Sustainability Science • Sustainability Science: A guide for researchers

Scope of the Research Guide

William C. Clark¹, Alicia G. Harley²

¹Harvey Brooks Professor of International Science, Public Policy and Human Development;
Director, Sustainability Science Program, Harvard Kennedy School,

²Post-doctoral Fellow, Sustainability Science Program, Harvard Kennedy School; Lecturer in
Environmental Science and Public Policy, Harvard College

Published on: Oct 05, 2020

DOI: 10.21428/f8d85a02.f53b4fd3

License: [Creative Commons Attribution 4.0 International License \(CC-BY 4.0\)](https://creativecommons.org/licenses/by/4.0/)

Cite as: Clark, William C., and Alicia G. Harley. 2020. “Scope of the Research Guide.” In *Sustainability Science: A Guide for Researchers*, edited by Alicia G. Harley and William C. Clark, 1st ed. Retrieved from <https://www.sustainabilityscience.org/pub/qn39vxly>

We present here a guide the central findings and current challenges of sustainability science. Research on sustainable development has grown explosively since the mid-1980s, with the field of sustainability science emerging as a global collaboration network in the early years of this century ([Bettencourt and Kaur 2011](#)). Many reviews, some of which we cite here, have assessed in detail the research on particular parts of the field. Our goal is to complement those focused assessments with a guide that highlights the principle insights that have emerged from sustainability science and their practical implications for the pursuit of the goals of sustainable development. We aim to provide a manageable overview of the field for scholars seeking to locate their work within the broad enterprise of sustainability science or to catch up on important findings in parts that are not their own, or to forge new collaborations across distant parts of this rapidly expanding and evolving enterprise.

1 Sustainable Development

Sustainability science, like agricultural science or health science, is an applied science defined by the practical problems it addresses—specifically, the problem of sustainable development ([Kates 2011](#)). That problem was defined a generation ago by the World Commission on Environment and Development (the Brundtland Commission) in a prescient statement that merits careful rereading today:

“Environment” is where we all live; and “development” is what we all do in attempting to improve our lot within that abode. The two are inseparable.... Humanity has the ability to make development sustainable: to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs ([World Commission on Environment and Development 1987, ix, 8](#)).

Subsequent deliberations in all manner of public forums—from community gatherings to the UN General Assembly—have reaffirmed the Commission’s vision but also expanded it. The challenges of sustainable development today are generally seen in terms that go beyond just meeting basic human needs to embrace a broader vision of sustainability as fairness: enhancing human **well-being**¹ to more equitably meet the needs of both current and future generations ([Stiglitz, Fitoussi, and Durand 2019](#)). Efforts to promote sustainability also increasingly acknowledge that its pursuit should treat humans, in Amartya Sen’s phrase ([Sen, 2013](#)), “not as patients whose interests have to be looked after, but as agents who can do effective things”—who have the freedom and **capacity**² to participate in setting their own sustainability goals and in choosing how to pursue them.

The growing concern for making development sustainable has been a response to tensions implicit in two global trends: rapidly increasing human well-being and rapidly increasing environmental degradation. These two trends, taken together, have come to be the perplexing and alarming characterization of what many are now calling the **Anthropocene System**³. The first global trend, portrayed by Angus Deaton as “*the great escape*” ([Deaton 2013](#)), consists of the unprecedented improvements in human health, knowledge, and material well-being that began in the late 19th century and accelerated especially in the second half of the 20th century. By the dawn of the 21st century, more than 80% of the people on earth had life expectancies higher than those of people in the richest parts of the world as recently as 1950. And the fraction of the world’s population living in absolute poverty was lower than it had ever been. This great escape had certainly left some people and regions behind, resulting in substantial inequalities ([UNDP 2019](#)). By almost any metric, however, human well-being on Earth had never been higher, at least before the outbreak of the SARS-CoV-2 pandemic ([Roser 2019](#)). The second Anthropocene trend, described by John McNeill as “*the great acceleration*,” consists of the increasing magnitude and global extent of human impacts on nature ([McNeill 2016](#)). By the dawn of the 21st century, no corner of the earth’s environment had escaped transformation by human activities. The great acceleration had certainly entailed significant cases of environmental protection and restoration. But its overall thrust showed few signs of abating, as reflected by increasing attention to the planet’s great poisoning by toxic chemicals ([UN Environment 2019](#)), the mass extinction of its biota ([IPBES et al. 2019](#)), and above all its multifaceted climate crises ([IPCC 2018](#)).

The Brundtland Commission warned that what it saw as the present trends of what we now call the Anthropocene System could not be sustained. It also expressed a guarded hope that humanity could still achieve a common future of sustainable development. But how?

2 Sustainability Science

Today’s development pathways are tightly bound up with dominant arrangements of states, markets, firms, and other powerful incumbent interests. Too many of these seem so dedicated to their own self-preservation that they appear unwilling to heed the ubiquitous distress signals of today’s Anthropocene. Indeed, many of these interests seek to block the innovations and rearrangements that are needed to address the crisis of unsustainability. Breaking such blockages so as to enable the serious pursuit of sustainability will almost certainly require a radical restructuring of the politics of the Anthropocene ([Dryzek and Pickering 2018](#)). The role of science in that restructuring has been captured by Amartya Sen in his call for **informed agitation**⁴ ([Sen, 2013](#)). “Agitation” because political mobilization is necessary to tackle the powerful entrenched interests behind a business-as-usual attitude that disproportionately benefits a few people in their here and now at the cost of impoverishing the prospects of the many elsewhere and in the future. “Informed” agitation because in

the absence of scientific understanding it is so easy to waste scarce political muscle on actions that end up having little impact or, like some biofuel mandates, to blunder blindly forward pushing development down even more destructive pathways.

“Sustainability science” is one convenient term for the research community’s contributions to the informed agitation required to address the challenges of sustainable development. The pool of potentially relevant scholarship is vast and rapidly expanding. To bound this Guide, we have (so far) forgone the temptation to sketch a history of sustainability science. We concentrate instead on the most recent work we know that captures the state and frontiers of sustainability science at the dawn of the third decade of the 21st century, relying on those publications we do cite to credit the foundational studies on which current understanding has been built. We focus on the subset of research on sustainable development that seeks to produce generalizable guidance for use in practical problem solving, i.e., that resides in what historian Donald Stokes has termed “Pasteur’s quadrant” ([D. E. Stokes 1997](#)). This means that we give short shrift to the important foundations of sustainability science that were built from curiosity-driven basic research in a variety of disciplines ranging from ecology to economics to history (i.e., work in Stokes’ “Bohr’s quadrant”). An overview of that work is available elsewhere ([Steffen et al. 2020](#)). We also stop short of reviewing the application of sustainability science to solve particular problems in particular contexts (i.e., work in his “Edison’s quadrant”). A taste of that vast body of applications work, ranging from the management of irrigation systems in Nepal to the promotion of energy transitions in Europe can be found in ([SDSN Association 2019](#)).

Even with our drastic bounding of this Guide to contemporary sustainability science centered in Pasteur’s quadrant, there are other questions we could have investigated, other interpretations we could have considered, and other publications we could have cited. Moreover, the field as a whole is growing so (gratifyingly) quickly that any Guide — this one included — will rapidly lose its currency if not regularly updated. As one response to these limitations, we are posting this Research Guide as an open-review, open-access document at <https://sustainabilityscience.org>. We will endeavor to update it as the field and our understanding of it continue to mature. But input and feedback from readers will be vital for making this experiment useful and timely: please join us in the experiment. (See the “About” tab on the web site listed above for more information on the experiment).

3 Organization of the Guide

We begin this Guide with survey of the interdisciplinary research programs that have most shaped understanding of sustainable development over the last several decades. From these programs, we extract a union set of elements (variables) and relationships (interactions) that have proven particularly powerful in illuminating sustainable development in at least some contexts. These, we argue, are plausible candidates for consideration in future work aimed at crafting generalizable theory

and models in sustainability science. We synthesize them in an integrative Framework for Research in Sustainability Science that we hope will help researchers better to communicate and collaborate with one another as the field continues to mature.

In the [Chapter on a Framework for Research](#), we summarize scholarship showing that nature and society in the Anthropocene have become intertwined in a globally interconnected, complex adaptive system. The heterogeneity, nonlinearities, and innovation characterizing that system generate development pathways that cannot, even in principle, be fully predicted in advance. The central implication of this finding, still not as widely appreciated as it should be, is that sustainable development can realistically be pursued only through an iterative strategy that combines thinking through and acting out ([Peçanha Enqvist et al. 2018](#)). That is, effective strategies for the pursuit of sustainability must certainly use science to help identify and create interventions likely to promote sustainability, but must also foster capacities to put those interventions into practice, monitor and evaluate the results, and take corrective action in an iterative and open-ended pursuit of sustainable development. Research has identified six such capacities. We list these in the abstract and table of contents for this Guide and explore what is now known of their character, strengths, and limitations in subsequent chapters.

We conclude with summaries of some of the most useful generalizable knowledge that sustainability science has produced over the last two decades and some of the central challenges the field faces in the years ahead.

Footnotes

1. **Well-being:** an integrating concept of the good life, the constituents of which will vary among people and across time [↵](#)
2. **Capacity:** the intention and the ability to accomplish a task or achieve an outcome [↵](#)
3. **Anthropocene System:** a term for what some call the earth system or world system that better captures the increasingly global and intimate intertwining of nature and society (Wing and Members of the Anthropocene Working Group 2019) [↵](#)
4. **Informed agitation:** the arousing of public concern about an issue, through the means of knowledge sharing, research, and deliberation, for the purpose of bringing about action (Sen 2013) [↵](#)

Citations

1. Bettencourt, L. M. A., and J. Kaur. 2011. “Evolution and Structure of Sustainability Science.” *Proceedings of the National Academy of Sciences* 108 (49): 19540–45.
<https://doi.org/10.1073/pnas.1102712108>. [↵](#)

2. Kates, R. W. 2011. “What Kind of a Science Is Sustainability Science?” *Proceedings of the National Academy of Sciences* 108 (49): 19449–50. <https://doi.org/10.1073/pnas.1116097108>. [↵](#)
3. World Commission on Environment and Development. 1987. *Our Common Future*. [Rev.]. Oxford; New York: Oxford University Press. <http://hollis.harvard.edu/?itemid=%7Clibrary/m/aleph%7C001468050>. [↵](#)
4. Stiglitz, Joseph E., Jean-Paul Fitoussi, and Martine Durand. 2019. *Measuring What Counts: The Global Movement for Well-Being*. New York: The New Press. [↵](#)
5. Sen, Amartya. 2013. “The Ends and Means of Sustainability.” *Journal of Human Development and Capabilities* 14 (1): 6–20. <https://doi.org/10.1080/19452829.2012.747492>. [↵](#)
6. Deaton, Angus. 2013. *The Great Escape: Health, Wealth, and the Origins of Inequality*. Princeton, NJ: Princeton University Press. [↵](#)
7. United Nations Development Programme (UNDP). 2019. “Human Development Report 2019: Beyond Income, beyond Averages, beyond Today: Inequalities in Human Development in the 21st Century.” New York: UNDP. [↵](#)
8. Roser, Max. 2019. *Our World in Data*. 2019. <https://ourworldindata.org/>. [↵](#)
9. McNeill, John Robert. 2016. *The Great Acceleration: An Environmental History of the Anthropocene Since 1945*. Cambridge, MA: Belknap Press of Harvard University Press. [↵](#)
10. United Nations Environment Programme (UNEP). 2019. “Global Chemicals Outlook II: From Legacies to Innovative Solutions: Implementing the 2030 Agenda for Sustainable Development.” Nairobi, Kenya: UNEP. <http://www.unenvironment.org/explore-topics/chemicals-waste/what-we-do/policy-and-governance/global-chemicals-outlook>. [↵](#)
11. IPBES, Sandra Díaz, J Settele, Eduardo Brondízio, H Ngo, M Guèze, J Agard, et al. 2019. “Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.” Bonn, Germany: IPBES secretariat. <https://www.ipbes.net/global-assessment-report-biodiversity-ecosystem-services>. [↵](#)
12. IPCC. 2018. “Global Warming of 1.5°C.” Geneva: World Meteorological Organization/United Nations Environment Program. <http://www.ipcc.ch/report/sr15/>. [↵](#)
13. Dryzek, John S., and Jonathan Pickering. 2018. *The Politics of the Anthropocene*. Oxford: Oxford University Press. <http://www.oxfordscholarship.com.ezp->

prod1.hul.harvard.edu/view/10.1093/oso/9780198809616.001.0001/oso-9780198809616. [↵](#)

14. Stokes, Donald E. 1997. *Pasteur's Quadrant: Basic Science and Technological Innovation*. Washington, DC: Brookings Institution Press. [↵](#)

15. Steffen, Will, Katherine Richardson, Johan Rockström, Hans Joachim Schellnhuber, Opha Pauline Dube, Sébastien Dutreuil, Timothy M. Lenton, and Jane Lubchenco. 2020. "The Emergence and Evolution of Earth System Science." *Nature Reviews Earth & Environment* 1 (1): 54–63. <https://doi.org/10.1038/s43017-019-0005-6>. [↵](#)

16. SDSN Association. 2019. "Sustainable Development Solutions Network." 2019. <https://www.unsdsn.org/>. [↵](#)

17. Peçanha Enqvist, Johan, Simon West, Vanessa A. Masterson, L. Jamila Haider, Uno Svedin, and Maria Tengö. 2018. "Stewardship as a Boundary Object for Sustainability Research: Linking Care, Knowledge and Agency." *Landscape and Urban Planning* 179 (November): 17–37. <https://doi.org/10.1016/j.landurbplan.2018.07.005>. [↵](#)