural resources and so on), water-related issues cut across many different policy fields. An analysis of the top ten 'overall ranking' indicators selected for each of the ten policy fields addressed under the PIP shows that the Water Pollution and Water Resources policy field is closely and directly linked to the Resource Depletion, Urban Environmental Problems and Dispersion of Toxic Substances policy fields. The linkages are described below.

- Water is a natural resource, so the Resource Depletion policy field is associated with three indicators which are directly related to quantitative aspects in the Water Resources and Water Pollution policy field. These are the indicators on groundwater abstraction by type of use (one for drinking water and one for agriculture/industry) and on overall water use per capita. The first two appear as aggregate indicators of total groundwater abstraction in the Water Resources and Water Pollution policy field, while, conversely, the 'total water use in industry' topic makes up part of the third indicator. In the current programme, water resources make up a policy field in their own right and, as a result, those indicators which are also associated with Resource Depletion need to be given top priority in the Water Pollution and Water Resources policy field. The Resource Depletion policy field could then focus more specifically on the analysis of pressures on natural resources other than water.
- In urban areas, net water consumption by public utilities and industries connected to public distribution networks is not very high since large quantities of wastewater are discharged through the sewage networks (from 60 per cent to over 90 per cent of all water used is subsequently discharged as wastewater). The Urban Environmental Problems policy field is associated with two indicators, respectively on untreated wastewater and on untreated wastewater which is directly discharged into urban surface water. These indicators contribute to both the overall wastewater treatment rate (with the relative proportion of untreated wastewater making up the remainder to the value 100) and the industrial wastewater treatment rate.
- Water carries pollution and therefore contributes to the dispersal of toxic substances. The Dispersion of Toxic Substances and Water Pollution and Water Resources policy fields are linked through three indicators. 'Consumption of pesticides by agriculture' in the former is linked to 'pesticides used per hectare of utilized agricultural area' in the latter. 'Emissions of persistent organic pollutants' in the former are reported as 'emissions of organic matter as BOD' in the latter. Finally, the former includes 'index of heavy metal emissions to water' while the latter includes 'index of heavy metal emissions'.

The last two topics are considered from the angle of wastewater discharges in the first case, and from the toxicity angle in the second. In so far as the aim is to describe pressures, it is suggested that the sectors in which the pressures originate should be given priority. In this case, if the indicator is also included in the Water Pollution and Water Resources policy field, it should be associated with the corresponding state indicator (concentration).

The Water Pollution and Water Resources policy field is also linked to the Marine Environment and Coastal Zones policy field, in so far as these two ecosystems are in continuity with each other. The two are considered separately under the PIP, since the first covers continental aquatic ecosystems, and the second marine aquatic ecosystems. Finally, there are indirect relationships with other policy areas such as Climate Change, which is likely to have a substantial impact on water resources through sea-level rise, increased or reduced rainfall and so on.

3. THE APPROACHES ADOPTED IN THE CONTRIBUTIONS

The first chapter for this policy field is by Joan Davis and Klaus Lanz and the second is by Josephina Maestu, Jose Maria Gasco, Jose Manuel Naredo and Federico Aguilera. The two contributions were analysed by means of a grid based on four criteria: the conceptual framework of each chapter, how types of pressure and their impacts were studied, what measures are suggested to reduce pressures, and how the PIP indicators were evaluated.

Conceptual Framework

Davis and Lanz analyse the topic on two levels: driving factors, which generate pressures on water resources (release of polluting substances), and symptoms, most of which are associated with pressure indicators. The authors distinguish between long-standing or ‘traditional’ problems associated with the renewal of resource systems in terms of both quantity and quality, and new problems which may be invisible (for example chemical pollution), complex and unpredictable (for example those associated in part with climate change, with the physical limits of water resources, and with wastewater collection and treatment). In considering the newer problems, Davis and Lanz stress the fact that there has been little or no reduction in underlying pressures, and, furthermore, that they are not considered as pressures at all in many cases, and therefore continue to harm the environment (for example pesticides and nitrates released by intensive agriculture).

Maestu et al. lay stress on the fact that qualitative and quantitative water resource problems are important for social, ecological and economic reasons. However, pressures on water resources vary from one European region to another, due to their edaphoclimatic diversity in particular. Pressures associated with water abstraction are critical in arid regions, while pollutants released by agricultural and urban activities reduce water availability throughout the European Union, as well as affecting human health and the integrity of ecosystems.

Types of Pressures and Impacts

Davis and Lanz identify three main causes of pressure. Increased water resource use by industry, agriculture and the population as a whole is the prime factor, followed by pollution. Visible pollution is highly apparent and often due to intensive agriculture (pesticides contaminating groundwater, nitrates and phosphorus causing eutrophication in lakes). 'Non-visible pollution' essentially results from the use of synthetic chemicals by industry. The third main cause identified by the authors is the deterioration of aquatic ecosystems, particularly as a result of wetland drainage to increase agricultural land surfaces.

Maestu et al. distinguish between pressures on water availability and pressures on water quality. The authors suggest that availability should be assessed on the basis of evapotranspiration demand after determining the water balance. Seasonal and geographical variations in distribution and demand should also be included to reflect cases where demand is not met or where conflicts arise between different uses. 'Natural pressures' are also taken into account, such as drought and flood risks, which may have considerable ecological, economic and social repercussions. Concerning water quality problems, salinization in the Mediterranean region is given as the main cause of soil deterioration, and also of reduced freshwater availability because of the need for additional freshwater input to dilute saltwater. Eutrophication is given as a consequence of excessive nutrient discharges, particularly in northern Europe. Organic pollution by substances released from urban centres and livestock farms is substantially reduced by wastewater purification and water treatment, but remains a major problem, particularly in southern European regions in summer, when high temperatures cause bacteria and micro-organisms to proliferate. Toxic pollution (by organic micropollutants, heavy metals and radioactivity) is a major problem in all European countries.

Proposed Pressure-reducing Measures

Davis and Lanz point out that reducing resource consumption, and therefore environmental pollution, requires both 'top-down' government measures (legislation, financial incentives) and 'bottom-up' measures (adequate information and incentives at community level, choice of appropriate indicators). The driving factors which determine change in pressures have to be addressed through long-term measures, while symptoms need to be dealt with in the short term. In the long term, major change requires not only measures which deal specifically with water, since water resources and water pollution are also affected by policy measures which address the social system and resource consumption patterns as a whole. In the short term, the most appropriate measures would be technical (introduction of water-saving processes, physical elimination of detergents, reduction in pesticide use through a shift away from crops such as maize, reduction in pesticide contamination) and economic (elimination of regressive tariff structures where these still apply).

Maestu et al. suggest a number of physical measures to reduce pressures on the available quantities of water. These would aim at improving both the water supply itself (inter-basin transfers, development of non-conventional resources including desalinized seawater) and water-use systems (improved management of trade-offs between conflicting uses, introducing water-saving processes, promoting change in social behaviour and customs). To reflect water quality, the authors suggest using an index, to be developed in line with the 'relative risk' concept, which would measure the absorption capacity of a given area. The index is defined as the capacity of an environment to receive, dilute and assimilate impacts. More concrete measures would include reducing the use of nitrates and pesticides in agriculture and controlling salinization by implementing reforestation policies and water sampling controls.

The Contributions and the PIP

Davis and Lanz stress that local water quality indicators are appropriate where the aim is to promote changes of attitude and action among the public, whereas aggregate indicators are more appropriate if the aim is to compare pressure indicators at international level. The PIP is designed to meet the latter objective.

Maestu et al. stress that pressure indicators can only be meaningful if they reflect situations in the different regions of Europe. Short-term and long-term measures as well as international comparisons should take account of this diversity.

4. SOME COMMENTS ON THE APPROACHES AND EVALUATION BY THE AUTHORS

Both chapters underline the major quantitative and qualitative problems resulting from the pressure of social and economic activity on water resources, but each of them also raises some specific points.

Davis and Lanz's approach stresses the need to develop activities which meet the conditions required to guarantee the renewal of environmental resources, and which increase public awareness in order to promote sustainable resource use among citizens. To achieve these aims, the indicators selected should include not only official aggregate data, but also other data which may be more readily interpreted and assessed by the public at large in the communities or regions where problems arise. Experience has shown that motivation and environmental commitment among the public go hand in hand with participation and cooperation.

Maestu et al. stress the diversity of pressure-related problems in the different natural areas in Europe, and place particular emphasis on those which are specific to the Mediterranean regions, such as high evapotranspiration and salinization.

5. A BRIEF DESCRIPTION OF THE INTERNATIONAL POLICY CONTEXT

The international policy context of the PIP is framed by the contribution of the United Nations Commission for Sustainable Development (UN CSD), by European water resource policy and by international agreements on transboundary water resource management.

Sustainable Development Indicators used by the UN CSD

Chapter 18 of Agenda 21 focuses specifically on the protection of freshwater quality and availability. A list prepared under the UN CSD's work programme on sustainable development indicators has been published in a 'Blue Paper'[2] and covers the major quantitative pressure-related problems addressed in Chapter 18: ground- and surface-water abstraction, household water consumption and wastewater treatment. Qualitative problems are addressed in the chapter through the topic of state indicators reflecting freshwater BOD and concentrations of faecal matter.

Indicators of pressures on water quality are described in the different chapters on activities considered as driving forces, particularly Chapter 14 (promoting sustainable agriculture and rural development), which deals with the indicators on pesticide and fertilizer use in agriculture. Emissions of some toxic substances, including heavy metals, are not addressed.

A Brief Description of European Water Policy

European water policy is essentially based on a corpus of regulations which establish either water quality standards for specific uses or emission standards for particular substances. The field of application of these regulations

Table 32.1 Main European water directives

Directives establishing quality standards for each type of use	• Directive 75/440/EEC on the quality of surface water used for drinking water • Directive 76/160/EEC on bathing waters • Directive 78/659/EEC on water used in aquaculture • Directive 79/923/EEC on water used in shellfish farming • Directive 80/778/EEC on drinking water
Directives establishing emission standards	• Directive 76/464/EEC on the discharge of toxic substances (+ sub-directives) • Directive 80/68/EEC on the protection of groundwater from pollution by toxic substances • Directive 91/271/EEC on urban residual water • Directive 91/676/EEC on agricultural nitrates • Directive 96/61/96 IPPC

has become quite substantial and is largely covered by the PIP indicators, which could therefore be used to monitor enforcement by EU Member States of the provisions set out in the directives, in particular through rates of compliance with quality and emission standards (see Table 32.1). These standards would then act as reference standards against which policy results could be evaluated or classified in order of importance.

European Union policy towards improved water management goes beyond the content of the 'water' directives, however. A number of other regulations, particularly those aimed at the sources of pressure on water resources, also target overall water resource management, for example, Directive 93/793/EEC on environmental hazards, which applies to the use of chemicals, or agro-environmental Regulation 2078/92. All these instruments are included under the European Union's fifth Environmental Action Programme.[3] Table 32.1 lists the main EC directives in the 'water' area.

The Main International Agreements

Water management is also the subject of numerous international agreements focusing on international waters (seas and oceans, international rivers). These include the North Sea Conference, the Oslo and Paris Conventions, the Bonn Agreement (1983), the Hague Convention (1990), the Action Plan for the

Rhine (1987), the Convention on the Protection of the North-East Atlantic (Paris, 1992), PARCOM and others.

Some of these international agreements have established targets for the reduction of pollutant loadings. These agreements include the Convention on the Protection of the North-East Atlantic (reduction of pollution by agricultural nutrients in the North-East Atlantic), the Action Plan for the Rhine (reduction of phosphorus and nitrate effluent in rivers and seas to 50 per cent of 1985 levels by 1995), or the North Sea Declaration (withdrawal or strictly limited use of 18 active substances, 50 per cent reduction of pesticide effluent to marine waters).

NOTES

1. First questionnaire: December 1995; second questionnaire: October 1996. See Editors' introduction.
2. Indicators of Sustainable Development, Framework and Methodologies', United Nations, New York, 08/1996.
3. See 5EAP in Terminology (Annex IV).