Summary of Week 2

Sustainability Science and Sustainable Development

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EEB 8990 - Sustainability Science: An Interdisciplinary Introduction

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This summary of the second week of the course *Sustainability Science: An Interdisciplinary Introduction* covers the material of the week, including Chapter One of *Sustainability Science: An Introduction*, key supplemental readings, remarks by chapter author Bill Clark, of Harvard, remarks by Jim Heffernan, of Florida International University, remarks by University of Minnesota student discussants, and responsive themes raised in the questions and online discussions of the students from the seven participating colleges and universities. We focus primarily on the three topics raised, collaboratively, by Jim Heffernan and the University of Minnesota students, which suggest ideas for further development of the chapter and alternative perspectives on the field of sustainability science itself. Finally, we go on to draw connections between the topics discussed during the Week 2 session and later discussions. The summary represents a consensus view of the University of Minnesota student group that took responsibility for presenting a formal response to the material of the second week.

Chapter One and Bill Clark's Remarks

Chapter One discusses the concept of sustainable development, illustrates contemporary challenges in sustainability, traces the roots of science and technology within sustainability science, and sets forth distinguishing characteristics of sustainability science. Starting with the modern definition of sustainable development from the Brundtland Commission, this introductory chapter states that the whole reader will take "a perspective on sustainability that is broad but unabashedly anthropocentric." Three contemporary challenges are briefly set forth, namely: 1) persistent poverty and hunger, framed in terms of agricultural system choices, 2) rising environmental costs associated with economic growth, using the example of China and 3) declining planetary life support systems, broadly understood. The important role of science and technology in sustainability science is explained in terms of international scholarly and diplomatic

organizational successes in prioritizing research on human-environmental intersections. The chapter focuses mostly on the four characteristics that distinguish sustainability science: 1) problem-driven focus on human-environment systems; 2) an integrative approach to understanding complex human-environment interactions; 3) special attention to the cross-scale dimensions of those interactions and 4) boundary-spanning work at the interface of research and practice. Transcending traditional boundaries of basic and applied research, sustainability science is "use inspired basic research" that is responsive to the human agenda of sustainable development.

In his remarks, Bill Clark focused on the distinguishing characteristics of sustainability science, speaking of work across and among disciplines, the need for research on vexing questions spanning human-environment systems - but not addressed adequately by either social or environmental science - and the necessity of building capacity for researchers to integrate core scientific knowledge with practical understandings. Sustainability science exists, he suggested, "because there are some sets of problems in which it is the dynamical interaction... back and forth between humans and environment" which push the problem beyond the framework of other disciplines. It is the subset of human-environment systems dealing with the normative agenda of sustainability that drive the core questions for sustainability science. Sustainability science includes work about interactions, impacts and consequences, driving forces, guidance mechanisms and policy.

Three Topics Raised By Jim Heffernan and University of Minnesota Students

Discussant Jim Heffernan of Florida International University and students from the University of Minnesota responded to Bill Clark's presentation of the chapter by raising three discussion points. These points represent a synthesis of thought and discussion points raised by the Minnesota students and Heffernan:

1. Human well-being as the foundation of sustainability science

Chapter one states that the sustainability science book will take an anthropocentric perspective on sustainability, focusing on "what is, can be, and ought to be the human use of the earth". The response from Jim Heffernan explored some alternatives to anthropocentrism: ecocentrism, biocentrism, or geocentrism. Should standard functioning biogeochemical cycles be preserved as an integral part of the earth system or only insofar as they affect human well-being? As Katie Lundquist discussed in the UMN response and Elizabeth Walker from Harvard highlighted on the discussion board, the gap between ecocentrism and anthropocentrism may not be as large as some perceive; humans are dependent upon ecosystem function for provisioning and regulating ecosystem services. Thus, the anthropocentric view still places high value on ecosystems, and tools like full-cost accounting can help incorporate ecosystem value into human decision-making. Regardless, the stimulating discussion on this topic suggests the book could benefit from further exploring and giving credit to alternative visions of sustainability in the first chapter, even if the rest of the book is "unabashedly anthropocentric".

2. The role of practice in sustainability science and sustainable development

The discussants next discussed the role of practice in sustainability science and sustainable development. The chapter, as summarized by Beth Mercer-Taylor on the discussion board, "describes the dichotomy between 'detached scholarship' and 'engaged practice' ... and suggests that at least in part it is the project of sustainability science to 'span not only disciplines but barriers separating scholars from practitioners.'" Baishali Bakshi from the UMN group discussed how the application of sustainability science and sustainable development is highly scale-dependent (temporal, spatial) and socially-dependent (institutions, cultures, governments, etc.). As such, definitions of sustainability in practice can vary widely, complicating any implementation of sustainability objectives. For example, "economic sustainability" may simply mean maximizing returns to shareholders over time, while the Triple Bottom Line stresses maximizing economic, social, and environmental returns. Marshall and Toffel (2005, UMN supplemental readings) suggest a sustainability hierarchy prioritizing human survival, human health, human rights, and species conservation. Baishali also discussed the Environmental Kuznets Curve, the empirical relationship between economic development and environmental degradation, as an example of sustainable development in practice. Jim Heffernan introduced a modification to Pasteur's quadrant (Fig 1.6), placing "theory-relevant applied research" alongside "use-inspired basic research". This framing suggests that research on the practice of sustainable development can help us better understand sustainability science while use-inspired basic sustainability science can likewise help us better understand the practice of sustainable development.

3. Inter-relationships between sustainability, sustainability science, and sustainable development

The relationship between sustainability science and sustainable development raised many difficult questions. Our various attempts at Venn diagrams to capture the independent and overlapping areas of "ownership" for these two fields demonstrate just how thorny this question is; no clear consensus arose from the discussions of the readings and of the presentations on the relationship. It is tempting to conclude that such "meta-analysis" of what is included within the domains of sustainability science and sustainable development may simply be a frustrating and pointless exercise in "navel-gazing."

Nothing could be farther from the truth, in our view, however. The debate on this topic highlights a critical problem faced by scientists engaged in work that has important societal and political implications. The proponents of a strong and distinct boundary between the science and its application to development echo the more traditional perspective of science seen as strictly empirical in its focus. To put it crudely, scientific objectivity should not be tainted with normative (in Matt Burgess's words "value-laden") agendas and opinions. Lillian Reid Margolin's post succinctly captured this view by noting that "the results of scientific papers are not, and should not be, written in a language that speaks directly to application." Somehow, careful "translation" of the science should serve as a buffer between scientists and policymakers.

In his clarifying comments on his presentation about the relation between sustainability

science and sustainable development, Matt Burgess suggested that the conflicting views of high and low overlap between the science and the development aspects of sustainability can be resolved—but only if the scientists working in the overlap between these fields are "honest" in separating their normative views from their scientific findings. That is only the first step toward what E.O. Wilson has referred to as "consilience." The controversy in Wilson's concept is that there is indeed achievable knowledge about important social and ethical aspects of sustainable development—beyond the "relativist" view that such ethical questions are a matter of subjective opinion.

The knowledge that informs the goals of sustainable development may be just as legitimate as the knowledge that informs our theoretical understanding of ecosystems that support the goal of sustainable development. Both forms of knowledge are fraught with uncertainty. And it is vital that we grapple with their respective (and distinct) uncertainties explicitly. The philosopher Mortimer J. Adler (Adler, M. J., *Adler's Philosophical Dictionary*. Scribner, New York, 1995) describes these two forms of knowledge as "descriptive" and "practical," where the latter refers to philosophical knowledge that informs our actions (such as politics and ethics).

There are at least two dimensions to the relationship between sustainability science and sustainable development, which are easily confounded in the discussion. Seen as two bodies of knowledge, they may overlap a lot. But, in the realm of knowledge versus action, they are quite distinct. Institutions and individuals engaged in action toward sustainable development are very different from those engaged in the pursuit of knowledge about sustainable development.

Conclusions from Week 2

E. O. Wilson speaks of sustainable development as an "end" or a goal. He also refers to it as an ethic. His ethic of sustainable development is the body of practical knowledge that informs the actions we take as a society to achieve the goal of sustainable development. It is in this sense that sustainability science is a "use-inspired", "Pasteur's Quadrant" field of study. Alicia Harley's post in which she presented a diagram of sustainable development as a goal that motivates (and is supported by) sustainability science captures this idea. But, in the dimension of knowledge, sustainable development contains both scientific (descriptive) and political/ethical (practical) knowledge. Implicit in our understanding of sustainable development as a goal is Bill Clark's view of sustainability science as "unabashedly anthropocentric." It is the widespread improvement in quality of life (human well being) that is the main focus of this work.

Going Beyond: Connections to Additional Course Topics

This introductory session served to lay much of the philosophical groundwork for the remainder of the semester: it defined sustainability science as scholarship that has a problem-driven focus on human-environment systems and is also integrative, cross-scale and boundary-spanning in nature; raised questions about the ethical responsibilities of sustainability science; and highlighted the ambiguous relationship between research and

practice. With that as background, over the course of the semester we identified two broad areas in which sessions expanded on those ideas.

1. Connecting philosophical underpinnings to metrics, quantification and methods

Turning the theoretical frameworks of sustainability science into measurable conclusions requires some standardization of methods. What those methods could feasibly look like was a topic touched on throughout the semester, along with what values would be implicitly supported by each methodological option.

The dominant framework that we discussed was using financial methods to value natural capital. Steve Carpenter introduced natural capital and ecosystem services in his Session 5 discussion, "The Environmental Services that Flow from Natural Capital." Carpenter, Patty Balvanera (the moderator) and the UMN student group all pointed out that ecosystem services are still poorly understood and very difficult to quantify, both due to the many scales that have to be considered when estimating the potential value of a given service and the uncertainty surrounding services' resilience in the face of environmental changes.

Despite those concerns, the chapters of the manuscript written by Partha Dasguspta as well as the week 7 ("Human well-being, natural capital and sustainable development") and week 12 sessions ("Metrics for sustainable development"), both given by Steve Polasky, went on to outline shadow pricing, an economic framework that uses monetary estimates to place prices on non-traditional forms of capital – in this instance, natural capital. Tracking shadow prices over time can also, in theory, allow sustainability scientists to conclude whether the CHES system as a whole is non-declining in value – meaning that shadow prices can determine by one measure whether or not human wealth as a global sum is decreasing or not. If we take that measure a step further and presume that human wealth can be an appropriate proxy for human well being, then shadow prices, if calculable, can quantify sustainability and allow sustainability science a direct connection between scholarship and research and practice.

That being said, several major leaps of value-laden logic have to be taken before those sorts of conclusions can be proliferated through academia and the other institutions interested in solving these problems. Whether or not science should or even can make those assumptions is a question that was bandied about during session 2 and continued to be a topic of concern for the remainder of the semester.

2. Role of sustainability science in institution- and CHES-based action

This topic brings us to our second set of connections between session 2 and the subsequent course sessions. Session 2 established that this course would operate under the assumption that sustainability science will be taken for granted as an anthropocentric, use-inspired science. As such, it seems appropriate that institutions be primed to use any results that could further human well being. But how connected should sustainability science and CHES institutions be? Should academia be limited to studying what the

effects of civil society and governance could be or what the potential consequences of those actions might be? Or should sustainability science incorporate the needs of public and private institutions from the outset?

During Session 8, Billie Turner spoke about the potential for CHES tipping points to be distinct from the tipping points scientists might see in ecological systems or social systems alone. These sorts of CHES-related regime shifts could undermine conventional environmental scholarship – for instance, the Environmental Kuznet's curve might suggest that there are not major shocks to the systems being considered, which won't be the case, of course, if a CHES as a whole undergoes a major change. Similarly, Elinor Ostrom emphasized the importance of institutions and how dramatically they can alter or influence sustainable development outcomes. Given the clear importance of institutions and the uncertainty surrounding our understanding of how they might behave in tandem with ecological systems, it seems critical that the sustainability scholarship support institutions. What form that support can take – from full integration on the high end to use-inspired questions and subsequent science outreach on the low end – is a quandary that emerged in session 2 and continued to appear throughout the semester.

Indeed, our group routinely ended conversations this semester by noting that one of the most critical challenges for sustainability science moving forward is what role it's going to embrace: in an interconnected world of cross-scale and boundary-spanning problems and solutions, where sustainability scientists are going to perch is likely going to be an ongoing conversation with an evolving, dynamic answer.

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