Civic Science for Sustainability: Reframing the Role of Experts, Policy-Makers and Citizens in Environmental Governance

Karin Bäckstrand

At the Johannesburg World Summit on Sustainable Development, the science and technology communities, along with other nonstate actors, were singled out as major partners in the quest for sustainability. This is in line with calls for refashioning scientific expertise into a more transparent, accountable and democratic enterprise. Participatory, civil, citizen, civic, stakeholder and democratic science are catchwords that signify the ascendancy of participatory paradigm in science policy. The participatory turn to scientific expert advice can be interpreted as a resistance to the perceived scientization of politics, which implies that political and social issues are better resolved through technical expertise than democratic deliberation. The notion of civic science, which is rather vague and elusive, serves as an umbrella for various attempts to increase public participation in the production and use of scientific knowledge. Civic science alludes to a changing relationship between science, expert knowledge and citizens in democratic societies. In this perspective, citizens and the public have a stake in the science-politics interface, which can no longer be viewed as an exclusive domain for scientific experts and policy-makers only.

What is the scope for restructuring scientific expertise in a more democratic fashion? Is it possible, or even desirable, to include citizen participation in the production, validation and application of scientific knowledge? While there is lip service paid to the need for civic science, the question of how it can be realized is largely unresolved. The rhetoric of civic science, which can be conceived as a response to the dangers of Bovine Spongiform Encephalopathy (BSE) disease and the risks of genetically modified food, signifies the heightened public concern about environment issues. Hence, the status of scientific expert knowledge in democratic societies as well as the role of the citizen in the age of experts has been brought to the fore. Public concern and controversy also surround the application of biotechnology and reproductive technology, the storing of toxic and nuclear waste, climate change and the human genome project.

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Conceptualizing Civic Science

In this article, I review the notion of civic science by mapping how the concept is articulated in international relations, science studies and democratic theory. I also examine the account of civic science underpinning the field of sustainability science that purportedly embraces a more participatory account of scientific expertise. A central proposition is that the promotion of civic science needs to be coupled with a theoretical understanding of the institutional, normative and epistemological divisions characterizing the term. This article begins such an effort by mapping the rationales, justifications and limitations of civic science. It aims to provide a conceptual grounding for future case studies of civic science in the context of biodiversity, bio-safety, climate change and desertification.

Climate change, management of natural resources and bio-safety represent areas where participatory expert knowledge is called for. The rise of global environmental regimes has meant that models for scientific advice on the domestic level now are extended to multilateral scientific assessment.[1] This prompts the question of how to find a balance between specialized expert knowledge and public participation in science.

In international relations the science-politics interface has been framed primarily as a matter for scientists and decision makers. Scientists inform policy-makers and policy-makers turn to science for knowledge and technical assistance. I suggest that the science-politics interface needs to be reframed to include the triangular interaction between scientific experts, policy-makers and citizens. The citizen is not just the recipient of policy but an actor in the science-policy nexus. This is in line with the argument that "[a]ny model of the relationship between scientific expertise and public policy-making should include the public sphere, that is those common spaces in which citizens meet to discuss public matters—In normative terms, the concept of public sphere refers to democratic values, namely public accountability and active citizenry."[2] In this vein, scientific knowledge can be conceived as a global public good in which the citizens have a stake.

The first section reviews how the discipline of international relations has grappled with scientific advice and how the question of civic science is featured in this scholarship. The second section conceptualizes the elusive concept of civic science. Civic science hosts many ambitions, such as enhancing public understanding of science, increasing citizen participation, diversifying representation in, and promoting democratization of science. In the third section I spell out three rationales for civic science mirrored in the literatures of risk society, science studies and normative democratic theory. The fourth section proceeds by examining the notion of civic science that underpins the evolving field of sustainability science. The concluding section summarizes the institutional, epistemological and normative challenges connected to civic science.

1. Miller 2001, 253.
2. Edwards 1999, 169.

International Relations and Civic Science

Civic science is a nascent issue in the discipline of international relations (IR) that primarily has addressed the institutional aspects of advisory science in global environmental politics. As of today, international scientific and technical advisory bodies are central in providing input for international environmental negotiations. The rise of "negotiated science" is a prominent feature in the ongoing diplomatic endeavors associated with climate change, air pollution, ozone depletion, biodiversity and desertification. Scientific assessment is increasingly organized on a multi-national and multi-disciplinary basis. For example, the negotiation and operation of the long range transboundary air pollution regime (LRTAP) rests on scientific assessment involving almost two thousand scientific and technical experts from a multitude of countries.[3]

There is a lacuna in IR with respect to the relationship between expertise and democratic governance in environmental politics. The normative aspects of scientific expert advice, including the issues of representation, transparency, participation, accountability and legitimacy are largely absent.[4] The legacy of isolating IR from social theory at large precludes a notion of "political" that includes the public. The dichotomy between the orderly and democratic inside of domestic politics and the disorderly anarchic outside of international affairs pervades the discipline.[5] Consequently, in this perspective, democratic participation in science is primarily confined to the context of domestic policy-making and is more limited in international diplomacy and scientific assessment.

In IR, research has revolved around the links between scientific expert knowledge and processes of global environmental governance. The research agenda has been framed around primarily two sets of issues. Liberal-institutionalism has been preoccupied with the conditions for effective uptake of scientific expert knowledge in international regimes. In contrast, the locus of constructivist IR scholarship has been on the contingent, uncertain and normative context for scientific expertise. The first issues concern the optimal conditions for making scientific experts influential in the decision-making process and international institutions. Regime-theoretical studies primarily focus on how science effectively can assist in mitigating global environmental risks through diplomacy, regime-building and multilateral negotiations.[6] Knowledge-based explanations of regime formation, such as the epistemic community, signify this approach.[7] The central argument is that the mobilization of consensus among transnational networks of scientific experts is instrumental in facilitating international policy coordination and agreement. Another issue is how the organization of scientific expertise can promote utilization of scientific knowledge in international environmental regimes and prevent the politicization of scientific expertise and the exploitation of scientific uncertainties by

3. Bäckstrand 2001
4. Bäckstrand 2003.
5. Walker 1993.
6. Young 1997; Young 1999; and Andresen and Skodvin et al. 2000.
7. Haas 1989; and Haas 1992.

recalcitrant actors. A precondition for the effective use of scientific knowledge is that there is a shared understanding of the nature of the problem among the authorized experts and that this consensus, in turn, is transmitted to international institutions as well as incorporated into policy. Recent studies move beyond the assumption of shared norms and aim to explain why some global norms—such as the normative compromise of liberal environmentalism—become selected and institutionalized.[8]

The constructivist research agenda revolves around how scientific knowledge and practices are embedded in various cultural and political contexts as well as in societal discourses. Research in this direction adopts insights from a multiplicity of perspectives such as discourse analysis, science and technology studies and constructivism. Studies of the role of scientific discourses in propelling policy action with regard to stratospheric ozone depletion, climate change and biological diversity signify this approach.[9] The plethora of literature on global environmental assessment underlines the importance of enhancing saliency, credibility and legitimacy of scientific assessment.[10] However, the question of how, and by what means, to institutionalize credibility and legitimacy of scientific assessment is unanswered. This issue looms large partly because there is a lack of theoretical foundation for coupling democratic citizen participation with scientific assessment.

In the wider post-positivist scholarship there is an ongoing critical revaluation of the status of expert knowledge in modern society. What are the boundaries between scientific and non-scientific knowledge, expert and lay knowledge, global and local knowledge, risk assessment and risk management? On what basis can these boundaries be maintained? Recent work marrying international relations and science studies start from an analysis of the co-production of the political order and scientific knowledge.[11] The production of scientific knowledge is not viewed as external to environmental politics as in the epistemic community approach. The boundaries between institutions of scientific expert advice and policy-making are blurred.[12]

An underlying premise is that scientific knowledge and practices operate inside rather than outside of politics. A key question is what counts as credible, authoritative and legitimate expert knowledge. Instead of taking shared understanding and scientific consensus at face value, the purpose is to unravel the process by which actors come to share common worldviews. Science and politics are in this vein indistinct realms with fluid boundaries subject to negotiation. Research on boundary work[13] and boundary organizations[14] highlight how legitimacy, credibility and authority of scientific expert knowledge are

8. Bernstein 2001.
9. Litfin 1995; and Miller and Edwards 2001.
10. Cash and Clark 2001, 9.
11. Miller and Edwards 2001a.
12. Miller 2001a.
13. Gieryn 1995.
14. Guston 2001.

maintained by establishing borders between the scientific and political spheres. The implication of this analysis is that scientific advisory processes are deeply intertwined with political processes. Without denying the critical importance of scientific knowledge to environmental policy, this perspective highlights the normative and value-laden context for scientific inquiry. Recent studies of climate science and governance illustrate the conflict between a top-down and a bottom-up scientific assessment process.[15] This opens up a space for theorizing the tensions between democratic and technocratic governance in environmental affairs. Research in risk society,[16] environmental sociology, science studies and democratic theory has addressed the prospect for democratic expertise in policy-making as well as examined the promises and pitfalls of enacting civic science. The next section discusses the contested concept of civic science.

Civic Science: Participation, Representation or Democratization?

Civic science has many meanings and aspirations. It is used interchangeably with civil, participatory, citizen, stakeholder, democratic science and lay knowledge. Civic science has been defined as the efforts by scientists to reach out to the public, communicate scientific results and contribute to scientific literacy.[17] Citizen science, on the other hand, denotes a science that is developed and enacted by the citizens, who are not trained as conventional scientists.[18] There is wide disagreement with respect to the question if citizens can, or should be able to deliberate on scientific matters. For instance, should the citizenry be invited to deliberate about the application of science or technology or should they be engaged in scientific problem formulation? In other words, should lay knowledge be limited to the process of risk management or should it also be integrated in risk assessment processes?[19]

Civic science harbors many ambitions, such as increasing public participation in science and technology decisions, securing a more adequate representation in science, vitalizing citizen and public deliberation in science or even installing a democratic governance of science. Representation, participation and democratization can be conceived as three different but interconnected dimensions. First, civic science as *participation* underlines the importance of increasing public participation by bringing citizens and civil society to the heart of the scientific endeavor and by embarking on participatory practices in the conduct of science. Consensus conferences, participatory technology assessment, citizen juries and public hearings in science and technology affairs are examples of institutionalized practices that attempt to incorporate citizens in environmental risk management.[20] Secondly, civic science defined in terms of *representation*

15. Miller 2001b.
16. Beck 1992; and Beck and Giddens et al. 1994.
17. Clark and Illman 2001.
18. Irwin 1995.
19. Kleinmann 2000.
20. Weale 2001.

aims at reversing the skewed representation in the production of science. The lack of representation of women and indigenous people in the scientific enterprise was highlighted at the World Summit on Sustainable Development.[21] Moreover, the poor representation of scientists from developing countries and countries in transition in international scientific assessment processes is recognized as highly problematic both for the quality and legitimacy of scientific knowledge.[22] Which and whose knowledges are represented as true, legitimate and authoritative? These insights are supported by critical feminist epistemology questioning the universal aspiration of modern science and calling for an inclusion of local, subjugated knowledge in societal and technological decision-making.[23] The representative paradox of science is that a very small group who holds the title of "scientist" can speak on behalf of a universal humanity.[24]

Thirdly, civic science as *democratization* challenges the conduct of scientific problem solving by aspiring to transform the institutions of science to incorporate democratic principles. Proposals to increase representation and participation in science do not necessarily entail a transformation of scientific norms, methods and practices. However, the aim to democratize science is a more challenging issue that goes beyond the issue of stakeholder representation and participation. Can the rules of modern democracy be readily transferred to the heart of scientific inquiry without compromising scientific quality and politicizing scientific expertise?

Embracing civic science can be conceived as a response to two developments; the emergence of "big" planetary science and the "legitimacy crisis" for modern science. First, civic science can be conceived as a reaction to the expansion of "mega-science" enabled by innovations in global environmental modelling. The international co-ordination, standardization and harmonization of scientific assessment signify the emerging Earth Systems Science.[25] This is epitomized by the expansion of global models of atmospheric, hydrological and terrestrial systems in international negotiations, research programs and international organizations. This emerging global environmental change science has been represented as global and universal knowledge even if the modelling activities are concentrated in a few laboratories in the Northern hemisphere. The top-down model of environmental problem-solving grants power to networks of scientific experts, specialists, and bureaucrats in environmental science. Critics point to a failure to couple global western scientific knowledge with local and indigenous knowledge, agendas, needs and concerns. A remedy for this is to increase public participation in scientific assessment processes, recognizing the "glocal" level of knowledge production.

Secondly, the call for civic science is a response to the legitimacy crisis of science, which is more pronounced in Europe in the backdrop of food safety

21. International Council for Science 2002a.
22. VanDeveer 1998; and Biermann 2002.
23. Haraway 1996; and Harding 1998.
24. Fuller 2000, 8.
25. Jasanoff and Wynne 1998, 58.

scares in the 1990s. The increased reliance of expert advice, negotiated and regulatory science defines issue areas from global warming, toxic waste and genetically modified organisms (GMOs). However, inflationary use of expert advice has paradoxically produced more uncertainty.[26] Science has been called on to provide a firm basis for justifying and making political decisions credible. Scientific knowledge is in many areas provisional, uncertain and incomplete. Thus, competing expert knowledge has in many instances given rise to a battle between experts and counter-experts. Corporate science has contested environmental advocacy science and vice versa.[27] This politicization of scientific knowledge has paved the way for the erosion of the authority and legitimacy of science as objective knowledge. When the public experiences that science can be both contested and uncertain, the policy-process, which relies on purportedly objective knowledge, loses credibility. The erosion of the legitimating function of science in certain domains has spurred the calls for making science more accountable and democratic. In the next section I explore three rationales for civic science and highlight the normative and epistemological divides surrounding the term.

Three Rationales for Civic Science

What are the reasons for enhancing public participation in science and making science democratically accountable? First, civic science, if geared toward enhancing public understanding, can potentially mitigate the growing public disenchantment with scientific expertise. Secondly, the sheer complexity of global environmental problems necessitates a reflexive scientific expertise that incorporates a wide array of lay and local knowledge. Thirdly, the primary purpose of civic science is to extend the principles of democracy to the production of scientific knowledge.

Civic Science as Restoring Public Trust in Science

The first rationale for civic science is to enhance public understanding of science by improved communication, scientific literacy and outreach. This emerged in the backdrop of the rhetoric of openness that marked the European policy debate on science and technology issues in the 1990s. The rationale was to enhance transparency, civil participation, dialogue and accountability in science policy.[28] An overarching effort was to bridge the increasing gulf that existed between science and society, which was epitomized by the vehement public reaction to the BSE disease and genetically modified food in Europe and calls for implementing the precautionary principle. A contrasting tale can be found in

26. Rutgers and Metzel 1999, 148.
27. Jasanoff 1990; and Fischer 2000.
28. Levidow and Marris 2001, 345.

the United States where GMO food is largely accepted in the public eye and where risk assessment and "sound science" are entrenched practices for assessing health and environmental risks associated with GM crops. The food crisis in Europe reflects a fundamental lack of confidence among citizens toward the scientific and regulatory management of these issues. As a corollary, the public has become more skeptical of both governmental and corporate science while investing more trust in the perceived "independence" of science authorized by nongovernmental organizations such as Greenpeace.

Better communication from the scientists to the public, deeper public understanding of science and improved scientific literacy have been seen as remedies. In this perspective, the basic root of the declining confidence in expert knowledge is the public misunderstanding of science. The so-called "deficit" model emerged as a dominant framework for governments' science policy in response to the reactions among the citizens. A central assumption in this model is that the strong reaction of the public is based on irrationality, fear, ignorance and lack of knowledge. In this vein, the mismatch between scientific and popular risk assessment stems from insufficient and inadequate knowledge among the public. The remedial strategy is information dissemination and "getting the scientific facts right." If citizens were more scientifically literate, the reasoning goes, they would do the same risk assessment as scientific professionals.

The deficit model has been criticized on many accounts and is increasingly rejected for its problematic assumptions.[29] While dressed in the language of transparency, dialogue and participation, the traditional mode of top-down scientific expert knowledge is still retained. A hierarchy is established between scientists and non-scientists and between enlightened scientific experts and ignorant laymen. Communication is one-way and on unequal terms, from the scientists to the public. The nature of scientific knowledge is not problematized in spite of the growing recognition that scientific knowledge is provisional and uncertain in many regulatory domains. This assumes that scientific knowledge is superior compared to other forms of knowledge. The stewards for sustainability should be scientists and engineers who need to reach out to the public. Needless to say, this model of civic science falls short from a more democratic model of public understanding that seeks to establish dialogue, collaboration and deliberation between experts and citizens.

Civic Science and the Complexity of Environmental Problems

The second rationale for civic science is a response to what has been perceived as the accelerating complexity of global environmental problems. In this sense, the condition of indeterminacy prompts the need for a new kind of science: "In terms of nature, the central paradox is that while the scale of control afforded by science and technology continues to increase, so does the domain of uncer-

29. Frewer and Salter 2002.

tainty and risk."[30] Civic science is ultimately justified by an epistemological argument. Collective decision-making in the global environmental arena is fraught with uncertainty since scientific knowledge of global environmental risks is inherently limited, provisional and value-laden. This condition of uncertainty, contingency and indeterminacy prompts a need for a more pragmatic and open-ended decision process. In this respect, politics is a substitute for certainty.[31] In light of non-remedial scientific uncertainties, ecological vulnerability and irreversibility, the policy process should be open, transparent and institutionalize self-reflection.

The gist of the argument is that we are witnessing a transition from normal to post-normal science. The concept of post-normal science captures issues defined by high decision stakes, large system uncertainties and intense value disputes.[32] Problems such as climate change, GMOs or biodiversity, which are fraught with uncertainties, cannot be adequately resolved by resorting to the puzzle–solving exercises of Kuhnian normal science. Established normal scientific practices for problem solving and risk assessment cannot provide the final answers to post-normal problems. In a situation involving large complexity, radical uncertainty and high stakes, new scientific practices to ensure quality control have to be established. This encompasses a re-orientation of science toward incorporating multiple stakeholders. Peer review should include "extended peer communities" in order to enhance dialogue between stakeholders such as the NGOs, industry, public, and the media. This is in line with the call for a "democratization of science," i.e. wider participation in scientific assessment beyond a narrow group of scientific elites. However, the proponents for increasing citizenry and public accountability in scientific endeavors are driven not by a general desire for democratization but to make science more effective.[33] The incorporation of lay knowledge in scientific assessment does not rest on the assumption that lay knowledge is necessarily truer, better or greener.[34] However, due to the uncertainty of future environmental outcomes, possible surprises and ecological catastrophes, a multiplicity of perspectives can prevent the narrowing of alternatives.

The implications of this paradox of incalculability, uncertainty and even undecidability of environmental risks[35] have also been addressed in theories of risk society and reflexive modernization.[36] The transition from industrial society (with its calculable risks) to risk society (with its incalculable mega-hazards) requires a redefinition of the rules, principles and institutions of decision-making. The reality of the new environmental risk will force the redesign of the basic

30. Sarewitz 2000, 91.
31. Saward 1993, 77.
32. Funtowicz and Ravetz 1992, 267.
33. Ibid., 273.
34. Wynne 1994.
35. Adam and Loon 2000, 13.
36. Beck 1992; and Beck and Giddens et al. 1994.

norms and institutions of societies. This includes the discourses and practices of science, which are at the heart of theories of risk society and reflexive modernization. The de-monopolization and democratization of science imply that authoritative decisions should not be made by a narrow group of experts, but should include a wider spectrum of stakeholders.[37] NGOs, the public and business should become active co-producers in the social process of constructing knowledge, revitalizing "sub-politics" as conceived in the risk society thesis. The whole argument rests on the assumption that we face new types of global ecological threats and techno-hazards. Beck's notion of reflexive scientization captures the idea that scientific decision-making on environmental risks should open up for social rationality. A modernization of modernity and science is needed. Hence, the traditional objectivist account of science has to be replaced by a more inclusive science that institutionalizes self-doubt, self-interrogation and self-reflexivity.[38]

Civic Science as the Democratization of Science

The most far-reaching notion of civic science is found in democratic theory and post-positivist policy studies. Citizen participation and deliberation on issues that have bearing on people's everyday lives are regarded as the normative core of democracy.[39] The realm of science and technology constitute such an arena. What are the reasons for bringing citizen participation and knowledge(s) to the scientific sphere? The first justification for a broader citizen involvement in science and technology is made by those who favor "strong" democracy,[40] which encompasses participatory, not only representative, democracy. Secondly, people should be able to deliberate on issues that affect their lives. Basically, those who bear the consequences of decisions should be able to have a say.[41] Science and technology decisions have in many instances ramifications on the everyday life of citizens. The release of GM food, storing of toxic and nuclear waste and reproductive technologies constitute such a domain. Thirdly, citizen participation can in many cases contribute significantly to scientific inquiry. Local knowledge has in many cases positively complemented professional scientific expertise. Diversity in expert knowledge is a desirable goal in itself.[42]

There seems to be an incompatibility between the quest for open-ended deliberation in democracies and the aim of prediction and control in science. "The fact that indeterminacy is not only inevitable, but essential, to democracy—something to be embraced rather than overcome—does not comport well with a scientific worldview whose most legitimating measures of success are pre-

37. Beck 1992, 163.
38. Beck 1992.
39. Cunningham 2002.
40. Barber 1994.
41. Harding 2000, 127.
42. Harding 1998.

dictive certainty and control of nature."[43] However, the conflict between these two realms eases if science is viewed as bounded rationality.[44] This perspective recognizes the contingency of scientific claims and that scientific practices are deeply ingrained in cultural and political processes. The democratization of scientific expertise prompts us to rethink our understanding of scientific knowledge itself. This entails questioning the borders between science and non-science, expert and lay knowledge, universal and local knowledge. A constructivist conception of knowledge paves the way for a more citizen- oriented, deliberative approach to risk analysis, where local knowledge can be incorporated into risk assessment.[45] The democratic version of civic science argues that the ordinary citizen is capable of more participation than is generally recognized. This echoes discursive or deliberative democracy that has dealt with the scope of citizen participation beyond traditional electoral politics. A basic tenet in this model is to promote public use of reason, argument and free deliberation. Free deliberation has the potential to transform preferences, enable a new collective will and render public decisions more legitimate. The model of deliberative democracy can therefore bridge the gap between the expert and citizen. Participatory risk assessment can be conceived as an extension of deliberative democracy. However, can insights from the participatory, deliberative and communicative model of democracy be applied to the institutions of scientific knowledge production? Most experiments with consulting citizens for technological decisions—such as citizen juries, consensus conferences, and technology assessments—are more situated in the realm of public policy while risk assessment is still regarded as the exclusive domain for scientific experts. The method of integrated assessment focus groups is one exception that aims to incorporate citizen knowledge in scientific problem formulation.[46]

Four questions have been raised against a democratic version of civic science. First, is it possible to extend principles of democracy to the heart of science, which has its own internal procedures and mechanisms for the production, verification, and control of authoritative knowledge? An unsettled issue is whether the rules for production of scientific knowledge will have to change in order to enact civic science. Is it possible or even desirable to reform the basic operation of science to incorporate effectively citizens and other stakeholders? Civic science can be conceived as an instrument to dethrone science or to deprive scientific knowledge from its authority and legitimacy conferred by society. Little guidance is provided on how the practices tied to scientific knowledge production, such as peer review, should be redesigned, complemented or replaced.

Secondly, skeptical voices argue that citizen deliberation in science will be cumbersome, time-consuming, ineffective and slow. Even an educated citizenry

43. Sarewitz 2000, 92.
44. Miller and Edwards 2001b, 19.
45. Fisher 2000, 246.
46. Durrenburger and Kastenholz et al. 1999, 342.

would have problems grasping the complexities of the highly specialized knowledge of environmental science. Elite models of democracy are highly skeptical of lay citizen participation. The ordinary citizen does not only lack time and capacity to understand the complexity of issues, but the public can be outright ignorant and irrational. Citizens do not have the knowledge to rationally calculate the risk of new technologies. They should trust specialized experts as they trust their political representatives.

Thirdly, the advent of global environmental problem-solving may limit the scope for civic science. Scientific assessments are increasingly global in scope relying on multi-disciplinary and multi-national collaborative research networks. The ongoing experiments with citizen and participatory expertise have primarily taken place at the domestic level. Is the strong version of civic science compatible with the effort to manage global environmental risks relying on global modelling and "big science"? How can local expertise be coordinated to provide alternative knowledges in transboundary or global risk management?

Fourthly, deliberative democracy may be insufficient in promoting the democratization of scientific expertise. The application of science and technology may be subject to public deliberation but not necessarily the production of science.[47] Deliberation does not necessarily change the ground rules for debate and may ignore the way power enters speech itself. The power largely resides in setting the agenda and establishing norms and rules for decision-making. For example, if "sound science" and risk assessment is the dominant framework for public deliberation on environmental risks, this will ultimately exclude alternative discourses and actors. Protest and resistance could change the decision-making framework from the risk assessment paradigm to a precautionary approach. Hence, participatory democracy has been advanced as an alternative model as it represents a more manifest critique of power and makes the exercise of power transparent.

Civic science should not be seen as a magical recipe for all cases and circumstances. Proponents for the democratization of science strongly stress that subjugated, local and indigenous knowledge should not necessarily be regarded as better or truer than modern scientific knowledge. In the end, to find the appropriate balance between technical and communicative rationality is a pragmatic and context-dependent judgment. Both technical expert knowledge and ethical judgments are needed in science-based decision making.[48] In certain cases technocratic strategies may prove to be more adequate in resolving environmental problems and attaining sustainability goals. Vice versa, in post-normal environmental risk areas surrounded by large scientific uncertainties and even ignorance, a model of civic science that includes societal stakeholders may be more effective. Public questioning of science constitutes a healthy feature of democracy, and calls for transparency in science do not automatically

47. Gaffaney 2001, 17.
48. Barry 1999, 215.

represent an anti-scientific position. A democratic model of civic science will enhance active citizenry, public engagement and scrutiny.[49] The next section takes stock of theory and practice of sustainability science to examine how this field has grappled with civic science.

Civic Science in Sustainability Science

How do the current proposals to restructure science toward the goals of sustainable development fare with civic science? Gearing science toward sustainable development means "that sustainability science must be created through the processes of co-production in which scholars and stakeholders interact to define important questions, relevant evidence, and convincing forms of argument."[50] Hence, in the evolving field of sustainability science a more participatory account of scientific expertise is articulated.

The concept of sustainability science articulates a proactive, interdisciplinary, transparent science that works in tandem with the needs of society.[51] A key focus is the dynamic interaction and interdependence between nature and society. In the past decade, national science academies have worked in collaboration with international scientific associations to redefine the functions, mandate, and scope for scientific inquiry. The ensuing self-reflection within the scientific community itself has consolidated a new vision for a science that is harnessed for the goals of sustainable development. An overarching idea is that science needs to turn toward society and even establish a "new contract" with society. The new model for sustainability science was consolidated in preparation for the World Summit for Sustainable Development. Interdisciplinarity, policy-relevancy and holistic perspectives are cornerstones of this new model of science. The overarching goal is to uncover the resilience levels for natural and human systems. Collaboration across disciplinary divides is a crucial component, both within and between natural science, engineering, social science and humanities.

Stakeholder participation, transparency, partnership and dialogue are code words for enacting a more inclusive science-policy relationship. This entails participatory procedures involving scientists, stakeholders, advocates, active citizens, and users of knowledge.[52] Sustainability science has to be accountable beyond peer review and include a variety of actors in assessment processes.[53] Scientists have to engage more in communication with the public with regard to scientific results. This also means bridging the knowledge gap and digital divide between North and South and providing developing countries with opportunities to participate in scientific assessment on more equal terms.

49. Durant 1999, 317.
50. Kates et al. 2000a, 2.
51. Kates et al. 2000b.
52. Ibid.
53. International Council for Science 2000b, 7.

Scientific capacity-building in the Third World and partnerships between industrialized countries and developing countries are therefore crucial components.[54] Moreover, the local-global connectivity is a central aspect of sustainability science. Global knowledge about environmental degradation has to be coupled with local knowledge to produce sustainable solutions. In the quest for sustainability, "universal" knowledge must be connected to "place-based" knowledge.[55] As a corollary, indigenous or traditional knowledge is recognized as a cumulative body of knowledge that can provide alternative, local perspectives. Science and traditional knowledge should be coupled in order to realize a more equitable partnership as well as mutual learning.[56]

Nevertheless, the focus is more on participation than on changing the rules and practices of scientific knowledge production, utilization and communication. Sustainability science envisions an increased transparency and participation in science and technology in order to foster the legitimacy of the scientific endeavor. Science also needs to enhance its communicative skills and outreach to initiate broader public involvement in science and technology. These proposals can be conceived as a step toward the kind of reflexive scientization that Beck calls for.[57] However, increased participation in scientific assessment does not necessarily have bearing on the practices, norms and institutions of scientific knowledge production.

Sustainability science does not address how the practices of science have to change to accommodate democratic participation. The implications for scientific knowledge production and practice are left unanswered, namely, how norms, institutions and procedures in science have to change to enable broader participation.[58] In this sense, there is a lack of a coherent social science perspective. While raising critical issues on how to make science more transparent and responsive to the needs of society, the field of sustainability science is still an expert-driven inter-disciplinary endeavor.

Conclusion

The notion of civic science prompts us to rethink the relationship between science, knowledge, democracy and environmentalism. The implications for the field of international relations are that we need to move beyond instrumentalist and managerial conception of science and bring the normative issues tied to the employment of scientific expert advice to the forefront. Representation, democracy, participation and legitimacy are crucial issues in facilitating a constructive science-policy dialogue. This means paying attention to the intermediary role of citizens in science and technological decision-making.

54. Ibid., 8.
55. Ibid., 19.
56. International Council for Science 2000a, 16.
57. Beck 1992.
58. Gallopin and Funtowicz 2001, 2.

Civic science is essentially a contested term, hosting conflicting institutional, normative and epistemological dimensions. In the wake of the declining public trust in scientific expertise, civic science has been advanced as a solution to reverse the growing public distrust in science. A "thin" conception of civic science starts from the premise that public trust in science and technology can be restored through improved science communication, scientific literacy and public understanding of science. A stronger account of civic science advocates reorienting science towards greater institutional reflexivity and responsiveness to citizens. Finally, the version of civic science as democratization suggests that scientific norms, institutions and procedures need to be reformed in accordance with democratic principles.

Civic science has been put into practice through various institutional innovations such as public hearings, consensus conferences, deliberative polls and participatory technology assessments. However, these experiments with participatory inquiry have taken place primarily in the domestic setting. There are limited experiences of citizen participation in multilateral diplomacy and scientific assessment. Another unsettled issue with regard to civic science is whether the citizenry should be invited to the heart of scientific endeavor, i.e. to participate in production of scientific knowledge or confined to deliberations about the applications of science?

The fault-line between the different proposals for institutionalizing civic science, especially the last one, revolves around the epistemological dimension. What is the nature of scientific knowledge? Is it defensible to privilege scientific knowledge over other knowledge forms? Civic science represents a very different project for the post-positivist view of science compared to the objectivist perspective. The former questions the boundary between scientific expert knowledge and lay knowledge, between global western knowledge and local indigenous knowledge. In this perspective, all expert knowledge is situated in a specific political and cultural context, inherently value-laden and imbued with worldviews. As a corollary, scientific and technological decision-making should rest on participation by and collaboration among scientists, citizens and civil society. In contrast, an objectivist epistemology emphasizes the uniqueness of scientific knowledge epitomized by its systematic features, its transformative effects and its global impacts. The systematic features of science, in terms of the capacity to observe, explain, describe and represent the world, reflect an unprecedented accumulation and progress of knowledge. Without denigrating the important contributions of local, indigenous, and everyday knowledge, these knowledge forms do not display the systematic and universal features of modern science. In this vein, the uniqueness of science grants natural scientists and engineers a continued privileged status in the quest for uncovering the scientific aspects for sustainability.

Hence, an unresolved issue is if the stewards of scientific knowledge production should be scientists and engineers or if the conduct of science should be geared towards a participatory, reflexive and collaborative effort involving so-

cietal stakeholders. However, no universal solution can be offered with respect to the balance between democratic and technocratic modes of scientific decision–making. The success of civic science is largely dependent on the context, i.e. the nature of the environmental risk and problem at hand. Finding a balance between traditional scientific inquiry and participatory expertise and between technical and deliberative approaches will be an ongoing endeavor.

References

Adam, Barbara, and Jost van Loon. 2000. Introduction: Repositioning Risk: The Challenge for Social Theory. In *The Risk Society and Beyond. Critical Issues for Social Theory,* edited by Barbara Adam, Ulrich Beck and Jost van Loon. London/Thousands Oaks/New Dehli: Sage Publications.

Andresen, Steinar, Tora Skodvin, Arild Underdal, and Jørgen Wettestad. 2000. *Science and Politics in International Environmental Regimes. Between Integrity and Involvement.* Manchester and New York: Manchester University Press.

Barber, Benjamin. 1984. *Strong Democracy.* Berkeley, CA: University of California Press.

Barry, John. 1999. *Rethinking Green Politics. Nature, Virtue and Progress.* London: Sage Publications.

Beck, Ulrich. 1992. *Risk Society: Towards a New Modernity.* London: Sage Publications.

Beck, Ulrich, Anthony Giddens, and Scott Lash. 1994. *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order.* Oxford: Polity Press.

Bernstein, Steven. 2001. *The Compromise of Liberal Environmentalism.* New York: Columbia University Press.

Biermann, Frank. 2002. Institutions for Scientific Advice: Global Environmental Assessments and their Influence in Developing Countries. *Global Governance* 8: 195–219.

Bäckstrand, Karin. 2001. *What Can Nature Withstand? Science, Politics and Discourses in Transboundary Air Pollution Diplomacy.* Lund Political Studies 116, Dissertation. Department of Political Science, Lund University.

_____. 2003 (Forthcoming). Precaution, Scientisation or Deliberation? Towards a Green Science-Policy Interface. In *Liberal Democracy and Environmentalism*, edited by M. Wissenburg and Y. Levy. London and New York: Routledge.

Cash, David, and William Clark. 2001. From Science to Policy: Assessing the Assessment Process. Faculty Research Working Paper. Kennedy School of Government, Harvard University, Cambridge, MA.

Clark, Fiona, and Deborah L. Illman. 2001. Dimensions of Civic Science: Introductory Essay. *Science Communication* 23 (1): 5–27.

Cunningham, Frank. 2002. *Theories of Democracy.* London and New York: Routledge.

Durant, John. 1999. Participatory Technology Assessment and the Democratic Model of the Public Understanding of Science. *Science and Public Policy* 26 (5): 313–319.

Durrenburger, Gregor, Hans Kastenholz, and Jeanette Bearingar. 1999. Integrated Assessment Focus Groups: Bridging the Gap between Science and Policy. *Science and Public Policy* 26 (5): 341–349.

Edwards, Arthur. 1999. Scientific Expertise and Policy-making: The Intermediary Role of the Public Sphere. *Science and Public Policy* 26 (3): 163–170.

Fischer, Frank. 2000. *Citizens, Experts and the Environment. The Politics of Local Knowledge.* Durham and London: Duke University Press.

Frewer, Lynn, and Brian Salter. 2002. Public Attitudes, Scientific Advice and the Politics of Regulatory Policy: The Case of BSE. *Science and Public Policy* 29 (2): 137–145.

Fuller, Steve. 2000. *The Governance of Science.* Buckingham & Philadelphia: Open University Press.

Funtowicz, Silvio O., and Jerome R. Ravetz. 1992. Three Types of Risk Assessment and the Emergence of Post-Normal Science. In *Social Theories of Risk,* edited by Sheldon Krimsky and Daniel Golding. London: Praeger.

Gaffaney, Timothy J. 2001. Philosopher Citizen and Scientific Experts. Paper presented at the Annual Meeting of American Political Science Association, San Francisco, August 30–September 2.

Gallopin, Gilberto, Silvio O. Funtowicz, Martin O'Connor, and Jerome Ravetz. 2001. Science for the Twenty-First Century: From Social Contract to Scientific Core. *International Journal for Social Science* 168: 219–229.

Gieryn, Thomas. 1995. Boundaries of Science. In *Handbook of Science and Technology Studies,* edited by Sheila Jasanoff, Gerald E. Markle, James C. Petersen and Trevor Pinch. Thousands Oaks/London/ New Dehli: Sage Publications.

Guston, David H. 2001. Boundary Organizations in Environmental Policy and Science. An Introduction. *Science, Technology and Human Values* 26: 399–408.

Haas, Peter. 1989. *Saving the Mediterranean.* New York: Colombia University Press.

_____. 1992. Introduction: Epistemic Communities and International Policy Coordination. *International Organization* 46 (1): 1–35.

Haraway, Donna. 1996. Situated Knowledges: The Science Question in Feminism and the Privilege of a Partial Perspective. In *Feminism and Science,* edited by Evelyn Fox Keller and Helen Longino. Oxford and New York: Oxford University Press.

Harding, Sandra. 1998. *Is Science Multi-Cultural? Postcolonialisms, Feminisms, and Epistemologies.* Bloomington and Indianapolis: Indiana University Press.

_____. 2000. Should Philosophies of Science Encode Democratic Ideals? In *Science, Technology and Democracy,* edited by D. L. Kleinmann. Albany: State University of New York Press.

International Council for Science. 2002a. ICSU Series on Science for Sustainable Development No. 4: Science, Traditional Knowledge and Sustainable Development. ICSU.

_____. 2002b. ICSU Series on Science and Technology for Sustainable Development no. 9: Science and Technology for Sustainable Development. ICSU.

Irwin, Allan. 1995. *Citizen Science. A Study of People, Expertise and Sustainable Development.* London and New York: Routledge.

Jasanoff, Sheila. 1990. *The Fifth Branch: Science Advisers as Policymakers.* Cambridge, MA: Harvard University Press.

Kates, Robert, et al. 2000a. Sustainability Science. Research and Assessment System for Sustainability Program Discussion Paper 2000–33. Belfer Center for Science and International Affairs, Kennedy School of Government, Cambridge, MA.

_____, et al. 2000b. Sustainability Science. *Science* 292: 641–645.

Kleinmann, Daniel, ed. 2000. *Science, Technology and Democracy.* Albany: State University of New York.

Levidow, Les, and Claire Marris. 2001. Science and Governance in Europe: Lessons from the Case of Agricultural Biotechnology. *Science and Public Policy* 28 (5): 345–360.

Litfin, Karen. 1995. Framing Science: Precautionary Discourse and the Ozone Treaties. *Millenium* 24 (2): 251–277.

Miller, Clark A. 2001a. Hybrid Management: Boundary Organizations, Science Policy, and Environmental Governance in the Climate Regime. *Science, Technology and Human Values* 26: 478–500.

_____. 2001b. Challenges in the Application of Science to Global Affairs: Contingency, Trust and Moral Order. In *Changing the Atmosphere. Expert Knowledge and Environmental Governance,* edited by Clark A. Miller and Paul N. Edwards. Cambridge, MA: MIT Press.

Miller, Clark A., and Paul N. Edwards. 2001a. *Changing the Atmosphere. Expert Knowledge and Environmental Governance.* Cambridge, MA: MIT Press.

_____. 2001b. Introduction: The Globalization of Climate Science and Climate Politics. In *Changing the Atmosphere: Expert Knowledge and Environmental Governance,* edited by Clark A. Miller and Paul A. Edwards. Cambridge, MA: MIT Press.

Rutgers, M. R., and M. Metzel. 1999. Scientific Expertise and Public Policy: Resolving Paradoxes? *Science and Public Policy* 26 (3): 146–150.

Sarewitz, Daniel. 2000. Human Well-being and Federal Science. What's the Connection? In *Science, Technology and Democracy,* edited by Daniel Kleinmann. Albany: State University of New York Press.

Saward, Michael. 1993. Green Democracy? In *The Politics of Nature. Explorations in Green Political Theory,* edited by Andrew Dobson and Paul Lucardie. London and New York: Routledge.

VanDeveer, Stacy D. 1998. European Politics with a Scientific Face: Transition Countries, International Environmental Assessment, and Long-Range Transboundary Air Pollution. ENEP Discussion Paper E-98–9, Kennedy School of Government, Harvard University.

Walker, Robert B. J. 1993. *Inside/Outside. International Relations as Political Theory.* Cambridge: Cambridge University Press.

Weale, Albert. 2001. Scientific Advice, Democratic Responsiveness and Public Policy. *Science and Public Policy* 28 (6): 413–422.

Wynne, Brian. 1994. Scientific Knowledge and the Global Environment. In *Social Theory and the Global Environment,* edited by Michael Redclift and Ted Benton. London and New York: Routledge.

Young, Oran, ed. 1997. *Global Governance: Drawing Insights from the Environmental Experience.* Cambridge, MA: MIT Press.

_____. 1999. *The Effectiveness of International Environmental Regimes. Causal Connections and Behavioral Mechanisms.* Cambridge, MA: MIT Press.