1.2. Science — Policy

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1.2.1. What is science based policy and where does it come from?

"The dynamics of politics and power, like those of culture, seem impossible to tease apart from the broad currents of scientific and technological change (...) What we know about the world is intimately linked to the our sense of that we can do about it, as well as to the felt legitimacy of specific actors, instruments, and courses of action" (Jasanoff, 2004).

Science has become an increasingly integrated part of western society, politics and government during the last 50 years, initially rising to unprecedented importance and visibility in the context of the Cold War, the nuclear arms race and space technology. In 1957, the institutionalization of a Presidential Scientific Advisory Committee in the USA paved the way for similar arrangements in other countries, opening up a new era in the relationship between politics and science (Weingart, 1999).

Science- or evidence-based policy making serves as a political rhetoric to legitimize forms of decision-making that are different from ideological or faith-based policy making (Head, 2010). It is characterised by systematic investigation towards increasing knowledge for policy making, based on a rational or technocratic approach often accompanied by phenomena such as lobbying or consulting (Böhme, 2002). For this, government agencies draw on knowledge and advice produced in external research organizations such as universities, consultancy firms, private think-tanks and not-for-profit social welfare bodies. Additionally, they maintain substantial research units within the public sector to gather and process scientific information relevant to the policy making process (Head, 2010). Some argue that scientific advisors (either persons or in form of advisory bodies, more on this later) have become indispensable to the politics of nations, as modern democratic governments rely on the backing of experts to assure citizens that they are acting in a responsible manner (Jasanoff, 2005).

The concept of basing decision-making on scientific reason arose to importance and grandeur in 19th century Europe, embedded in the enlightenment ethos of human development arising from greater understanding and knowledge (Friedmann, 1987). Its relevance for policy making was institutionalized in western nations during the post-war era, when Keynesianism and welfare-oriented social planning were integrated in government policies during the 1940s and 1950s, followed by science-based educational reforms and urban renewal in the 1960s and 1970s (Wagner et al., 1991). This development not only signified a shift from ideological to evidence-based policy making, but, so the argument or Morgenthau, also in a way a shift of power from people to the government. Where democratically elected leaders had formally made decisions bound by the will of their electorate, scientific and military elites increasingly decided on the direction and style of policy making (Morgenthau, 1964). In recent years this critique is re-emerging in the context of the ‘ecological crisis’ (Hulme, 2012).

Similar arguments are made cautioning against prescriptive policy advise instead of descriptive (Cairney, 2014) and evidence-based policy making in turn is frequently criticised for relying on a technocratic, linear understanding of the policy making process and on a naïve empiricist understanding of the role of evidence hence unable to engage with the role of the underlying discursive frameworks and paradigms (du Toit, 2012).

During the 1960s, the increasing importance of science in policy making was accompanied by a demand for improving ‘scientific standards’, i. e. the increased use of quantitative data and experimental methods in the social sciences (Campbell, 1968). This was not without consequence, and several scholars at the time criticized the focus on quantitatively measurable results, warning that technocracy leads to arbitrary decision making and a restraint in policy options (Habermas, 1966; Offe, 1969). It reduced the human component from policy making, with government policy evaluations focusing on quantitative measures of pre-defined goals rather than assessing the value of the programme to the people affected by it. By the 1980s, qualitative evaluations by social scientists had virtually disappeared. Instead, governments spent large amounts on geographical information systems that rarely influenced change in programmes as they were not designed to understand end-users or the planning process (Innes, 2002).

In reaction to this excessively technocratic approach and its inadequacy to tackle complex or ‘wicked’ problems (especially concerning the global environment), attention was raised on the need for “post-normal” or “civic-science” in policy making, i.e. the inclusion of stakeholders and alternative types of knowledge alongside scientific assessment (Bäckstrand, 2003). In contrast to the former, linear relationship between science and policy, a more interactive approach was suggested where system uncertainties and high stakes are tackled through an ongoing dialogue between science, government and an extended peer community (Funtowicz & Ravetz, 1993).

TEXT BOX 1

Evidence-based policy making experienced a significant vogue of interest after 1997 in Great Britain, when the Labour Party replaced the conservatives in government. The term ‘evidence-based policy making’ was coined in this period, based on the governments mantra of ‘what works is what matters’ and ‘what gets measured gets managed’. The Labour Party’s agenda explicitly focused on the need for policy practice to be informed by scientific evidence, accompanied by large investments in research institutes focusing on the science of government policies (Solesbury, 2002; Clarence, 2002). *However, although the government of Great Britain may have coined the term, similar trends (under different names) have been visible in the United States and other EU countries since the 1960s* (Innes, 2002; Böhme, 2002).

Global change, is urgent and of high public and political concern entangled in values, and the science, especially the post-normal science is complex, incomplete and uncertain (Gluckman, 2014). Diverse meanings and understandings of risks and trade-offs dominate. At the European level, this change in methods was integrated in the 6th Framework Programme for Research and Technological Development (FP6), which called for ‘‘developing appropriate means for creating scientific references and channelling scientific advice to policymakers and equipping policy-makers with tools to assess and manage scientific uncertainty, risk and precaution''; for new consultations mechanisms in this regard; and for assessing the ''interaction between experts, industry, civil society and policy-makers'' (Council of the European Union, 2002). At an international level, the interactive approach is visible in the ongoing deliberations between governments and international research bodies such as the Intergovernmental Panel on Climate Change (IPCC) (Agrawala, 1997) or the new Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (Görg, Neßhöver, & Paulsch, 2010).

1.2.2. Development of science policy for sustainability

Science-based natural resource management has been common at a local or national level for almost two centuries; "Since the origins of resource management in Europe, its elaboration in empires and colonies, and its application to resources in North America and elsewhere, decisions regarding forestry, fisheries, wildlife and other resources have been considered the domain of technical professionals" (Bocking, 2004). Often however, science was not primarily used to sustainably manage ecosystems, but rather to intensify extraction.

The awareness that humans are able to influence the environment at a global scale only arose in the early years of the cold war, when measurements of nuclear fallout were made far away from the corresponding testing sites. Since then, environmental research has increasingly shifted towards examining the globe as a single system, deepening knowledge through research on the cycling of elements, weather patterns and physical processes (Bocking, 2004).

In the course of this development, environmental research also changed its values and in the 1960s and 1970s started issuing warnings of the detrimental effects of human activity on the environment (Carson, 1962; Meadows et al., 1972). Some prominent examples for this are ozone depletion, the transport of contaminants across borders and hemispheres, and climate change. The recognition of these global issues at a scientific level sparked efforts to manage the global biosphere at an international level.

The 1969 UNESCO Intergovernmental Conference of Experts on the Scientific Basis for Rational Use and Conservation of the Resources of the Biosphere represented a milestone event for the environmental science-policy interface. It brought together more than 300 scientists and policymakers, recommending action to resolve environmental problems (UNESCO, 1969). Major environmental conferences such as the 1972 United Nations Conference on the Human Environment (UNCHE) in Stockholm or the 1992 United Nations Conference in Environment and Development (UNCED) in Rio de Janeiro, and international agreements such as the Montreal Protocol for the Protection of the Ozone Layer, the Convention on Long-Range Transboundary Air Pollution (LRTAP) and the Kyoto Protocol on Climate Change implemented these recommendations to some extent.

TEXT BOX 2

Historical Context

In the early days of global sustainable development policies, the 1972 UN Conference on the Human Environment stated that science and technology must be applied to the identification, avoidance and control of environmental risks, and the solution of environmental problems for the common good of mankind, as well as that of scientific research; development must be promoted and the free flow of up-to-date scientific information and transfer of the experience must be supported. In 1992, the UN Conference on Environment and Development in Rio de Janeiro repeated the call to states to cooperate to strengthen capacity building for sustainable development by: improving scientific understanding through exchanges of scientific and technological knowledge; making science more accessible; and contributing effectively to the decision-making processes concerning environment and development. A further twenty years later, Rio+20 repeated these calls and emphasised the need to strengthen the science-policy interface and for inclusive, evidence-based and transparent scientific assessments to be conducted.

More recently, the science policy interface in global environmental change and development is furthermore challenged to contribute to not only translate the massive amounts of scientific knowledge into the policy arena but also to foster its transformation into action (Bille Larsen, 2013), or as Mike Hulme (2012) puts it in regard to climate change "The science is clear. The politics is not. Knowing facts is not the same as enacting change."

However, using scientific knowledge to trigger action at the international level remains challenging. For one, the relationships between science and policy vary from country to country, and while science may have a major influence on government when ties between the two are close, these ties dissolve when funding and reporting responsibilities are diffused (Engels, 2005; Renn, 1995). Furthermore, the necessity for geographical balance in scientific input at international level makes it easy for political conflicts to be drawn into the assessment, blurring the lines between scientific result and national advocacy (Biermann, 2002; Karlsson, 2002) or ideology. Finally, the manner in which the scientific community goes about communicating uncertainties to policy makers as well as its emphasis of global effects rather than national or regional causes reduces feelings of responsibility and ownership, and opens space for argumentation on who should take action and whether action should be taken in the first place (Bocking, 2004). In this context, the outcome document of the Rio+20 conference of 2012 reiterates the need to improve the impact of science on policy making and to "strengthen the science-policy interface", emphasizing "inclusive, evidence-based and transparent scientific assessments" (UNCSD, 2012). Importantly however, the understanding of science in this document is limited and utilitarian (Zondervan, 2015b, 2017; Zondervan & Volt, 2018).

The more recent development in response to improving the impact of science on policy making at international level is the creation of a Scientific Advisory Board (SAB) to the Secretary-General of the United Nations. Created by Ban Ki-moon in September 2013, the SAB was composed of 26 scientists from different parts of the world and covers a broad spectrum of academic disciplines in order to work on the social, economic and ecological dimensions of sustainable development. The chosen scientists were responsible for advising the UN Secretary-General and the executive heads of UN organizations on scientific, technological and innovation matters, communicating up-to-date knowledge in a comprehensible manner and identifying knowledge gaps that could be addressed by research programs outside of the UN system

(German Commission for UNESCO 2014). Although these scientists have officially been selected for their scientific merits, it can be criticized that they do not represent the top class of their field. The requirements for geographic and gender balance ultimately make any official scientific body at UN level a political matter. Nevertheless, a significant strength of the SAB is that it tried to form a bridge between the UN and international research, which itself is undergoing major reform (Gaffney, 2014). The issue with all of these kind of advisory groups in the UN System however, is that they have no formal role or rights in the intergovernmental negotiation process, which in the end matters most. Their influence or even mere existence depends on the grace of the secretary-general or the willingness to listen by the UN system and member states (Zondervan, 2015a). Thus not surprisingly, the SAB was retired when the new UN Secretary General took office.

The 2030 Agenda for Sustainable Development emphasizes that the new Global Sustainable Development Report (GSDR) is one important component of the follow-up and review process for the 2030 Agenda for Sustainable Development. The GSDR is intended to inform the high-level political forum, and shall strengthen the science-policy interface and provide a strong evidence-based instrument to support policymakers in promoting poverty eradication and sustainable development. After some pilot versions, the first GSDR written by a group of 15 independent scientists will be released in 2019.

1.2.3. Why is science-based policy useful?

"*It is often said that knowledge is power, but more often than not relevant knowledge is not used when political decisions are made*" (Grundmann & Stehr, 2012).

Using scientific research for policy making can have two principle functions, being either instrumental or legitimating. Earlier discussions about science in policy making focused on its instrumental role only, i.e. its capacity to deliver useful solutions to policy problems. The legitimating role of science was only recognised and examined more closely in the 1990s, i.e. that policy makers use specific scientific results to legitimize pre-conceived decisions

(Weingart, 1999). These two distinct but rather general functions have been further subdivided into ten more specific functions, among them: legitimacy; persuasion; delaying or avoiding action; justification for unpopular policies; arbitrating disputes; and clarification of conflicting interests (Boehmer-Christiansen, 1995; Weiss, 1979).

Especially the latter two functions are important in the context of the European Union, where scientific evidence is one of the few means to harmonise conflicting national interests and create a common interest (Theys, 1995). Interestingly, in 2014 NGO's called for the abolishment of the EU's Chief Science Advisor position, created just 4 years earlier, and calling for variety of independent, multi-disciplinary sources instead. A call that underscores the important point that science policy can be and frequently is politicised (see with further examples (Pielke Jr., 2014)).

In the case of natural resources and environmental issues, science can serve to counter the tragedy of the commons. It is often perceived to provide a neutral perspective on sustainable resource management, unrelated to the self-interest of the resource users. Its instrumental role here is to provide an objective, rational view of the facts of nature, enabling management that is not swayed by local interests and political conditions. This view has of course been challenged, as 'cherry-picked' scientific evidence can of course also be used to legitimate interest-driven, pre-defined policies. However, the instrumental role remains an important element of the public image of scientific advisors (Bocking, 2004). Value and knowledge development in science can also cause innovation in resource management and problem solving. For example, the academic development towards fields sympathetic to the environment such as ecology and sustainability science has led to the integration of adaptive management and ecosystem management in the North American forestry sector (Bocking, 2004).

1.2.4. How can science influence policy?

The extent to which scientific results are relied on for policy making is largely determined by the type of policy problem at hand (Engels, 2005). More complex or cross-sectoral policy problems generally require more scientific input than others, as research is needed to determine the driving forces of a problem and the effects that a policy may have on the system in question (Engels, 2005). Furthermore, stakeholders often draw on scientific evidence when a policy is hotly contested to strengthen their position. In these cases, scientific evidence can be mobilised as "arrows in the battle of ideas" and sometimes used contrary to the authors intentions (Head, 2010). Although visible in many different policy areas, evidence-based policy making has been most prominent in healthcare, social services, education, criminal justice and environmental/resource management. So far, its adoption is most prevalent in advanced democratic nations which have invested in policy-relevant research, but its analytical techniques also being applied to some extent in several of the rapidly developing nations (Head, 2010).

The ways in which science can influence policy making specifically vary depending on the phase of the policy cycle and the intent of the scientific result. In the absence of public concern, scientific warnings can bring attention to a new risk and place it on the policy makers' agenda. This process can be initiated either through findings of new data or new interpretations of existing data and is often connected to high uncertainty, making the issuing of a public warning risky.

Once a risk has been identified, science can help define the actual problem by delivering information on drivers, impacts, threats and reaction strategies. This process is usually contested and controversial, as it defines whose interests are being affected and whose behaviour must change. At the stage where policy makers decide on which policy instrument to use in order to tackle the problem, scientific ex-ante assessments can help in anticipating the possible impacts and results that a specific tool may have. Often this is done in the form of a monetary cost-benefit analysis or using an integrated impact assessment. Once a policy has been implemented, scientific ex-post assessment (often initiated by the opposing political party) is used to evaluate its effects. Although methodologically this type of evaluation contains the least uncertainty, it is rarely neutral as the justification or discreditation of policies inevitably involves taking sides. Finally, the implementation of a policy may need to be monitored on a regular basis if it is to yield the intended outcome. This phase is usually executed by the technical staff of governments rather than scientists per se, although neutral scientific monitoring may be needed in cases where policies are contested and the success of a policy is dependent on stakeholders with diverging interests (one of which may be the government itself) (Engels, 2005).

Across this policy cycle, science can have different types of impact depending on its intent. If research has been tailored to address a specific issue previously identified by policy makers, its findings may be adopted and implemented *directly*. Examples for this would be the ex-ante and ex-post assessments directly initiated by government bodies or opposition, which target the evaluation of a specific policy. Research that does not answer to a specific policy problem can influence policy more *indirectly* by enhancing the understanding of processes or providing new frameworks of thought. Any research may also influence policy *symbolically* if it is taken up as a weapon in a partisan debate (Weiss, 1979).

1.2.5. The Institutionalization of the Interface

“Linking science to policy (...) is home to a variety of diligent, smart, hard working and creative people. It is more akin to Plato's agora than a chasm of despair: a place where our most closely held ideas about knowledge and democracy are continually being tested, reworked and improved” (Paul, Ryan, & Peat, 2013).

Calls for the closer integration of science and policy are and have been made for decades. Sometimes these calls require scientists to be more policy relevant or ‘usable’ (Ford, Knight, & Pearce, 2013) or even to get involved in politics. But this is unrealistic (Sutherland, 2013). Scientists distance themselves from the muddy-waters of science policy, sometimes inadvertently, as they tend to pursue a research agenda they are passionate about, as they regard their job as finished when they report their results in a specialized research journal, or argue that advocating for a particular societal position compromises their scientific credibility, and because they feel that dealing with societal issues is some other profession’s problem (Hadly et al., 2013).

Less frequently, these calls are addressed to politicians, suggesting to break their scientific-ignorance and to teach science to politicians. This is unrealistic likewise, although, as suggested by Sutherland et al., some interpretive scientific skills instead of fundamental science itself, could form part of the broad skill set of most politicians (Sutherland, 2013) as some policy and politics knowledge could be useful for scientists (Tyler, 2013). Related are proposals for standard-setting and auditing of research quality (beyond the established peer-review systems) to mitigate unreliability and bias in science, to provide policy officials and others with a reliable way of assessing evidence quality, and to drive up standards in scientific research (Boyd, 2013).

Politics and science are deeply intertwined. As such, the science-policy interface does not exist, at least not as a clearly identifiable space in the overlap of the two systems. It rather permeates throughout science and policy. However, as nevertheless the two systems have their own aims, rationales and logic, which is very hard to overcome by the efforts of getting scientists more engaged in policy making or policy makers more understandable of sciences, there is an increasing professionalization and institutionalization happening. Through so-called boundary organizations, much of the actual (as different from the scientific studies about) science-policy work is undertaken.

Boundary organizations are organizations whose central purpose is to create and sustain meaningful and mutually beneficial links between knowledge producers and users. Their roles include translation (between science and non-science, between long-term research and short-term policy needs, etc.); participation and co-production (including fostering the space-physical, temporal, institutional, political, etc. where co-production can occur); and dual accountability (Meyer & Knight, 2014). There are many such organisations. Prominent types of science policy boundary organisations include Chief Science Advisors to governments, and Scientific Advisory Bodies, and to some extend also the global scientific assessment institutions like the IPCC, IPBES, or GEO. However, the most innovative, creative and effective boundary organizations are often small to medium size private-sector companies, NGOs, and not at least individuals.

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