

The Role of Public Participation in Managing Uncertainty in the Implementation of the Water Framework Directive¹

Short title:
Public Participation, Uncertainty and the Water Framework Directive

Jens Newig², Claudia Pahl-Wostl³, Katja Sigel⁴

This is a preprint of an article published as:

Newig, J., C. Pahl-Wostl and K. Sigel. 2005. 'The Role of Public Participation in Managing Uncertainty in the Implementation of the Water Framework Directive.' *European Environment* 15 (6):333-43. See: <http://www.interscience.wiley.com>.

Abstract:

The European Water Framework Directive (WFD) constitutes a complex regulation that calls for numerous decisions under uncertainty on the part of the implementing agencies in the member states. This contribution first discusses two different types of uncertainty that may arise in the implementation of the WFD and identifies ways to manage them. Results of a text analysis show that uncertainties are not systematically addressed both in the directive itself and in CIS guidance documents. This paper shows that an important instrument to both manage and, where possible, reduce uncertainty is the participation of interested parties and the broader public. The focus lies on the perspective of the competent authority that has the responsibility to develop and implement the management plan. The paper concludes with recommendations of how to profit from public participation in managing uncertainty but also of where to look out for possible stumbling blocks.

¹ This article is based on a contribution presented at the International Symposium "Uncertainty and Precaution in Environmental Management (UPEM), Copenhagen, 7-9 June 2004.

² Institute of Environmental Systems Research (USF), University of Osnabrück, Barbarastraße 12, D-49069 Osnabrück, Germany. Telephone: +49 (0) 541 969-2315, Fax: +49 (0) 541 969-2770, E-Mail: jens.newig@usf.uni-osnabrueck.de

³ Institute of Environmental Systems Research (USF), University of Osnabrück, Germany.

⁴ Centre for Environmental Research (UFZ) Leipzig-Halle, Germany.

1. Introduction

The European Water Framework Directive (WFD) is a complex regulation; its implementation in the member states and river basin districts constitutes an even more complex task within the years to come. In implementing the directive, the competent authorities regularly have to make decisions many of which call for a large amount of information to provide a sound base for decision making. However, not all of the required information is or will be available and part of the information will be associated with uncertainties. Furthermore, an authority may be in doubt what goal to pursue or what actions to take in order to achieve these goals. Decisions have thus to be taken under uncertainty. Take, for instance, the description of the status of all water bodies that all member states must have carried out according to Annex II WFD until December 2004. This not only involves uncertainties in measurements of environmental variables but also uncertainties in assessing the sources of pressures (Annex II 1.4 WFD) as well as the uncertainties regarding the probability that water bodies will not reach good status. Or take the requirement to decide which particular water bodies with intensive human activities will be exempt from the overall goal to reach ‘good’ status and thus only need to reach less stringent environmental goals (Art. 4(5) WFD). Often, information concerning the properties of these water bodies and their deterioration by human activities is lacking; furthermore, of what level should the less stringent goals be? Or take, finally, the measures that will be decided upon to reach the goals of the directive. Mostly, their effectiveness can only be guessed – for reasons of scientific nature but also concerning the willingness of the addressees to comply with the rules. All these are decisions under uncertainty.

Whereas traditional approaches have focused either on empirical methods and modelling to reduce uncertainties, to better integrate uncertainties in using existing data (cf. Laux 1998; Eisenführ and Weber 1999), or on formal methods to aid ‘optimal’ decision-making under uncertainty if uncertainties can be expressed in probabilistic terms (see, e.g., Kreps 1988), some recent developments draw on a more fundamental way to deal with (not only: to reduce) uncertainties. These ideas range from an epistemology of ‘pluralistic’ science rooted in post-modernism and social constructivism (cf. Pahl-Wostl et al. 1998; Pellizzoni 2003) to rather hands-on methods of participatory decision-making (Wiedemann et al. 2000; Wateco 2002). All of these approaches acknowledge the importance of the societal dimension of decision-making and the fact that some uncertainties cannot be reduced. They share the notion that in decision situations facing uncertainty it is important to draw on different perspectives – and often enough: on different societal interests –, thus enabling a pluralistic dialogue leading to better informed and easier implemented decisions.

This paper is organized as follows: In the subsequent section, we briefly review different types of uncertainty that may arise in the implementation of the WFD and mention ways of dealing with uncertainty. Each requires different instruments to be managed. In the third section, we investigate how uncertainties are addressed in the implementation of the WFD based on a text analysis of the directive itself and of accompanying guidance documents (as part of the Common Implementation Strategy). In the fourth section, then, we propose ways how participation of interested parties and the broader public can help to both manage and, where possible, reduce uncertainty and thus improve decisions under uncertainty. We focus on the perspective of the competent authority that has the responsibility to develop and implement the management plan.

The paper concludes with recommendations of how to profit from public participation in managing uncertainty but also of where to look out for possible stumbling blocks.

2. Two types of uncertainty in decisions - and ways to manage uncertainty

Uncertainty itself has proven an extremely complex matter. Accordingly, uncertainty has been treated in the recent literature in quite different ways and numerous conceptualisations have been put forward (cf. Smithson 1989; Walker and Harremoes 2003; van Asselt 1999; Handmer and Norton 2001; Faber and Proops 1998). In this contribution we do not attempt to unravel this debate; instead we apply those (qualitative) concepts that seem appropriate from the viewpoint of an administrative decision-maker facing uncertainty.

Accordingly, in this paper we will distinguish two types of uncertainty affecting decisions: *normative uncertainty* and *informational uncertainty*. These two fundamentally different types of uncertainty will have to be dealt with differently – in particular with respect to the implications as far as public participation is concerned.

Normative uncertainty

The European legislator cannot and should not reasonably prescribe every detail of implementation – particularly not within a ‘framework’ (sic!) directive –, but leaves many decisions regarding the operationalisation of goals and measures to the member states and the river basin authorities. The rationale of this applied subsidiarity principle (cf. Collier 1997; Kraemer 1998) is, of course, that despite the overall goal to reach good water status, regional conditions differ in terms of culture, water uses, water-related problems and so forth. However, the openness of the directive is also partly a product of watered-down compromises (Kaika 2003: 311). In any case, it is both sensible and requisite that a considerable amount of decisions are made on a regional level by authorities familiar with regional conditions. This extended discretionary scope on the part of the authorities entails normative uncertainty (Arentsen et al. 2000), i.e. normative considerations of goals and tastes (cf. March 1978)⁵. An actor may be in doubt (or a group of actors may be undecided – which on a collective level amounts to the same) what goal to pursue and what actions to take in order to achieve these goals. Both aspects are captured by normative uncertainty. This calls for the participation of the different societal actors that have an interest in the decision of the goal setting process (Arentsen et al. 2000: 601). One example that illustrates the spectrum of possible stakeholders are the so-called ‘area cooperations’ which are currently (summer 2005) being put into place in the German federal state of Lower Saxony with the aim of involving actors in the implementation of the WFD on the level of each local working district (sub-basin). These groups are composed of ten people representing the local municipalities, water suppliers, the local and the regional water administration as well as the local associations of agriculture, industry, fishery, navigation and nature conservation, calling in additional actors, such as land owners or forest officials, as needed in specific phases and contexts.

⁵ This has also been termed “decision uncertainty” in the sense of “state of rational doubt as to what to do” (Green et al. 2000).

Typical for normative uncertainty is the fact that it only prevails so long as no decision is being made; once this has happened, the uncertainty ceases to exist unless goals and measures are subject to critical evaluation and possibly change during the implementation process. The latter practice is increasingly being adopted in more adaptive management practices due to the high uncertainties in making predictions about the efficiency of measures in Integrated Water Management (Richter et al. 2003; Pahl-Wostl in press). Here it is even more important to involve stakeholders from the very beginning into the process of setting goals and measures to achieving them and also defining criteria how to monitor success or failure.

Parts of the directive's goals need to be further specified for the river basin districts. Prominent examples are less stringent environmental goals for certain water bodies (Art. 4(5) WFD) or the operationalization of 'good ecological potential' of artificial and heavily modified water bodies (Art. 4(3) WFD). The directive does not state, however, at what level these less stringent goals should be situated. Although the member states cannot decide arbitrarily on these levels, there is considerable room for discretion.

Moreover, in the course of the implementation of the WFD, many decisions concern the choice of appropriate measures to attain the goals of the directive. The directive leaves the choice of measures entirely⁶ up to the member states (or the river basin authorities); it only suggests in Art. 11(3) and (4) possible measures on a rather general level. Consider, e.g., an area of high nitrate concentrations in the groundwater due to heavy application of manure from intensive agriculture. Which measures are to be taken in order to attain a level of nitrate that complies with the 'good chemical status'? Although for many aspects of the WFD, guidance is provided by the non-legally binding documents produced within the Common Implementation Strategy (see section 3); most decisions must finally be taken by the competent authorities in the member states and river basins.

Informational uncertainty

Second, there is informational uncertainty⁷ which relates to the knowledge deficits of the decision maker. In the context of the WFD it captures for example the lacking knowledge about the present and future conditions of the water bodies and about the causal relationships regarding the origins of pollution (and other distortions of the water status) and the effects of proposed measures. A good deal of the description and classification of water bodies due in December 2004 (Art. 5, Annex II WFD) faces this type of uncertainty.

⁶ I.e., within the framework of other existing EU legislation.

⁷ Also denoted "environmental" uncertainty (Boerner and Macher 2001: 7) or "factual" uncertainty (cf. Grin et al. 2004) or "limited knowledge" (van Asselt/Rotmans 2002).

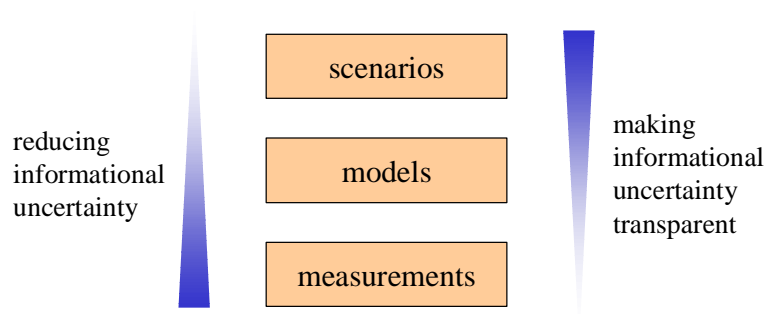


Figure 1: Different options to deal with informational uncertainty and their main functions

Informational uncertainty may be more or less fundamental. Let us take up the example of nitrate in a groundwater body that shall be determined in a way that a classification as ‘good’ or ‘poor’ chemical status (Annex V 2.4.5 WFD) is possible. There may be mere inexactnesses due to measurement errors or simply missing measurements. In both situations, uncertainty can be reduced by additional or improved measurements (see figure 1). It may also be the case that because of the heterogeneity of the groundwater body, sufficient measurements are too costly. Due to the complexity of the system under investigation more than one assumption about causal relationships and future developments may be compatible even with more sophisticated and detailed data sets. Simulation models can help e.g. to interpolate and thus also reduce uncertainty. Furthermore, models (as man-made simplifications of reality) may serve to communicate the implications of different assumptions, variability and lacking knowledge and thus render the basis for decision-making more transparent. Models may thus well be applied in participatory settings. Yet another incident is that contradicting sets of measurement are available that might lead to different classifications of the groundwater body. In this case, a reduction of uncertainty is less likely; rather, a scientific dialogue among the relevant experts may help as well as the construction of scenarios for each expert’s opinion or data set. Thus, different possible futures of water bodies may be sketched according to different assumptions about causal factors and guesses about the development of external influences. In either case, the participation of relevant experts and interested parties can be helpful to discuss possible consequences of the uncertainty at issue and make them (more) transparent. Figure 1 summarizes these three different options to deal with uncertainty and shows the complementarity of the main functions.

3. The understanding of and strategies how to deal with uncertainty in the WFD and the implementation process

Given the crucial importance of uncertainty in the implementation of the WFD, we will now examine how the directive and the implementation process deal with the issue of uncertainty. For this purpose, we conducted a text analysis of the WFD as well as three ‘guidance documents’ which are part of the Common Implementation Strategy for the

WFD⁸, namely ‘Economics and the environment’ (Wateco 2002), ‘Guidance for the analysis of pressures and impacts’ (Impress 2003) and ‘Guidance on the planning process’ (Proclan 2003). We analyse both (i) the overall understanding of uncertainty and (ii) the main strategies for dealing with uncertainty, and then discuss the potential shortcomings and suggestions for improvement.

The overall understanding of uncertainty

The *WFD* does not refer to ‘uncertainty’ as such. Instead, the converse expression ‘adequate level of confidence and precision’ is used in relation to: (i) the process of establishing the reference conditions for surface water body types (Annex II 1.3 *WFD*); (ii) monitoring the ecological and chemical status of surface waters (Annex V 1.3 *WFD*) and (iii) the identification of trends in groundwater pollution (Annex V 2.4 *WFD*). The three-pronged demand in the Annex of the directive for an ‘adequate level of confidence and precision’ should presumably be regarded as merely an example, because the problem of uncertainty also arises in other domains of the implementation process. Instead of the term ‘adequate’ (as applied to the level of confidence and precision), the *WFD* also uses the expressions ‘sufficient’ and ‘acceptable’. The simultaneous employment of the terms ‘confidence’ and ‘precision’ expresses the subjective (confidence) and objective (precision) nature of uncertainty. On the whole it can be said that the *WFD* only alludes to the problem of uncertainty.

Although the *guidance documents* analysed all refer explicitly to ‘uncertainty’, the way in which this term is understood varies greatly between the different documents. Wateco deals in great detail with ‘uncertainty’ because it covers the subjects ‘decision making’ and ‘information management’. The main ‘sources for uncertainty’ throughout the process of identifying measures and developing river basin management plans according to Wateco are “the assessment of pressures, impacts, baseline, costs or effectiveness” (Wateco: 40). However, Wateco does not describe these sources of uncertainty in detail. Only one special type of uncertainty is mentioned: “Gaps in information and knowledge” (Wateco: 47). Since these gaps have to be filled over time, Wateco refers here to a form of reducible ignorance.

Impress points out that uncertainties have to be taken into account when analysing pressures and impacts and in the environmental conditions required to meet the directive’s objectives (Impress 2003: 19). These uncertainties will decrease after the first Impress report 2004 because of designed and targeted monitoring programmes, the increased expertise of the competent professionals and the establishment of reference conditions by the Member States. Thus, according to Impress, the problem of uncertainty is initial rather than fundamental.

Proclan defines uncertainty as “the occurrence of events that are beyond our control” (Proclan 2003: 20). The cause is the complexity of the many factors involved in planning processes, such as meteorological, demographic, social, technical and political

⁸ The CIS constitutes an up to now unparalleled institution to foster and ensure the coherent implementation of an EU directive. Within its scope, 14 thematic guidance documents have been produced until 2003 which have been “adopted” by the “water directors” of the member states and the commission. Since these documents constitute neither legal rules nor decisions of the commission, they remain legally unbinding. It may however be expected that they will be of significant importance in the course of interpreting the *WFD* by the European Court of Justice in case of a lawsuit. Because the member states anticipate this, the CIS guidance documents may de facto have considerable influence on the actual implementation of the *WFD*.

conditions. According to Proclan, uncertainty is always an element in planning processes.

Strategies

Concerning strategies for dealing with uncertainty, the WFD states that the 'level of confidence and precision' has to be 'estimated' and 'adequate'. These two steps, *estimating* and *evaluating uncertainty*, can be designated as central components of any kind of strategy for dealing with uncertainty. In addition, the WFD provides several regulations which play a potentially important role in dealing with uncertainty as they influence the way in which information and (imperfect) knowledge are handled. Whereas these provisions are not explicitly designed to deal with uncertainty, some of them are mentioned with regard to this function in the *guidance documents*. Examples include public participation, planning styles and monitoring. These provisions are designed to deal with more than just uncertainty, which is why they can be referred to as multifunctional or general.

The role of *public participation* in the economic process is stated by Wateco as follows: "To integrate stakeholders into the economic analysis can prove very useful as it brings expertise and information, it provides opportunities to discuss and validate key assumptions and it increases the ownership and acceptance of the results of the economic analysis" (Wateco: 9). The direct link with uncertainty is made in the statement that public participation needs an adequate way of communicating uncertainty to the public and stakeholders (Wateco: 65). There is, however, neither guidance to support a judgement what the term 'adequate' could imply, nor on potential consequences of uncertainty, in particular in the case of conflicts.

The strategy introduced by Proclan takes a similar track, arguing that *planning strategies* are crucial for managing uncertainty. The more 'interactive', 'discursive' and 'adaptive' planning processes are designed to be, the more important uncertainties are judged to be (Proclan 2003: 19, 21). However, the document remains quite vague regarding more specific recommendations to include the need to cope with different types of uncertainties into planning strategies during the different stages of the process of developing and implementing a river basin management plan.

Impress aims to boost confidence in the assessments of pressures and impacts by *designed and targeted monitoring programmes*. Whenever the assessments nevertheless contain significant uncertainty, those water bodies should – by way of precaution – be classified as at risk of failing to meet their objectives (Impress 2003: 19).

Potential shortcomings and suggestions for improvement

The fact that the WFD and all the guidance documents analysed raise the issue of uncertainty emphasizes its relevance. The guidance documents give important clues about where uncertainty occurs and how it could be dealt with, each focusing on specific parts of the implementation process, the various sources and types of uncertainty and how they effect development and implementation of river basin management plans. Because of the different understandings, the various descriptions of uncertainty cannot be put together to form a complete framework for the whole process. The manner in which uncertainty is described is rather rough and fragmentary. Moreover, although important strategies are identified, the concrete role they may play to reduce or manage uncer-

tainty has yet to be defined. Below, we intend to specify the role of public participation as a strategy based on the two types of uncertainty as described in the previous chapter.

4. The role of public participation

The WFD is one of the first European regulations that explicitly demands a high degree of involvement of non-state actors in the implementation. According to Art. 14 WFD, member states shall encourage the active involvement of all interested parties in the implementation of the directive; more detailed and stringent rules are given for public information and consultation in the production of the river basin management plans (cf. European Commission 2002; Kaika 2003; Mostert 2003; Newig 2005). Our argument is that this bears the chance for the competent authorities to use the potentials of participation to manage and – where possible – reduce the uncertainties at stake. The resources for participatory processes must be provided because of the mentioned legal requirements; and indeed the current implementation of the WFD in Germany shows that considerable effort is being made in informing and consulting the public and relevant stakeholders (Newig 2005).

Participation as a means to manage normative uncertainty

When different societal values and goals contribute to the uncertainty of an upcoming decision of implementing parts of the WFD, a participatory approach is particularly obvious. Because mediation of interests and goals is the main purpose (see figure 2, item D), in this case, those actors should be involved that have a clear *interest* in the issue at stake (Pellizzoni 2003: 218). This means that not the broad public in general and not all experts that have an opinion on the subject should be involved. Possible techniques to design a participatory process where different perspectives can be expressed and combined with factual analyses are the use of group model building and of participatory scenario development (Pahl-Wostl in press, van der Heijden 1996). They can reveal the source of potential conflicts arising from differences in value judgements, the need for collective action to achieve a goal, and shed light on the consequences of alternative decision options. Thus these techniques structure the process of goal determination and make the steps required to achieve these goals more transparent. When the differing societal views on an issue result from informational uncertainties and subsequent differences in framing by different actors, care should be taken that these are made explicit and reasoning thus more transparent. Otherwise, actors will talk at cross-purposes (cf. Funtowicz and Ravetz 1990).

Often, normative uncertainty is experienced by authorities involved in the implementation of the WFD who do not have the responsibility to take these decisions; they must wait for other, typically: higher level, authorities to decide. Normative uncertainty then takes the form of regulatory uncertainty – a term that stresses the unpredictability of future imposed measures (cf. Galligan 1986). The non-competent public agency itself then is the role of an interested party in a higher-level decision – and should be involved in the latter. By being involved in an early stage, normative uncertainty on the side of the non-competent public authorities can be reduced which facilitates their planning of

the implementation process and management of uncertainties associated with realizing given environmental goals.

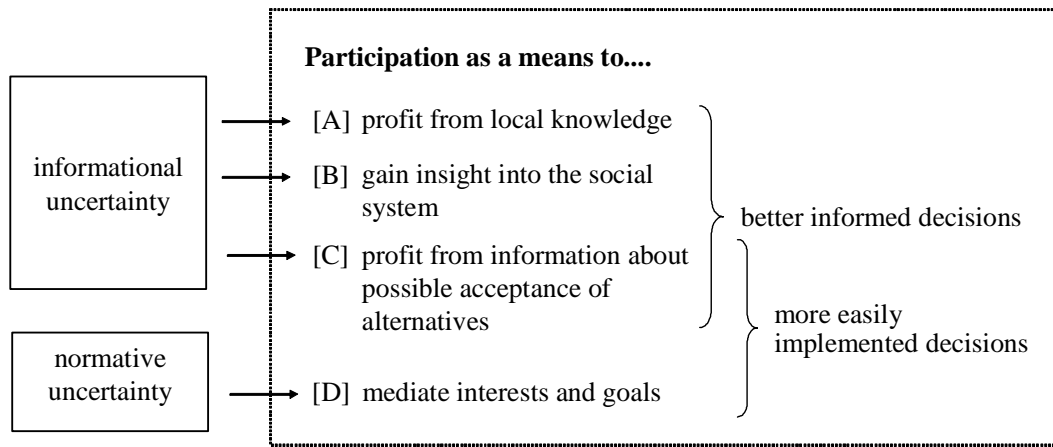


Figure 2: Possible reasons [A] to [D] for an authority to conduct public participation in decisions affected by informational and normative uncertainty

Participation as a means to manage informational uncertainty

Here, the main task is to improve the information basis of decisions. A much discussed aspect is that, involving non-state actors, the competent authority may profit from their (local) knowledge (see figure 2, item A). Numerous contributions in the field stress the importance of 'lay local knowledge' (e.g. López Cerezo and González García 1996; Wynne 1992; Yearley et al. 2003; European Commission 2002; Pellizzoni 2003). In the case of groundwater pollution due to intensive agriculture, for instance, farmers could provide valuable insights of their manure application techniques and habits. Some authors, on the other hand, argue that the lay public has not much to offer in terms of local knowledge, for the authorities regularly have other and more reliable means to obtain relevant information (Fisahn 2002). On second thought, it appears that the degree to which lay local knowledge can be new and helpful to the authorities depends considerably on the context of the decision at stake. Thus it seems plausible that the potential benefits from consulting the lay public in those member states with a highly differentiated legal system and a strong tradition of public administration will be smaller than in countries with a tradition of less formalized public decision-making. Furthermore, issues of high interest for the general public are likely to be better 'researched', and information about it is likely to be spread by the news media to the effect that the lay public can only add little to this.

Furthermore, public authorities may also gain insights into the 'social system' in which measures will be implemented (López Cerezo and González García 1996: 64). Sticking to the above example, it may become apparent in a participatory process if and how farmers' associations can communicate with citizens' initiatives; what customs prevail, telling about the social 'costs' of the implementation of measures and thus about how likely it is that they will actually be implemented (see figure 2, item B).

This leads to a third aspect: In letting non-state actors participate in decisions, authorities can obtain information about the local acceptance of proposed measures (cf.

van Asselt and Rotmans 2002; European Commission 2002), see figure 2, item C. At the same time, the participatory process itself is likely to improve the acceptance of measures on the part of the addressees, in particular in situations where uncertainties and decision stakes are high (Joss and Brownlea 1999; Pahl-Wostl 2002). The results of procedural justice research gather that the preferences regarding an outcome of a decision are highly dependent on *how* the decision was derived (cf. Lind and Tyler 1988; Tyler 1990). Thus, participation reduces the uncertainty of implementation by involving the addressees of regulation. This implies to keep local actors informed about details of the regulation and the envisaged implementation, i.e. to meet *their* information needs, and to make uncertainties explicit (cf. European Commission 2002: 66).

The actors that should be involved when informational uncertainties are at stake are particularly those who are *experts* (in a broad sense) in the issue at stake. In face of the previous paragraph, this implies that those actors who have a clear interest in the issue but who can neither provide additional knowledge nor contribute to its solution should only be involved when this adds to the general understanding of the social system or provides information about the acceptance of measures.

Generation of uncertainty through participation?

In this context, Garis et al. 2003 point out that an open discussion of uncertainties among experts might reduce the trust of public in measures. So on one hand care has to be taken not to unsettle the involved actors. Furthermore, the honest and comprehensive communication of uncertainties may be rather time-consuming; it increases the complexity that the involved actors have to grasp and process. On the other hand, it should be in the interest of any scientific expert who is consulted in the decision-making process to clearly communicate uncertainties. In particular in case of conflicts of interest different expert views may be (ab)used to support the interests of different groups. This trade-off results in a certain dilemma for the competent authority: While the communication of uncertainties might result in a short-term reduction of trust on the part of the stakeholders, the non-communication of the former might lead afterwards to the accusation of holding back uncertainty information. At any rate, this dilemma should be taken into consideration explicitly.

On the other hand, the participatory process itself might create new uncertainties, i.e. uncertainties that would not have arisen without letting interested parties participate. (see Arentsen et al. 2000). E.g., a given issue that is crystal clear to the competent authority might be reframed by the public participants. However, this also implies opportunities in the sense that the participatory process may take the form of a citizens' initiative leading to results that lead beyond the mere implementation of the proposed measures (Beierle and Cayford 2002: 27–28).

5. Recommendations and caveats

Participation of non-state actors in the implementation of the WFD constitutes a major opportunity to achieve better informed decisions and more effectively implemented measures. It is crucial that the role of uncertainties in participatory processes is explicitly taken into account. As we have shown, authorities should reflect what kind of uncertainties they are dealing with: Is it mainly a decision that must be taken, or has the

necessary knowledge base to be improved? Depending on how this question is answered, different parts of the public should reasonably be involved and different approaches to communicate and deal with uncertainty should be used.

A particular caveat is indicated: It concerns the strategic use of uncertainty. So far, we have assumed a 'rational' decision-making authority in the sense that it decides in terms of how the WFD can best be implemented. However, it is no secret that individual rationality of officers may differ from this (cf. Niskanen 1971; Tullock 1965). Thus, those interested in a quick and effective implementation might regard issues as rather clear and straightforward, whereas those favouring a delayed and ineffective implementation might stress the uncertainties involved (cf. Newig 2003: 194). Furthermore, an actor might strategically stress an issue's complexity – and hence the information costs involved in understanding it – by framing a situation as overly uncertain in order to feign asymmetrical information in favour of itself. Finally, those actors who benefit from data-gathering and modeling activities, such as research institutes and consultancies, tend to stress uncertainty. Thus, multiple reasons exist why uncertainty might be strategically over or underemphasized, depending on the respective interest position.

All in all, the regulatory openness of the directive can be perceived as a major chance to implement innovative management schemes; yet it also entails the challenge of dealing with the subsequent normative uncertainties. Here it will be particularly important to involve stakeholders in the process and guarantee the required degree of flexibility in sequential decision making and a fair balance of all interests in this process. The implementation process of the WFD will thus provide valuable experiences that should be monitored carefully to improve future policy processes.

Acknowledgements

The authors wish to thank Dr. Herwig Unnerstall and two anonymous referees for helpful comments on an earlier version of this article.

Literature

- Arentsen, M.J., H.T.A. Bressers and L.J. O'Toole. 2000. 'Institutional and policy responses to uncertainty in environmental policy: A comparison of Dutch and US styles.' *Policy Studies Journal* 28 (3):597-611.
- van Asselt, M.B.A. 1999. *Uncertainty in Decision-Support: From Problem to Challenge*. Maastricht: International Center for Integrative Studies (ICIS), Maastricht University.
- van Asselt, M.B.A. and J. Rotmans. 2002. 'Uncertainty in Integrated Assessment Modelling: From Positivism to Pluralism.' *Climatic Change* 54:75-105.
- Beierle, T.C. and J. Cayford. 2002. *Democracy in Practice. Public Participation in Environmental Decisions*. Washington, DC: Resources for the Future.
- Boerner, C.S. and J.T. Macher. 2001. *Transaction Cost Economics: An Assessment of Empirical Research in the Social Sciences*.

- Collier, U., ed. 1997. *Subsidiarity and shared responsibility: new challenges for EU environmental policy*, *Schriftenreihe des Europäischen Zentrums für Föderalismus-Forschung Bd. 9*. Baden-Baden: Nomos.
- van der Heijden, K. 1996. *Scenarios: the art of strategic conversation*. Chichester: Wiley.
- Eisenführ, F. and M. Weber. 1999. *Rationales Entscheiden*. Berlin, Heidelberg, New York: Springer.
- European Commission. 2002. *Guidance on public participation in relation to the water framework directive. Active involvement, Consultation, and Public access to information.*: EU.
- Faber, M. and J.L.R. Proops. 1998. *Evolution, Time, Production and the Environment*. Berlin, Heidelberg: Springer.
- Fisahn, A. 2002. *Demokratie und Öffentlichkeitsbeteiligung*. Tübingen: Mohr Siebeck.
- Funtowicz, S.O. and R.J. Ravetz. 1990. *Uncertainty and Quality in Science for Policy*. Edited by W. Leinfellner and G. Eberlein. Vol. 15, *Theory and Decision Library; Series A: Philosophy and Methodology of the Social Sciences*: Kluwer Academic Publishers.
- Galligan, D.J. 1986. *Discretionary powers: a legal study of official discretion*. Oxford: Clarendon Press.
- Garis, Y.d., N. Lutt and A. Tagg. 2003. 'Stakeholder Involvement in Water-Resources Planning.' *Water and environmental management journal* 17 (1):54-58.
- Green, C.H., R. Nicholls and C. Johnson. 2000. *A framework for analysis and decision-making in the face of risks and uncertainties; eport to the Environmental Agency*, Enfield: Flood Hazard Research Centre. Enfield.
- Grin, J., F. Felix and B. Bos. 2004. 'Practices for reflexive design: lessons from a Dutch programme on sustainable agriculture.' *International Journal of Foresight and Innovation policy* 1 (1/2):126-49.
- Handmer, J.W. and T.W. Norton. 2001. *Ecology, Uncertainty and Policy. Managing Ecosystems for Sustainability*. Harlow: Pearson Education Limited.
- Impress. 2003. *Analysis of Pressures and Impacts. Common Implementation Strategy for the Water Framework Directive, Guidance Document No. 3. Produced by Working Group 2.1*. Luxembourg.
- Joss, S. and A. Brownlea. 1999. 'Considering the concept of procedural justice for public policy - and decision-making in science and technology.' *Science and Public Policy* 26:321-30.
- Kaika, M. 2003. 'The Water Framework Directive: A New Directive for a Changing Social, Political and Economic European Framework.' *European Planning Studies* 11 (3):299-316.
- Kraemer, R.A. 1998. Subsidiarity and water policy. In *Selected Issues in Water Resources Management in Europe*, ed. F. Nunes Correia. Rooterdam: Balkema.
- Kreps, D. 1988. *Notes on the Theory of Choice*. Boulder: Westview Press, Boulder.
- Laux, H. 1998. *Entscheidungstheorie*. Berlin, Heidelberg, New York: Springer.
- Lind, E.A. and T.R. Tyler. 1988. *The Social Psychology of Procedural Justice*. New York, London.
- López Cerezo, J.A. and M. González García. 1996. 'Lay knowledge and public participation in technological and environmental policy.' *Phil & Tech* 2 (1).
- March, J.G. 1978. 'Bounded Rationality: Ambiguity, and the Engineering of Choice.' *Bell Journal of Economics* 9:587-608.
- Mostert, E. 2003. 'The Challenge of Public Participation.' *Water Policy* 5 (2):179-97.

- Newig, J. 2003. *Symbolische Umweltgesetzgebung. Rechtssoziologische Untersuchungen am Beispiel des Ozongesetzes, des Kreislaufwirtschaft- und Abfallgesetzes sowie der Großfeuerungsanlagenverordnung*. Vol. 84, *Schriften zur Rechtssoziologie und Rechtstatsachenforschung*. Berlin: Duncker & Humblot.
- Newig, J. 2005. 'Die Öffentlichkeitsbeteiligung nach der EG-Wasserrahmenrichtlinie: Hintergründe, Anforderungen und die Umsetzung in Deutschland.' *Zeitschrift für Umweltpolitik und Umweltrecht* 28 (4):469-512.
- Niskanen, W.A. 1971. *Bureaucracy and Representative Government*.
- Pahl-Wostl, C. 2002. 'Participative and Stakeholder-Based Policy Design, Evaluation and Modeling Processes.' *Integrated Assessment* 3 (1):3-14.
- Pahl-Wostl, C. in press. Participation in Environmental Scenarios. Paper read at Scenarios in Environmental Management Workshop "Scenarios of the Future - the Future of Scenarios" in Kassel 17th to 19th of July, 2002.
- Pahl-Wostl, C., M. van Asselt, C. Jaeger, S. Rayner, C. Schär, D. Imboden and A. Vckovski. 1998. Integrated Assessment of Climate Change and the Problem of Indeterminacy. In *Views from the Alps: Regional Perspectives on Climate Change*, eds. P. Cebon, U. Dahinden, H. Davies, D. Imboden and C. Jaeger. Cambridge, Massachusetts: The MIT Press.
- Pellizzoni, L. 2003. 'Uncertainty and Participatory Democracy.' *Environmental Values* 12 (2):195-224.
- Proclan. 2003. *Guidance on the planning process. Best practices in river basin planning. Common Strategy on the Implementation of the Water Framework Directive*.
- Richter, B.D., R. Mathews, D.L. Harrison and R. Wigton. 2003. 'Ecologically Sustainable Water Management: Managing River Flows for Ecological Integrity.' *Ecological Applications* 13 (1):206-24.
- Smithson, M. 1989. *Ignorance and Uncertainty: Emerging Paradigms*. New York: Springer.
- Tullock, G. 1965. *The Politics of Bureaucracy*.
- Tyler, T.R. 1990. *Why People Obey the Law*. New Haven.
- Walker, W.E. and P. Harremoes. 2003. 'Defining Uncertainty. A Conceptual Basis for Uncertainty Management in Model-Based Decision Support.' *Integrated Assessment* 4 (1):5-17.
- Wateco. 2002. Economics and the Environment - The Implementation Challenge of the Water Framework Directive. Common Implementation Strategy for the Water Framework Directive, Guidance Document No. 1. Produced by Working Group 2.6.
- Wiedemann, P., C. Karger, A. Brüggemann and W.-D. Fugger. 2000. 'Innovation, Unsicherheit und Öffentlichkeitsbeteiligung.' *TA-Datenbank-Nachrichten* 9 (3):51-57.
- Wynne, B. 1992. 'Misunderstood misunderstanding: social identities and public uptake of science.' *Public Understanding of Science* 1 (3):281-304.
- Yearley, S., S. Cinderby, J. Forrester, P. Bailey and P. Rosen. 2003. 'Participatory Modelling and the Local Governance of the Politics of UK Air Pollution: A Three-City Case Study.' *Environmental Values* 12 (2):247-62.