Three crucial considerations when presenting alternative paradigms in sustainability research

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Abstract
Sustainability science (SS) is a diverse field of problem-driven and solution-oriented research that is still developing. The further maturation of the field relies on its practitioners formulating alternative paradigms to use-inspired knowledge production to facilitate comparison and reasoned judgment on what constitutes scientific best practices. In this short article, we flag several blind spots that can arise in attempts to articulate potential paradigms in SS. We identify and discuss three crucial components that should be included when constructing and presenting potential paradigms in the field, namely the necessity of 1) comparing suggested alternatives with available competitors, 2) preserving scientific integrity in scientific knowledge production, and 3) clarifying the particular contribution of scientific knowledge to social change. Keeping sight of these three important issues will allow the still developing field of SS to mature in a way that builds on scientific comparison and reasoned judgment among the field’s practitioners, with implications for advancing its research agenda. The issues we outline here should not only concern authors, but reviewers and editors of SS journals as well.

Keywords Sustainability science · Action-oriented research · Scientific knowledge production · Competing paradigms

Introduction: Sustainability science—a still developing field
Sustainability science (SS), broadly defined, is at its core a problem-driven and use-inspired field, located in what Clark and Dickson (2003) called “Pasteur’s quadrant” due to its dual emphasis on knowledge and practice. As such, its many researchers from diverse disciplinary traditions should be able to provide solution-oriented approaches to scientific knowledge production relevant to the problems faced by its wide audience. Beyond its overarching commitments to advancing sustainability, however, SS is a still developing field largely characterized by diversity rather than consensus, with a variety of unresolved tensions (Clark and Harley 2020). While diversity in perspectives is a strength not only in SS, but any branch of science, the likelihood of clashes arising between theoretically and practically incompatible approaches requires that researchers rationally judge between available options. This implies that the presentation of components of a particular approach to research needs to be done in such a way that facilitates scientific comparison and reasoned judgment between alternatives, including assessment of their practical efficacy, in arguing for what constitutes the “best available approaches.” In this short article, our objective is to flag problems with the way alternative approaches to scientific practice are being presented by some sustainability researchers, which we argue can hamper this kind of fruitful scientific comparison. From this, we argue that attempts to set forth a potential paradigm in SS need to fulfill at least three basic criteria: 1) compare the suggested alternative with available competitors, 2) ensure the preservation of scientific integrity in scientific knowledge production and 3) specify the particular contribution of scientific knowledge in processes of social change. It is our position that these considerations, while not exhaustive, are indeed fundamental for SS since, following Lakatos (1978), the maturation of SS like any research field in the making depends on the coalescence of a diversity of competing research paradigms (or research programmes in Lakatos’ terminology).
Discussion: Presenting alternative paradigms—three key considerations

We fully appreciate any researcher or research team that put the time and effort into articulating and defending their preferred approach to conducting SS to others, and see this as a fruitful exercise across the field, and encourage others to follow suit. Here, we are primarily concerned with how paradigms (as potential approaches to scientific knowledge production) should be presented to other researchers, rather than with the specific content of any given paradigm per se. We put forward our ideas vis-à-vis a recent prominent contribution (i.e., Caniglia et al. 2021) which we see as representing an important step forward in the SS literature in its attempt to explicitly establish a coherent research paradigm, while at the same time exhibiting the typical shortcomings that come with neglecting the concerns we discuss below.

Compare with competing alternatives

First, the pursuit of scientific best practices requires that researchers advance potential research paradigms in dialogue with other competing approaches, not in isolation nor resting on tendentious framings of the field that may obfuscate respective comparative (dis)advantages. This would entail for example an honest appraisal of other available and relevant alternatives, and a reasoned motivation for the preference of the promoted approach in contrast. While preference for a particular approach can be motivated in relation to any number of criteria, we would argue that the way researchers purport to handle persistent, cross-cutting tensions faced by all of the field’s practitioners may provide the most useful dividing lines between competing paradigms. These include, for example, differences in interdisciplinary practice regarding why and how to incorporate knowledge from various scientific disciplines, as well as differences in how to justify the normative values deemed relevant to SS, both which come with important methodological implications (Boda and Faran 2018; Boda, 2021).

The confusion that can arise from not engaging in this kind of direct comparison can be exemplified in the recent perspective by Caniglia et al. (2021), where they present what they call an “integrated and pluralistic” approach for conducting action-oriented SS. Rather than explicitly engaging in comparison with other approaches, the authors simply assert that action-oriented SS is “commonly situated within Mode 2 and post-normal framings” of science with roots in “pragmatist philosophy,” while other modes of scientific knowledge production, which they reduce to “technocratic or linear understandings of how to create change” are brushed aside as “not adequate.” While the authors imply consensus on the field, it is perhaps telling that such “post-normal,” “Mode-2” and “pragmatist” framings are not directly included in the most recent, authoritative review of prominent influences in SS (see Clark and Harley 2020, p. 359), illustrating the lack of consensus regarding what is considered core to SS (see also Thorén and Breian 2016).

In order to ground scientific preferences in a context of non-consensus, researchers must compare their approach with others, and motivate why and how it is better, with empirical evidence and/or theoretical reasoning. This is especially the case when the approach being promoted emerged only very recently in the history of science. It has been well-known, at least since Kuhn, that there are competing paradigms in different branches of science, both in the “hard” sciences (e.g., Physics) and interdisciplinary scientific fields (e.g., Development Studies, Feminist Studies). The fact that many ideas being adopted by SS practitioners are so novel in the history of science, including ideas of “post-normal” science and “transdisciplinarity,” makes comparing such approaches with historically established paradigms even more crucial.

While we recognize that, given the breadth of diverse influences in the SS field, a systematic comparison with all available alternatives may not be feasible in the space of a single article, comparison should be made at very least with the most proximate or dominant competitor in relation to the approach being advanced. For example, Harnesk and Isgren (2021) explicitly frame their suggested approach to action-oriented SS in relation to the increasingly prominent alternative of transdisciplinary co-production, and by means of such comparison clarify how their approach differs from this competitor in terms of positioning within the philosophy of science and how they differently address questions of normativity and interdisciplinarity in research practice (i.e., methodology).

As we see it, comparison is necessary to maintain clarity regarding the substantive differences between competing approaches, which is what allows for the transparent and rational evaluation of the adequacy of how they conceptualize problems and the efficacy of resulting solutions produced within a particular paradigm. It is worth noting, for example, that sympathetic reviews of the kind of transdisciplinarity/co-production advocated by an increasing number of SS practitioners show how they often fail to produce the intended results (Polk, 2014; Turnhout et al. 2020). We would also argue that the same necessity of comparison and reasoned justification also extends to interdisciplinary practice in SS, such as in the rational selection and application of specific disciplinary concepts.
in SS research (Boda and Faran 2019; see also Olsson and Jerneck 2018).

Preserving scientific integrity in scientific knowledge production

Second, scientists must ensure the scientific integrity of their proposed approaches to research, particularly when such approaches have explicit normative ambitions. Indeed, it is incumbent upon researchers to be clear about how they manage to maintain scientific integrity when producing normative, action-oriented scientific knowledge, or risk undermining the credibility of SS as a science (Boda, 2021; Nagatsu et al. 2020; Schneider et al. 2019; Boda and Faran 2018).

Take for example the following comparison. Isgren et al. (2019) argue that scientific knowledge of, e.g., social and economic systems can be very useful and actionable for political movements, and producing this knowledge and thus contributing to such movements does not necessarily entail any violation of the scientific principle of objectivity, by which we mean communicable, demonstrable and replicable knowledge (not perfect or absolute, and certainly not “value-free”). Caniglia et al. (2021), on the other hand, present what they call “multiple knowledges” they consider relevant to action-oriented SS, but neglect the most important divide in the context of scientific practice, explicitly made by Isgren et al. (2019), namely that between scientific knowledge and extra-scientific knowledge (experiential, situated, indigenous etc.), a.k.a. the demarcation problem. In fact, Caniglia et al.’s (2021) claim that action-oriented SS in general “rejects the idea that knowledge is first generated through research and then translated or disseminated into society” and that it instead should “emerge from entangled processes of action, learning and capacity building through co-production and transdisciplinary involvement of multiple societal actors” (94) seems to abandon any attempt to produce specifically scientific knowledge itself. However, the inclusion of “multiple societal actors” in actionable scientific knowledge production does not require the complete abandonment of scientific principles, but may include, e.g., the adoption of additional extra-scientific quality criteria like “salience, legitimacy and credibility,” as seen in the large body of research on “boundary work” in SS (e.g., Clark et al. 2016a, 2016b; van Noordwijk et al. 2011). Attempting to produce scientific knowledge that is useful for solving problems still requires that the researcher(s) be able to justify how their value-laden scientific practice follows, for example, the methodology of scientific research programmes (Lakatos), principles of falsifiability (Popper), or any other criteria presented by philosophers of science when designating knowledg as specifically scientific (see Nagatsu et al. 2020; Boda, 2021).

To be clear, we are not rejecting the possibility or desirability of bringing different kinds of knowledge together to understand and act on sustainability challenges. Our insistence on maintaining clarity regarding what constitutes scientific and extra-scientific knowledge is based in a recognition that these different kinds of knowledge contribute different kinds of insights to processes of social change (see Faran and O’Byrne 2015; Tengö et al. 2014). As mentioned above, science can contribute very meaningful insights on how natural and social systems function and how actors may intervene in them in different ways, and what the potential implications of such interventions might be, all essential knowledge when formulating effective strategies for change (Isgren et al. 2019). However, extra-scientific kinds of knowledge gained, e.g., through contextual lived-experiences and interactions are also essential in the practical pursuit of social change. For example, a scientific analysis of the economic system can help the labor movement understand what kinds of demands are feasible within a certain country, where to target their demands and/or with whom to potentially form alliances. But only the experience of boots-on-the-ground organizers and rank-and-file union members can inform when the right time to call a strike will be (see McAlevey, 2016). Likewise, a scientific analysis of ecosystem processes can help pastoralists articulate demands on what interventions may be conducive to increased pasture availability in the landscape, while only experienced pastoralists know what specific places and functions in the landscape are critical to their specific community (Axelsson-Linkowski et al. 2020). Of course, the question of whom (i.e., which social agent) research should engage with will always arise. The answer to this question is not trivial, but could potentially shape the research agenda and questions around particular societal interests, rather than being derived from processes of rational scientific investigation (see Slater, 2012). Again, there are various ways of reasonably justifying whom scientists will engage and why, e.g., through completely open “stakeholder” dialogues or through scientific analysis itself (the latter being our own position, in line with Harnesk and Isgren 2021); the point is to do so explicitly and with good reason.

If scientists neglect the distinction between scientific and other forms of knowledge, it becomes practically impossible to differentiate between certain kinds of interactive approaches to action-oriented scientific knowledge production and consultancy, community organizing, advocacy campaigns, and other forms of political process. That is to say, not acknowledging the different jurisdictions of scientific and extra-scientific knowledge, and how they interact, risks undermining the unique yet inevitably limited contribution of science with communicable, demonstrable and reproducible (i.e., objective) knowledge. Those engaged in SS must attempt to handle rather than evade the unique challenge
that arises from an avowed solution-orientation; namely how to contribute normative insights without sacrificing scientific integrity (Boda, 2021; Boda and Faran 2018; see also Nagatsu et al. 2020). We are of course aware that there are some post-modern theories of science that deny the possibility of objectivity. We obviously do not adhere to these, but still see them as valid positions to take up. However, if researchers do adhere to such a position, they should say so explicitly and handle the repercussions accordingly.

**Clarify the particular contribution of scientific knowledge to social change**

Finally, building on the second point, we see it as essential to maintain a distinction between how researchers can contribute to social change as *scientific knowledge producers*, and how individuals can participate in political processes as *citizens*. Scientists need to be open and explicit regarding how the scientific knowledge being produced in a given research project or collaboration is meant to contribute to processes of social change, and at what level(s). This includes of course a recognition of the limits of scientific knowledge contributions, particularly in areas where situated, experiential, indigenous, or otherwise extra-scientific knowledge is required. O’Byrne (2020) for example shows how particular scientific knowledge contributions can be made and combined at a variety of organizational levels, from macro-systems critique, to mid-level cultural dynamics, to micro-level processes of social organization. Such analytical insights can be useful (i.e., actionable) for, e.g., social movement organization engaged in alliance building, but they leave open plenty of space for the combined use of extra-scientific forms of knowledge in pursuing particular kinds of change on the ground. It is not to the detriment of science that we maintain a distinction between contributions made as scientists and as citizens, but to recognize the importance and even primacy of extra-scientific political struggle in achieving long-lasting change for sustainability (Smith et al. 2020).

As we see it, researchers that imply scientific institutes should focus less on objective knowledge production and more on, e.g., “attempting to cultivate the relationships and conditions that allow for change to unfold” (Caniglia et al. 2021), lead the mandate for the role of scientists in social change astray. While we agree that it is undesirable for science to attempt to “direct change” (Caniglia et al. 2021), we have argued that scientific knowledge itself can contribute very meaningful, diverse and unique insights to processes of social change. However, the *utilization* of this knowledge in processes of social change, as we see it, occurs in the extra-scientific realm of politics and social interaction. Note that this distinction does not preclude the possibility of science contributing normative insights with implications for political actions and goals (Boda and Faran 2018; cf. Castree, 2019). Whether change is actually achieved is a testament to, among other things, the adequacy of the scientific analysis provided, the appropriateness of the political strategy utilizing the analysis in combination with other relevant extra-scientific knowledge (e.g., tactical experience, etc.), and the form of interaction between scientific institutions and other agents in society more broadly.

To be clear, our point is not about science becoming “too political”; in our view contributing scientific analyses to social movements is no less political than contributing to governments or private industry, and we side with others that actively encourage the former in the face of glaringly inadequate action taken by formal government and private industry to address current social and ecological crises (Isgren et al. 2019; Boda and Jerneck 2019; O’Byrne, 2020; Harnesk and Isgren 2021). The point, rather, is maintaining a *particular* contribution for scientific knowledge specifically. This is important both for holding scientific knowledge producers accountable for their avowed relevance and for maintaining awareness in relation to the centrality of political struggle in processes of social change.

**Concluding remarks:**

SS is a still developing field, with contributions coming from a variety of disciplines across the natural, social and engineering sciences. This diversity is certainly a good thing, and unduly restricting new or otherwise “counter” perspectives will only lead to the impoverishment of SS and its avowed relevance. However, this acceptance and appreciation of the field’s diversity is not diminished by the rational search for “scientific best practices.” While multiple perspectives engage in SS as in any interdisciplinary field, many of these perspectives will be theoretically and practically incompatible, which in turn requires that researchers reasonably judge between available options (with their respective methodologies) rather than assuming they can always be integrated or combined. With the aim of supporting efforts to identify effective approaches among the field’s diversity, we have outlined three important considerations when presenting alternative paradigms to action-oriented knowledge production in SS, i.e., the need to compare with competing paradigms; the need to ensure scientific integrity in scientific knowledge production; and the need to specify the particular contribution of scientific knowledge to processes of social change. We are not claiming that this list of concerns is exhaustive, but they are fundamental. Further, the issues we have outlined here should not only concern authors, but reviewers and editors of SS journals as well.
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