Environmental Science & Policy 55 (2016) 449–455

Contents lists available at ScienceDirect

Environmental Science & Policy

journal homepage: www.elsevier.com/locate/envsci

Ecological knowledge and North Sea environmental policies

Folkert de Jong

Common Wadden Sea Secretariat, Virchowstrasse 1, 26382 Wilhelmshaven, Germany

ARTICLE INFO

Article history:
Received 10 November 2014
Received in revised form 26 August 2015
Accepted 27 August 2015
Available online 16 September 2015

Keywords:
Eutrophication
Science–policy interface
Post-normal science
Rational policy-making
Precautionary principle

ABSTRACT

In an analysis of North Sea eutrophication science and policies, focusing on the period 1980–2005, it was investigated how scientific information was used in policy-making. The analysis focused on the central assumptions of the rational policy-making model, i.e. that scientific information can be used to formulate decisions, based upon objective scientific information (rational decision-making), and secondly, can support implementing these decisions (rational management). In general terms, the following was concluded:

- More knowledge has increased rather than reduced uncertainty;
- In order to handle the problem of dealing with complexity and uncertainty at the political level, a simplification of facts has occurred, in this case focusing on nutrients as the main cause of the problem, at the same time excluding other possible causes;
- Both the limited scientific view (i.e. the nutrient view) and the exaggeration of the seriousness of the problem (impacts, scope) have been used as an authoritative basis for the justification of political decisions. Both were not supported by the majority of the scientific community;
- New scientific knowledge, not in support of existing policies, has been excluded from the policy process;
- The science–policy interface, mainly consisting of "civil-servant scientists", that emerged and increased its influence over the period of investigation, has been the central element in the simplification and exclusion process.

The main lesson learned is that work at the interface of science and policy must be subject to democratic principles, i.e. be transparent and involving all parties with a stake in the issue under consideration.

1. Introduction

Since World War II ecological knowledge has played an increasing role in environmental and nature conservation policy and management (De Jong, 2006). During this period the "rational policy-making model" has been the central paradigm in environmental policies (Brooks, 1987; Nowotny, 1987). A basic assumption of this model is that through the generation of scientific knowledge, the uncertainty about the problem under consideration is reduced, and information becomes available that can be used as a basis for political decision-making, for the justification of decisions taken and for the fine-tuning and implementation of decisions (Wettestad and Andresen, 1990). Several alternative models for generating and applying scientific knowledge in environmental policy and management have been proposed, requiring amongst others, broadening the range of scientific disciplines, involving stakeholders and making scientific advice more salient, credible and legitimate (Collingridge and Reeve, 1986; Brooks, 1987; Nowotny, 1987; Jasanoff, 1990; Funtowicz and Ravetz, 1993; Funtowicz et al., 2000; Collins and Evans, 2002; Cash et al., 2003; Nowotny, 2005; Lentsch and Weingart, 2012). Central in most of these alternative models is the bridging of the gap between the scientific and political realms through translation, integration, selection, aggregation, evaluation, assessment and transfer of scientific knowledge, often taking place within specific structures at the interface of the scientific and policy communities. In this contribution, the development and functioning of the science–policy interface dealing with Wadden Sea and North Sea eutrophication will be described and analysed from the perspective of the contribution of scientific knowledge to help understanding and managing the problem.

There are many ecological interactions between the North Sea and the Wadden Sea (Van Beusekom et al., 2012). This is also the

E-mail address: dejong@waddensea-secretariat.org.

http://dx.doi.org/10.1016/j.envsci.2015.08.018
1462-9011/

case for marine eutrophication, the loading of the marine environment with phosphorus and nitrogen compounds.

Already in the 1950s marine ecologists had identified marine eutrophication as a potential pollution problem. The issue started to achieve world-wide attention in the 1970s, be it predominantly from the side of marine ecology. At the beginning of the 1980s, scientists connected serious oxygen depletion events in the Danish Belt Seas, the Kattegat and the German Bight with excess loads of nutrients from the mainland to the sea (Miljøstyrelsen, 1984; Von Westernhagen and Dethlefsen, 1983). In Danish fjords the oxygen depletion caused fish mortality, arousing high public consternation and thus political impact (Jensen, 1989). In 1988 a massive bloom of the toxic alga *Chrysochromulina* in the Skagerrak-Kattegat area again caused strong public interest and reinforced the issue of marine eutrophication on the political agenda. Also interest in eutrophication in the Wadden Sea increased, based to a large extent on monitoring data from the Marsdiep area, the most western inlet between the North Sea and the Wadden Sea. Here, increasing proliferation of the foam building nuisance alga *Phaeocystis* was observed and connected with increasing nutrients loads from the Rhine river (Cadée and Hegeman, 1986).

The above described developments resulted in national and international political action, culminating in 1987, at the second international conference on the protection of the North Sea, London, in the agreement between North Sea states to reduce by 1995 inputs of nitrogen and phosphorus compounds to the North Sea by 50%. However, this was required only for discharges of nutrients into areas "where these substances may cause pollution." Such areas would, as decided at the third North Sea Conference (The Hague 1990), have to be determined on the basis of scientific research. This also included the objective determination of "pollution", in other words, defining undesired impacts of nutrients in the marine environment, occurring at levels above a certain threshold. By doing so, politics had laid a heavy burden upon the scientific community because the answers to these questions could have serious financial and economic impacts on societies, for example through the need to install water purification plants. Consequently, marine eutrophication research had become substantially politicised. One of the central questions in this contribution is whether and how this has influenced the use of scientific information in environmental policies.

2. Analytical framework and methodology

The analysis of the role of scientific knowledge – in this case knowledge generated by the marine science community – in decision-making and management with regard to marine eutrophication focuses on two aspects, relevant for the interaction between science and policy, the structural and the normative aspect.

The analysis of the structural aspect of the science-policy interaction deals with the development and functioning of a network for the exchange of information between the scientific and the political communities. According to Lambright (1995), the principal actors in the interaction between science and politics are researchers, managers and politicians. Normally, that is under normal research conditions, these actors are distant. But in the case of policy-relevant science, that is when science is needed in the policy process, either advocated by scientists (science driven) or by politicians (policy pulled), the relationships intensify and the science-policy connectivity is enhanced. Increased science-policy connectivity is accompanied by the formation of institutions for the communication between science and policy. In this study I will use the term "science-policy network" for the network consisting of the scientific community, the political community and mediating bodies. The latter will be referred to as the "science–policy interface."

The normative aspect is about the model of rational policy-making. Although, as mentioned above, several alternative approaches to the use of scientific knowledge in policy and management have been proposed, the expectations to science to solving societal problems by providing the proper tailored solutions are still very high and reflect to a high degree the assumptions of the rational policy-making model. This is particularly so for large scale international environmental issues with a heavy political overlay, as was the case for marine eutrophication and as is still relevant for the topical issue of global warming.

This study is based mainly upon a comparative analysis of three categories of publications throughout the period 1950–2010, all of which are listed in Annex 1:

1. Scientific sources, in this particular case predominantly from marine biology and marine ecology. These scientific disciplines are most relevant for the case, i.e. the investigation of the impact of excess nutrients on the marine ecosystem. The scientific sources can be divided into four sub-categories:
   a. key scientific publications, with a focus on review articles in scientific journals;
   b. articles frequently cited within the science-policy network;
   c. proceedings of major scientific symposia;
   d. scientific advisory reports by ICES.
2. Official documents produced by bodies working at the science–policy interface.
3. Official documents of international political conferences and the EU.

The analysis focuses on the comparison of the contents of the scientific sources with the contents of the policy advice prepared within the bodies working at the science–policy interface. It is emphasised that the functioning of these bodies, in particular the translation from scientific advice into policy advice, is central in this study and not the functioning of the scientific community in preparing scientific information and advice (compare Lentsch and Weingart, 2012) or the political interactions between the national states involved.

The work was partly carried out at the Marine Biology section and the Science & Society Group of the University of Groningen.

3. The temporal context

Before embarking upon the analysis of the structural and normative aspects of science-policy interactions related to marine eutrophication case, first a brief overview is presented of the development of marine eutrophication within the temporal context of marine pollution in general.

Stimulated by the 1972 Stockholm Conference on the Human Environment, a series of international regulations to control dumping and discharges of hazardous substances into the marine environment was agreed upon in the first half of the 1970s. According to these regulations there were substances for which dumping or discharges should be forbidden or eliminated, and substances for which discharges should be regulated. This clearly reflected the general feeling within the marine science community that the sea could be used as a medium to receive wastes, under certain scientific based premises, such as the dilution factor and the sensitivity of the area where waste would be discharged (Kinne, 1980). For the Northeast Atlantic Ocean, the Oslo and Paris Conventions became responsible for regulating pollution from sea-based, respectively land-based sources (Osparcom, 1984).

From 1980 to 1990 a global wave of international political activity with regard to environmental pollution occurred, focusing on acid rain, Chlorofluorocarbons (CFCs) and, mainly in western