Enabling Science to Deliver Change

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Abstract Delivering change through science to address the many environmental problems we face, cannot happen in a vacuum and without public support. However, we live in an age when it seems that citizens increasingly question experts' advice and reject science as an authoritative source of knowledge. But is this a disbelief in science or is it an erosion of trust in 'experts' and to how science is applied? Considering the complexity of environmental problems, there appears to be a pressing need for people to not simply accept solutions, but to understand such problems and even get involved in defining them. Recent calls for the traditional neutral, disinterested and objective expert to evolve into a good communicator have delivered short lived benefits and contributed to the decline of public trust in the infallibility and neutrality of scientific expertise. Instead, *epistemic trustworthiness* -the integration of expertise, integrity and benevolence- is what inspires public trust more. People want explanations before accepting decisions. They need to be involved and engaged, and this process must be fair, inclusive and transparent, taking place through fruitful public debate. The drive to a society which is more scientifically literate, aware of the many interdependencies that define the problems we face, and able to cope with the strengths and limitations of the available science, might be a real prerequisite to enabling science to deliver change.

Keywords: Climate change, science, public-policy, public engagement

1. Introduction

From water scarcity to climate change, loss of biodiversity to air pollution, it is increasingly acknowledged and recognised by science and policy that to solve these problems there is an urgent need for change. However, human society has great inertia: even getting people to recognize these problems, let alone agree on a course of action, can be an excruciating process (see the debate over climate change). In an age where science and technology are at the forefront of human development, where science, engineering and innovation are driving the world economies, people are less engaged than ever with science, and its role in the process of political decision-making continues to be the subject of debate. Conversely, public perception plays a critical role in sustainability policies and environmental management decision making, affecting both what solutions are explored and at the same time if, and how, successful implementation can take place.

In an era of backlash against authority, the neutral, disinterested and objective expert promoted – not least by scientists themselves – as the rational and authoritative arbiter of policy disputes over scientific issues, faces a suspicious public concerned about the independence and integrity of science, often produced to address 'policy needs'. This paper investigates the link between science and public perception, focusing on the role of science in addressing environmental challenges. Looking at the complexity of environmental issues, it reviews the roles of science and policy in addressing these challenges and delivering change.

2. Environmental Challenges

As the global footprint of human activity continues to expand, humanity faces a plethora of environmental challenges associated with resources and pollution. These are products of interactions that vary with time and space, involving multiple actors and disciplines, composed of interconnected relationships often with nonlinear effects. Because of these complex relationships among people and the environment, human health and well-being are closely linked to the integrity of local, regional, and global ecosystems.

Ecosystems and industrial systems are tightly coupled and dynamic, often operating far from equilibrium, exhibiting nonlinear and sometimes chaotic behaviour. Our difficulty in perceiving the complex and unpredictable dynamics of these systems, limits our ability to make better decisions. Understanding this complexity requires an explicit knowledge of important attributes such as spatial and temporal variability, social heterogeneity, nonlinearity, interconnectivity (Figure 1) and their implications for management. For example, because of spatial variations, management objectives differ at different geographical scales of assessment (Wilbanks 2007), whilst temporal variations may require the development of scenarios or long-term simulation models as foresight tools for exploring time-lags in environmental problems as well as the potential changes in the environment resulting from human interventions (Mietzner and Reger 2005).

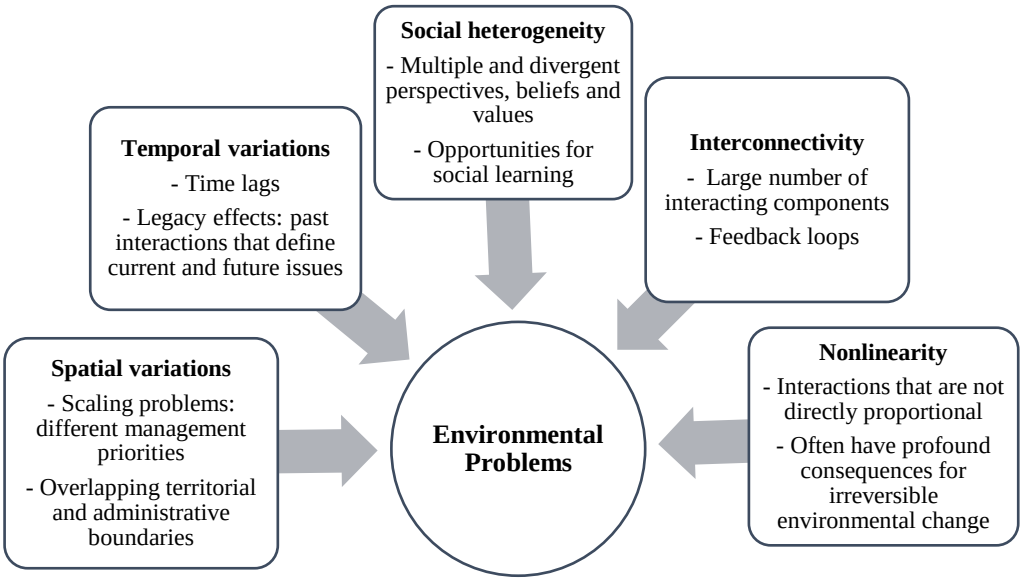

Figure 1. The complexity of environmental problems

Furthermore, what if the major problems now facing humanity; poverty, emerging diseases, and global warming to name a few, are so intertwined that we cannot hope to address one without addressing the others? These problems are difficult or impossible to solve because the often incomplete, contradictory, and changing requirements that are often difficult to recognize, are on the rise and constantly evolving.

Historically, our efforts have been driven by an oversimplified understanding and linear thinking asserted from simplistic causal relationships offering deceptive certainty and predictability. As a result, our practices have been sector and compartment-oriented, leading to fragmented policy-making and decisions that move problems in time and space, rather than to solve them (Voulvoulis et al., 2013). There is a widespread recognition that most environmental problems cannot be addressed separately within the confines of individual disciplines or even by the application of science alone (Figure 2). Scientific evidence has limited application without reference to the social and economic context of the question it aims to address.

An interconnected world needs new forms and patterns of intellectual inquiry that challenge existing disciplinary and institutional boundaries. The interdisciplinary needs of environmental problems could for example be addressed to some extent, by increasing provisions for public participation in policy (Voulvoulis et al., 2017). This in turn, creates the impetus for the integration of multiple perspectives and skills for effective policy-making in environmental governance (Steyaert and Ollivier 2007).

3. Evidence based policy and expert knowledge

'Policy needs' increasingly shape scientific agendas (Koppelman et al., 2010), with researchers often under pressure to demonstrate that they are making an impact and want to help bridge the evidence-policy gap (Cairney, Oliver and Wellstead 2016). Evidence-based policymaking helps people to make well-informed decisions about policies, programmes and projects, by placing the best available evidence from scientific research at the heart of policy development and implementation (Pedersen 2014). As a result, governments and civil servants have been drawing on expert knowledge to fill gaps, answer questions and justify decisions in relation to various policies.

'Expert knowledge' is what qualified individuals know as a result of their technical practices, training, and experience (Booker and McNamara 2004). Experts are usually identified on the basis of qualifications, training, experience, and professional memberships (Ayyub 2001), although broader definitions of expertise may include untrained people who possess direct, practical experience or those recognised as 'experts' by their peers (Burgman et al., 2011). But why do people trust some experts but reject others? Why do many people seek medical experts for medical issues, but distrust climate experts for climate ones?

Today, people are exposed to more information than ever before, provided both by technology and by increasing access to every level of education.

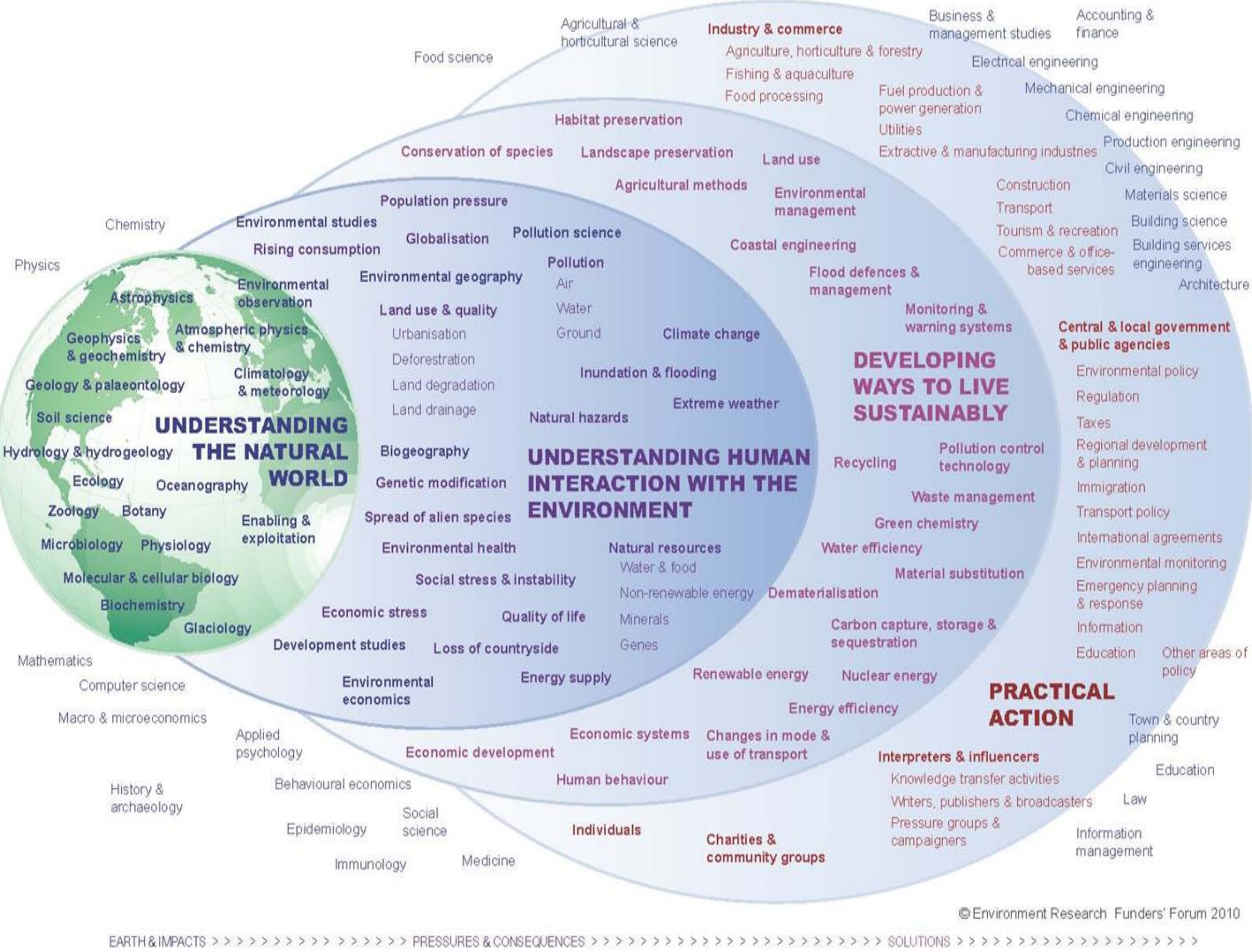

Figure 2. Sciences, sectors and stakeholders involved in addressing environmental challenges

The digitization of knowledge and the fact that it is usually freely available has the potential of democratizing and empowering of people to get information to shape their views. But paradoxically, this increasingly democratic dissemination of information, rather than producing an educated public, has often instead created an army of ill-informed and angry citizens who tend to denounce authority, scientific or not. The General Social Survey, one of the oldest and most comprehensive recurring surveys of American attitudes, shows that although trust in public institutions has declined over the last half century, science is the one institution that has not suffered any erosion of public confidence. The distrust seems to be mainly about how science is used.

Humans have a basic psychological tendency to perpetuate their own beliefs, or even to really discount anything that runs against their own prior views. Once convinced of something, research suggests facts do not make a difference. Even more, there is evidence that trying to correct a person's misperception can have a 'backfire effect' (Nyhan et al, 2010). It has been shown that often when one encounters facts that don't support their idea, their belief in that idea grows stronger instead.

Serious concerns that the current rejection of expertise and learning, noting that when ordinary citizens believe that no one knows more than anyone else, democratic institutions themselves are in danger of falling either to populism or to technocracy - or in the worst case, a combination of both (Nichols 2017).

Contributing to the public's erosion of trust in experts, is the sacrifice of breadth for depth that comes with the acquisition of expert knowledge. A tendency for technical experts to adopt specialized worldviews, and the drawbacks that modern forms of technical expertise entail, has also contributed to 'expert fatigue'. Disciplinary 'experts' tend generally to regard fields other than their own with considerable suspicion. Because of institutional practices, funding mechanisms, assessment and recognition of research excellence and publication strategies, 'interdisciplinary' research is often actively discouraged as being, among other things, too speculative, and interdisciplinary experts are hard to find (Baigent et al., 1982). Even more difficult though is becoming to find 'objective' experts (in line with the Baconian understanding as detachment and neutrality) – experts that are competent and disinterested – as often advance knowledge and non-epistemic interstates are heavily intertwined (Gethmann et al., 2015).

At various points of policy making, scientists or experts are also often faced with normative questions and background values. But is it a task for them to respond to these questions? Rather, in so far as policy decisions depend on normative questions, it is for the wider democratic community to determine how to deal with them

(Kappel 2012). Simply listening to the best-qualified scientists for policy advice may not always ensure that research and development are conducted for the public good.

Rejection of experts therefore, has occurred for many reasons, including the openness of the internet, the emergence of a customer satisfaction model in higher education, and the transformation of the news industry into a 24-hour entertainment machine (Nichols 2017). And the solution is not simply about turning scientists to polished communicators, which is shown to further contribute to the decline of public trust in the infallibility and neutrality of scientific expertise. It is more about *Epistemic Trustworthiness*, our decision to place trust in, and listen to, an expert when we need to solve a problem that is beyond our understanding (Hendriks, Kienhues and Bromme 2015). Epistemic trustworthiness -the integration of expertise, integrity and benevolence- is what inspires public trust. Experts need to 'know their stuff' but also need to be honest and good-hearted.

Although science cannot and should not make what are essentially political decisions, there is clearly an important role to play as a contributor to political debates.

4. Discussion

Science aims to produce more and more accurate explanations of how the natural world works, what its components are, and how it got to be the way it is now. Its role should be enabling the public to understand the complex interactions between environmental quality and our quality of life, in order to take action.

Citizens, if and when directly affected by policies, get increasingly informed and active in the policy-making process. They want to know and be informed about the government decisions and actions. They want to receive explanations before accepting decisions. They are not subjects but agents of democracy and, in this sense, participatory processes become crucial both to have a democratic process, and to avoid opposition phenomena as 'not in my backyard'. That is why policy makers now more than ever are expected to be accountable and policy-making is 'evidence-based' rather than based on unsupported opinions difficult to argue (De Marchi et al., 2016).

Ultimately, environmental management can only be successful with the support of stakeholders on a genuinely systemic basis. Environmental policy success relies on public involvement, with decisions made in a collaborative and transparent manner (Kaika 2003). Strengthening the evidence base to address the complexity of environmental problems and facilitating public participation to create opportunities for better policy decisions are key steps (Howarth 2009).

There should be a proactive approach to openness, preferably through multi-stakeholder engagement (UNDP 2012), to help rebuild the relationship between people, experts and institutions (Mathieson 2016). The scale and quality of stakeholder involvement can determine the legitimacy of the resulting strategy, the feasibility of its financing, and the viability of its implementation. Exacerbated by the eminently political nature of most environmental problems, this process can bring together competing interests and sectors that require concessions and trade-offs between actors. For example, addressing climate change requires an inclusive approach that takes into consideration the transversal nature of climate change risks and impacts – affecting all stakeholders, levels and sectors of society – and identifies the critical links between climate change and present and future development planning horizons and decision-making modalities (UNDP 2012).

In modern society, scientific experts are not the new priests. It is not therefore the public's trust that we should be after. Experts do not pronounce on all manner of things with scientific knowledge as the ultimate authority (Martin 1991). To challenge experts should be a duty and not a heresy. Individuals' and groups' abilities to understand problems and make decisions are important skills. Considering that change cannot happen in a vacuum and without public support, science, 'the torch which illuminates the world', has a critical role empowering the public to not simply accept but to understand and engage in the process of change. The need to engage the public and enable it to play an active and constructive role in this process is clear (Kirkman and Voulvoulis 2016).

Understanding the complexity of environmental problems therefore requires a shift in problem structuring; transforming the way problems are defined into a more collaborative process with a deliberative focus on the exploration and assessment of these human-nature interactions if problem causalities are revealed and management efforts are informed accordingly. Enabling people to understand, can empower them to see things for what they are and to make the right decision as a result. Placing the citizen at the centre of policymakers' considerations, not just as target, but also as agent, needs to be in the centre of a systematic pursuit of sustained collaboration between government agencies, non-government organisations, communities and individual citizens (Holmes 2011). It is about informed 'citizens', who exercise their right to participate directly or indirectly in decisions that affect them. Such an approach honours the fundamental principle of a democratic state that power is to be exercised through and resides in its citizens.

Science and democracy are based on a social contract shaped by different but often implicit political norms. In a well-ordered society, democratic decision-making and public debates must be informed by a scientific approach to the relevant facts (Pedersen 2014). The public needs to be involved and engaged, and this process must be fair, inclusive and transparent, taking place through fruitful public debate. In a scientifically literate society, people need to learn to acknowledge the uncertainties and limitations of scientific knowledge, the range of different kinds of risks and benefits which might accrue to different sections of society, and to operate with open and inclusive decision-making systems that can be shown to be scientifically and democratically legitimate (Miller 2001). The drive to a society which is more scientifically literate, aware of the many interdependencies that define the problems we face and able to cope with the strengths and limitations of the available science, might prove to be a critical step in allowing science to deliver change.

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