

Grand Challenges of Sustainability Science

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Sustainable development

- Defined by the World Commission on Environment & Development (1987)
 - Environment is where we 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.

Grand Challenges?

















The test of our progress is not whether we add more to the abundance of those who have much; it is whether we provide enough for those who have too little.





Why is sustainability important?

- Economic growth without environmental protection
 - Kills the people that development is meant to benefit
 - *Pollution leads to ~100 million years of life lost each year (number of people * years of life lost per person)*
 - Limits our ability to produce essential food and fiber
 - *“Brown clouds” from biomass burning combined with climate change to significantly reduce growth of rice yields in Asia*
 - Undermines economic growth itself...
 - *Pollution and resource degradation cost the median country around 1.5% points of its GNP growth/yr, with more than ¼ of countries losing >5% points of GNP/yr.*
- Mobilizing science to support sustainable development is important because the alternative is an avoidable waste of human life & potential, thus a moral failure.

Sustainability Science ...

- A *field* of ‘use-inspired’ research and innovation, like ‘agricultural science’ ‘health science’;
- *Defined* by the practical problems it addresses, specifically those of sustainable development;
- *Conducted* by drawing from and integrating research from natural, social, medical and engineering sciences, and by combining this with the knowledge of practice;
- Building a *core of scientific understanding* about interacting human-environmental systems...

A progress report

- Gratifying advances in *understanding*
 - Drivers of change in human-environment systems
 - H-E dynamics, including adaptive self-organization
 - Measurement and governance of HES...
- Less in linking resulting knowledge with action
 - The “Grand Challenge” of sustainability science is to radically extend and deepen such linkages...
 - In ways that more effectively advance transitions to sustainability in time, at scale

About *Drivers* of H-E interactions

- Population levels per se are less important in determining environmental pressures than population structure (household size, migration, age structure, divorce rates)
- Attributing emissions to place of consumption assigns responsibilities very differently than focusing on place of production
- Kuznets (economics) isn't fate: policies matter in how increasing wealth changes environmental damages

About *Impacts and Interactions*

- Land changes per se can trigger regional climate changes equal to or in excess of global climate change
- Intensification of agriculture can but often doesn't spare land from degradation
- The greatest environment and health benefits of moving away from fossil fuels are not about climate...
- Tipping points in the earth system are dense, unpredictable... and unlikely to be avoidable through early warning indicators. It follows that...
- "... safe operating spaces" and "planetary boundaries" are thus highly suspect and potentially the new "opiates"

About *Governance, Monitoring*

- One-size-fits-all “panaceas” (privatization, carbon taxes, decentralization) don’t promote sustainability
- Trans-national agreements on environment-development can be effective, but the ones that are generally have limited membership, limited goals, near term benefits...
- Tropical conservation set-asides can also enhance human well being
- Certification schemes have their impact through changing behaviors of producer/retailers, not consumers
- Most partnerships don’t work; we know which (kinds) do.
- Meaningful metrics have been developed for evaluating the sustainability of alternative programs, pathways...

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Linking Knowledge with Action for Sustainability: “Barriers and Bridges...”

- Much lies beyond our immediate control as academics in worlds of politics, economies, and earthquakes...
- However, as ever, much of the fault is not in our stars, but in ourselves...
- In particular, how choose to engage in the 3 core activities of universities and academia:
 - Research, Teaching, and Outreach...

Research: What we choose to study...

- “Interest areas” at this conference (*Resilience, Innovation and Sustainability*):
 - Sustainability 15%
 - Innovation 1%
 - Poverty / Affluence 1%
- “Topics” in *PNAS Sustainability Science*
 - Earth’s life support systems 60%
 - Innovation 5%
 - Poverty / Affluence 4%
- Challenge is to foster more emphasis on “meeting human needs,” not just conserving environment

Teaching: What do our students learn?

- Basic literacy in the challenges of and pathways to sustainable development?
 - Mostly environment? Development?
 - [Readings in Sustainability Science and Technology \(Robert Kates, 2010\) http://tinyurl.com/sustsci-reader](http://tinyurl.com/sustsci-reader)
- Experiential learning about sustainability?
 - Shared methods, cases?
 - [AAAS Survey of University-Based Sustainability Science Programs \(2007\)](http://sustainabilityscience.org/content.html?contentid=1484)
 - <http://sustainabilityscience.org/content.html?contentid=1484>

Outreach: How do we better connect with the world of action?

- Challenge
 - Action toward sustainable development is local / contextual (family, firm, city, region...); much sustainability science is discovered “somewhere else”, aka “global” ...
- Possible models / precedents
 - Innovation-based businesses (eg. Syngenta)
 - For responsible (green?) production of *private* goods
 - Translational medicine partnerships
 - For flexible production of *mixed* (public/private) goods
 - Extension services (land grants; CGIAR)
 - For effective production of necessary *public* goods
 - Land grants, CGIAR; RISAs → (inter)national climate service ??
- The New (American) University?

Grand Challenges of Sustainability Science:

Further Information

- This presentation, appendix and related materials (soon)
 - <http://www.hks.harvard.edu/centers/cid/programs/sustsci/>
- *Reader in Sustainability Science* (key papers - R. Kates ed)
 - <http://tinyurl.com/sustsci-reader>
- *PNAS Sustainability Science* (current research results)
 - <http://www.pnas.org/misc/sustainability.shtml>
- *Annual Review of Environment and Resources* (reviews of core topics in sustainability science)
 - <http://arjournals.annualreviews.org/loi/energy>
- AAAS Forum *Science and Innovation for Sustainable Development* (please join as 'Network member')
 - <http://sustainabilityscience.org>