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Usable environmental knowledge from the perspective of decision-making: the logics of consequentiality, appropriateness, and meaningfulness

Art Dewulf[a], Nicole Klenk[b], Carina Wyborn[c], Maria Carmen Lemos[d]

[a] Public Administration and Policy Group, Wageningen University and Research, Hollandseweg 1, 6706KN Wageningen, The Netherlands, art.dewulf@wur.nl (corresponding author)

[b] University of Toronto, Departments Physical and Environmental sciences and Political science, 1065 Military Road, Toronto, Ontario, Canada, M1C1A4, nicole.klenk@utoronto.ca

[c] Luc Hoffmann Institute, IUCN Conservation Centre, Rue Mauverney 28, 1196 Gland, Switzerland; Department of Society and Conservation, University of Montana, 32 Campus Drive, Missoula MT, 59801, USA, cwyborn@wwfint.org

[d] School for Environment and Sustainability, University of Michigan, Ann Arbor, MI, 48103, USA, lemos@umich.edu

Abstract

Environmental knowledge is a critical input for public and private decision-making, yet often useful environmental knowledge appears to be unusable for decision-makers. To better understand how usable knowledge can be produced, we need to build on a better understanding of decision-making processes. We distinguish three different logics of decision-making and discuss their implications for knowledge use: (1) the logic of consequentiality, rooted in theories of rational choice, in which environmental knowledge is used because of its utilitarian value; (2) the logic of appropriateness, rooted in institutional theories, in which environmental knowledge is used because it fits existing rules and routines; and (3) the logic of meaningfulness, rooted in theories of sensemaking and interpretation, in which environmental knowledge is used because it makes sense to decision-makers. The theory and practice of environmental knowledge (co-)production can profit from considering these different logics of decision-making.

Keywords

environmental knowledge use; decision-making logics; usable knowledge; sensemaking

1. Introduction

In the quest for environmental knowledge that is not just potentially useful but actually usable [1,2] or actionable [3–5] for decision-makers, a range of different approaches have been developed by scholars and practitioners, including co-production [6–9], transdisciplinarity [10–12], and citizen science [13–15]. While these approaches are built on in-depth understanding of environmental knowledge making [16], they are not always based on a thorough understanding of environmental decision-making processes and contexts [17]. Moreover they tend to scope knowledge within a narrow pathway from production to use rather than the more disconnected and disperse landscape of knowledge, ideas and use that happens when producers and users of knowledge do not interact with each other. For example, in the multiple streams model of decision-making [18–20], problems, solutions and participants are disconnected and may only get together when at the right time a choice opportunity emerges for decision-makers. Indeed, scholars in organization science, management science, economics, policy science, public administration, and political science have studied individual, organizational and governmental decision-making for decades [21] but relatively little of this interdisciplinary field has influenced current scholarship on actionable knowledge.

In this review we argue that insights from this vast literature can critically inform both theories and the practice of actionable knowledge making. Public administration and policy scholars have distinguished two logics of decision-making [22–24]. The first one is the *logic of consequentiality*, according to which decisions are made based on the expected consequences of decision options in terms of a given set of preferences. For example, climate-savvy city planners may expect to be better prepared for the impact of climate change if they create and implement a climate adaptation plan [25]. The second one is the *logic of appropriateness*, according to which decisions are guided by institutionalized rules that prescribe what needs to be done by particular people in particular situations. For example, water managers in three US regions often underplay the role of climate information in their planning given their strong professional routines and tight regulatory context surrounding drinking water supply [26]. While these two logics are essential in understanding the use of environmental knowledge in decision making, we argue that there is a need for a third decision-making logic, namely the *logic of meaningfulness [27]*, which considers at its core, the ideas of sensemaking and interpretation. Decision-making here is guided by how decision-makers make sense and interpret the meaning of a decision problem, its context and the decision options. For example, in the Netherlands between 2007 and 2010, a substantial decrease in the relative importance of climate change as a meaningful concept in policy circles went along with decreased interest in climate science and reliance on moderate rather then extreme climate change scenarios [28].

In the next sections, we briefly discuss each of the logics and their implications for knowledge production and use, based on recent literature. Each logic is build on different assumptions about human decision-making, with consequentiality reflecting an instrumentalist perspective or the *homo economicus* [29,30], appropriateness reflecting a institutionalist perspective or the *homo sociologicus* [29], and meaningfulness reflecting an interpretivist perspective or the *homo semioticus [31,32]*. As such, each of the logics represents a body of knowledge about decision-making processes, and understands decision-making as guided by a different set of questions (see Table 1) [22]. Considering these three logics of decision-making in inquiries into the use of environmental knowledge in

decision-making may lead to pursuing different research questions, identifying different mechanisms of knowledge use, and providing alternative explanations of success and failure.

Table 1. Key questions in three logics of decision-making

Logic of consequentiality	Logic of appropriateness	Logic of meaningfulness
What are the decision options? What are my preferences? What are the consequences of the alternatives for my preferences? Choose the decision option that has the best consequences	What kind of situation is this? What kind of role do I have in the situation? Which rules apply to this decision? Choose the decision option that is most appropriate	What is going on here? Who can I interact with to discover what the situation means? Which interpretation of the situation makes most sense? Choose the decision option that is most meaningful

2. The logic of consequentiality: is the knowledge consequential?

Many attempts to foster the use of environmental knowledge in decision-making subscribe to the logic of consequentiality, conceiving decisions as rational choices [22,33–35]. The assumption here is that decisions are taken based on the anticipation of the future effects of current actions, and that alternative decision options are evaluated in terms of their expected consequences [22]. Early on, the assumptions of rational choice theories have been challenged by studies of real-world decision making [33,36], where not all alternatives are known and where there is uncertainty about their consequences. Moreover, decision makers do not have the time to consider all the possible consequences, have incomplete and inconsistent goals, and satisfice rather than maximize [22,37]. As a result, rational-synoptic [38] or rational-comprehensive [39] approaches have given way to theories of bounded rationality [40], portrayed decision-makers as operating under more or less severe constraints, but still intending to make rational decisions guided by the expected consequences of decision options. For example, deciding about water conservation measures in the Peruvian highlands can be guided by a cost-benefit analysis of the expected consequences for upstream and downstream stakeholders [41,42].

In this logic, scientific knowledge is supposed to provide a more comprehensive list of decision options, better estimates of the consequences of decision options, and/or more sophisticated ways of valuing the options in terms of the preferences of decision-makers and potentially a larger group of stakeholders. The continued relevant of this decision-making logic is evident in approaches like environmental cost-benefit analysis [43], evidence-based policy [44,45] and ecosystem service valuation [46,47]. Whether an organization utilizes

information or not stems from the perceived utility of information [48–50]; how it fits decision contexts [51,52] and of the characteristics of knowledge itself in terms of credibility and salience [53]. However, working from the assumptions of the logic of consequentiality alone makes it difficult to understand why environmental knowledge that is ostensibly useful in terms of enhancing the knowledge base about options and consequences for certain decisions, often fails to be usable for decision-makers [54–56].

3. The logic of appropriateness: is the knowledge appropriate?

Taking into account the logic of appropriateness allows us to understand how knowledge use is affected by the formal and informal rules and norms that guide decision-making processes [57–59]. Particularly in well-structured decision situations, a combination formal and informal rules may preclude the uptake of new information because there is no way to fit it into existing rules, or because bringing new knowledge in well-established decision contexts can be perceived as negative [26,51]. Hence, the decision-making logic of appropriateness takes an institutional perspective [29,60,61] and assumes that decision-makers act according to what they consider to be appropriate in their specific role and situation.

Theories that regard decisions not so much as intendedly rational choices but as rule-based actions [22,60,62] pay much more attention to organizational routines and institutionalized rules as drivers of decision-making. A complex mix of regulations, standard operating procedures, professional standards, cultural norms and/or informal rules guides the choices of decision-makers [36]. Decision-making in the logic of appropriateness revolves around rules, obligations and what others expect from decision-makers in particular situations. For example, deciding about water conservation measures in the Peruvian highlands can be guided by a new national rule that water utilities have to invest in benefit-sharing mechanisms with highland communities [41,42].

Empirical research focusing on the usability of climate information in urban adaptation in the UK and Germany has shown that that climate information use is critically influenced by the broader institutional and regulatory environment in each country [63]. A study of climate information use by water managers in two river basins in the Great Lakes region of the US identified lack of a strong regulatory signal as a main barrier to climate information uptake [64]. At the organizational level, rules and norms influence an organizations' capacity to absorb new information [65]. Whether an organization uses information or not stems from the organizational attitude towards using new and, in particular, external information [48,66], and from how new information interplays with other information already in use [62]. The use of knowledge by organizations and individuals is influenced by institutional "rules of the game", such as incentive systems, regulatory frameworks, or informal rules and social expectations [2,67]. These rules shape what questions are asked, what methods are used, and how knowledge is generated, shared, and used, in the broader context of knowledge governance [68].

4. The logic of meaningfulness: is the knowledge meaningful?

In more complex decision-making situations characterized by uncertainty (incomplete knowledge) and ambiguity (conflicting views), clarity about the consequences or

appropriateness of decisions options is usually lacking [69,70]. Ambiguity can be understood as “the simultaneous presence of multiple valid, and sometimes conflicting, ways of framing a problem” (p. 78) [70]. What exactly is the problem remains vague and constantly shifts, due to fluid participation, problematic preferences and unclear technology [71]. Interpretive policy analysts interested in decision-making have stressed that ambiguity is not always a nuisance for decision-makers – vague and ambiguous goals can unite different groups who otherwise would disagree on specifics [72]. Defining decision problems, listing alternative options and evaluating them are highly amenable to interactional framing [73], through which the meaning of the decision is negotiated between the key players in the decision-making process. Decision-making in collaborative settings depends on connecting frames [74,75], while in competitive settings decision-makers strategically manipulate ambiguity by employing labels and symbols that affect meaning, highlighting one dimension of the problem over others [20]. Providing meaning and clarity in a world replete with ambiguity and problematic preferences is a powerful political tool. Decision-making, then, is often more like a struggle over meaningfulness than like an orderly process of assessing consequences or following rules.

To understand decision-making and knowledge use in these circumstances, we argue for a third logic of decision-making, namely the logic of meaningfulness. This logic builds on sensemaking theory [76,77], where the emphasis is on how people make sense of complex situations through acting in those situations and constructing what the meaning of the situation might be, usually through interacting with others. Here, decisions become strongly driven by how the decision-makers make sense of the decision problems in terms of what the decision is really about, what it means, and what the meaningful options are. For example, deciding about water conservation measures in the Peruvian highlands can be guided by the meaning of highlands as sources of water for cities downstream, their meaning as living space of local communities, or their meaning as hotspots of biodiversity [41,42].

According to the logic of meaningfulness, knowledge use depends on whether new knowledge fits with the frames of decision-makers or provides a meaningful new perspective. When environmental knowledge gets implicated in policy controversies [78], knowledge use seems to be driven strongly by what is considered meaningful by decision-makers. For example, in a controversy about the necessity of a policy for managing eel populations in the Netherlands [79], the national government leaned towards the “fishery sector is not the main cause” view, and did not rely on scientific knowledge on declining eel populations. Interestingly, at a later point decision-makers at the EU level who were sympathetic to the “closed fishing season is the best solution” view did take these numbers very seriously and enforced EU regulation that required member states to draw up eel management plans [79]. It is also difficult to understand why certain governments or administrations rely on climate science in their policy development, and why others do not, when only consequentiality and appropriateness logics are considered [28,64]. Climate change is such an all-encompassing policy issue that polarized political and ideological frames on how to address it seem to drive what people accept or reject as relevant scientific knowledge [80–83]. Sensemaking is not a neutral activity but a political process in which meanings are promoted, contested, and negotiated [84,85]. The use of particular types of information may itself take on specific meanings for decision-makers. For example, water

managers may perceive using climate information as a sign of weakness because it communicates to consumers the potential vulnerability of the water supply system [62].

5. Discussion and conclusion

A fuller understanding of environmental knowledge use in decision-making requires insight into the different logics that guide decision-making. The rational choice assumptions that underpin much of the thinking about policy-relevant environmental knowledge provide an important but narrow view on decision-making. Complementing this logic of consequentiality with insights from the logic of appropriateness increases our understanding of the institutional drivers of environmental knowledge use. We have argued that adding the logic of meaningfulness is necessary to understand how sensemaking, meaning and interpretation drive environmental knowledge use, particularly in decision-making contexts characterized by uncertainty and ambiguity.

When scientists leave the ivory tower and interact more closely with a variety of societal actors, the opportunities to generate knowledge that is highly meaningful to those actors multiply [86]. Creating meaning can be for example, through engaging on a dialogue about the role of knowledge in solving problems, or exploring different ways knowledge can foster meaningful change. At the same time, there is no neutral ground anymore: conflicting frames and ideological divides might lead to controversies about the very knowledge that is being produced. Therefore, reflecting about the frames [87] implied by environmental knowledge and dealing with controversy also becomes part and parcel of the knowledge creation enterprise.

The decision-making logic of meaningfulness requires decision-makers, scientists and practitioners to become responsive to and take responsibility for meaning making in science-policy interfaces. To do this requires skills in discerning what matters to whom, to what extent, in what manner, in particular problematic situations [88]; being responsive to the differences that punctuate our tidy methodologies, objectives and normative programmes [89]; and, evaluating the impacts of science in addressing complex problematic situations [90]. Meaningfulness is not an automatic outcome of science-policy encounters nor of transdisciplinary research involving stakeholders. Rather, meaning is an achievement. Conditions of success are hard to know in advance, because addressing the question of meaning, participants encounter obligations, constraints, claims and demands that influence and compose their roles, institutional norms and objectives. For science-policy scholars and practitioners looking for a clear, predictive and generally application formalization of the conditions of success in producing knowledge and meaning that is actionable in any and all science-policy interfaces, the logic of meaningfulness may be disappointing. Yet the path of sensemaking as an approach to decision-making in the context of complex environmental problems offers a promising trajectory in environmental knowledge production and use.

Conflict of interest

None declared.

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Annotated references

* 2. This overview paper distills lessons for people aiming to produce usable knowledge for sustainable development. They need to know about innovations systems, complex systems, political systems and adaptive systems, and they need to build capacity for knowledge governance, stakeholder collaboration, social learning and researcher training.

* 7. Based on review of published case studies, this identifies broad factors that inhibit or facilitate the co-production of environmental knowledge, highlight specific practices, and identifies necessary competencies for undertaking co-production.

* 16. This paper reviews the theoretical foundations of different disciplinary approaches to co-production and find enough convergence for strong conceptual foundation.

* 34. This paper discusses the need to consider both ‘rational’ and ‘irrational’ choice, the importance of multiple theories to portray the multifaceted nature of complex contexts, and advocates the combination of applied and basic research.

* 39. This analysis of water governance in central Peru shows how differently framed policy storylines (‘urbanshed’-level investment in water supply infrastructure, community-level cultural restoration for improved local agricultural production, or nationwide watershed-level financial mechanisms for highland ecosystem conservation) intersect and generate momentum for conservation-based watershed investments.

* 60. This paper analyses the impact of institutional context on the use of climate change projections by local governments in England and Germany, and find that there is little demand for climate projections in local adaptation planning due existing policy, legal and regulatory frameworks.

* 77. This paper finds that despite tailored climate information availability, actual use by resource managers remains low, because of perceptions of climate change as politically risky, lack of formal mandates to use information, problems with the information itself and lack of demand by managers.

* 80. This paper examines the way empirical findings are translated into political knowledge in the context of the post-truth debate, and illustrates these points with the case of climate change denial.

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