Sustainability Science and Sustainable Development

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Overview

- 1. Sustainable development and why promoting it requires targeted research
- Sustainability science as a new emerging field of scholarly research, applied to 21st Century challenges of sustainability
- 3. A sample of core research questions now being pursued in sustainability science

1) Origins of "Sustainability" thinking

- Conservationist thinking
 - Sustainable agriculture, "exotic" wildlife
 (1800s) →
- Environmental science thinking
 - Vernadsky's "biosphere and noosphere" (1940s) →
- Development thinking
 - Ghandi's "too much wealth, too much poverty"
 (1972) →

Sustainable development today

- 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."
- Firmly positioned at the "high table" of international affairs by Kofi Annan (2000):
 - "The 3 great challenges of the Millennium are helping the world's peoples to achieve freedom from want, freedom from fear, and the freedom of future generations to sustain their lives on this planet."

What's to be sustained? What's to be developed?

- Nature
 - Earth, biodiversity, ecosystems
- Life support
 - Ecosystem services, resources, environment
- Community
 - Cultures, groups, places

- People
 - Child survival, life expectancy, education, equity, opportunity
- Economy
 - Wealth, productive sectors, consumption
- Society
 - Institutions, social capital, states, regions

Over what period? How linked?

For us... "Sustainable development improves human well-being while conserving the earth's life support systems over the long run..." 5

2) Sustainability Science?

- Effective policies to promote sustainable development require...
 - Enlightened political leadership
 - Engaged civil society
 - Accountable institutions for governance...
- Also needed is appropriate science, technology
 - development "is built not merely through the accumulation of physical capital and human skill, but on a foundation of information, learning and adaptation" (World Bank, 1999)
 - "S&T are increasingly recognized to be central to both the origins of sustainability challenges and to the prospects for successfully dealing with them..." (ICSU, 2002)

- An *emerging field* of 'use-inspired' research and innovation, like 'agricultural science' before it;
- *Defined* by the practical problems it addresses, specifically the problems 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 (strongly) interacting human-environmental systems;
- An exciting *academic career track*, publishing in the best journals (*Nature, Science, PNAS*), growing jobs!

A Field of Use-Inspired Research?

| — 1 | | Considerations of use? | | | | |
|-------------------------------|-----|--------------------------|---------------------------------------|--|--|--|
| Research inspired by | | No | Yes | | | |
| | | "Soaking and | Applied research | | | |
| | No | poking" | (Edison) | | | |
| Quest for | | | | | | |
| fundamental understanding? | Yes | Basic research (Bohr) | Use-inspired research (Pasteur) | | | |
| | | | | | | |

(redrawn from Stokes, 1997)

Dynamically linking knowledge & action



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The Problems Driving Sustainability Science

| | Food | | Biofuels | | | |
|--------|---------|-----------------|-----------------|---------|-------------------|--------|
| ds for | Energy | | | | | |
| an nee | Water | | | | | |
| mud Br | Shelter | | | | | |
| Meetir | Others | | | | | |
| | | Atmo- sphere | Hydro- phere | Climate | Biodiv- ersity | Others |

While preserving life support systems of...

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Interdisciplinary research methods...





... combined with knowledge of practice



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3) Core Scientific Questions of Sustainability Science (Toward a problem-driven understanding of coupled human-environment systems)

Sustainability Goals

Human Systems

Environment Systems

Core Questions of Sustainability Science: An Overview

- Driving forces
 - The origins of "transitions" beyond the demographic
 - Production-consumption relationships
- Impacts / consequences
 - Nature of "limits," thresholds, tipping points
 - Vulnerability of coupled H-E systems to multiple stress
- Policy guidance
 - Incentives for environment-conserving innovation
 - Institutions for governing H-E systems

(Kates et al., 2001, Science)

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4) Building Sustainability Science

- Forum on Science and Innovation for Sustainability
 - Track programs, events, jobs: <u>http://sustainabilityscience.org</u>
 - Join the Network: <u>http://sustsci.aaas.org/joinnetwork.html</u>
- Journals to follow...
 - Comprehensive list on *Forum* (Resources/Journals)
 - Annual Review of Environment & Resources (reviews)
 - Ecology and Society (natural science orientation)
 - Ecological Economics (economics orientation)
 - Global Environmental Change: Human & Policy Dimensions (political science orientation)
 - Proc. National Academy of Sciences / Sustainability Science
 - <u>http://www.pnas.org/misc/sustainability.shtml</u>
 - Special features, Editors' choice, drop down list of all papers