

## **Earth Stewardship: A framework to transform the trajectory of society's relationship to the biosphere**

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*Submitted in response to the National Science Foundation's "Dear Colleague Letter for SBE 2020: Future Research in the Social, Behavioral & Economic Sciences (NSF 10-069)" which invited groups and individuals to submit white papers outlining grand challenge questions to guide strategic planning in NSF's Directorate for the Social, Behavioral, and Economic Sciences.*

**Abstract:** Over the past half-century, human activities have accelerated the rates of climatic change and the degradation of Earth's life-support system. A grand challenge facing humanity is to shift toward a more sustainable relationship between society and the biosphere. More specifically, our grand-challenge question is: **What linkages between environment, human perceptions and actions, and institutional dynamics govern the sustainability of society and the biosphere in a globally coupled social-ecological system?** Addressing this question requires societally relevant fundamental research that advances our understanding of people and nature as a coupled social-ecological system and identifies specific ways in which this understanding can be implemented. We suggest a strategy in which academic societies collaborate through interdisciplinary working groups to develop to a strategic action plan in the following steps: (1) workshops that identify and clarify the critical interdisciplinary questions, (2) engagement of academic-society membership through white papers in key journals and joint symposia, (3) workshops of academics and practitioners to redefine and implement promising strategies, and (4) workshops of academics, practitioners, and educators to develop and disseminate education and communication strategies.

Over the past half-century, human activities have accelerated the rates of climatic change and the degradation of Earth's life-support system. However, at local scales many resource-dependent societies manage resources relatively sustainably for long time periods while others have moved along less sustainable trajectories (Ostrom 2007). A grand challenge facing humanity is how to shift toward a more sustainable relationship between society and the biosphere. This requires societally relevant fundamental research that advances our understanding of people and nature as a coupled social-ecological system and identifies specific ways in which this understanding can be implemented. The goal is to promote an ethic of Earth Stewardship.

A key element of the challenge is that, historically, social-ecological coupling occurred primarily at local scales, with the environmental consequences of human actions affecting resources and people at that scale. Tight local feedbacks allowed learning to occur and enabled people to adjust behavior so as to modify their impacts and to continue to meet their needs, thus perpetuating well-being of the community in some cases. As human-environment interactions

have expanded in scale, many of the key environmental impacts are more distant and/or diffuse, making it increasingly difficult for those who cause impacts to perceive and learn from the consequences of their actions. Eutrophication from midwestern farming, for example, has greater impact on fishermen in the Gulf of Mexico than on the farmers who over-fertilize their crops. Developed nations that emit most carbon dioxide are often less affected by climate change than are marginal developing-nation economies that are more directly tied to local food harvest. This change in scale of the human enterprise requires careful analysis and conceptualization of the linkages that couple people and nature in an increasingly globalized world. In addition to the challenges of distant and diffuse impacts in a globalized world, there are opportunities associated with rapid global information exchange and increased capacity for visualization and communication. This leads to our grand-challenge question: **What linkages between environment, human perceptions and actions, and institutional dynamics govern the sustainability of society and the biosphere in a globally coupled social-ecological system?** In practical terms, this leads to the following question: **How can society transform from a trajectory of environmental degradation and disparity in human well-being to a more sustainable trajectory that provides greater opportunity for present and future generations to meet their needs?**

Addressing this question requires reexamination of the circumstances under which core assumptions of participating disciplines are robust. For example:

- Under what circumstances do individuals and groups of individuals make choices that maximize individual wealth (as contrasted to overall utility or well-being)? More practically, under what conditions will people put their social group ahead of individual welfare, and what factors would encourage them to think of their social group as encompassing larger sets of people and ecosystems? If the latter is not feasible, how are people motivated to care about people in those other groups (including future generations)? Also, at what scales are these decisions functionally important and commonly understood (households, local communities, nations, Earth)? How can social learning influence the answer to these questions?
- What factors influence human perceptions of causal relationships between their actions and ecological consequences at various scales? More practically, how can scientists convey the science of social-ecological linkages in ways that motivate people to engage in behavior that enhances group well-being at various scales (households to the Earth)? What influences the spatial and temporal scales that motivate human behavior?
- What factors influence resilience and adaptation of institutions (patterns of human behavior) to changing conditions? How can globalized information networks inform society about the aggregate global consequences of individual choices in ways that alter human behavior toward more sustainable trajectories? In what ways can information transfer and communication expand the scale of social learning?
- What factors influence the extent to which humans care about the individuals, communities, and natural systems that are most negatively influenced by their choices and behaviors? More practically, what conditions and power relationships allow humans to broaden their circle of care and trust beyond their family or local community?

We suggest a strategy in which academic societies collaborate through interdisciplinary working groups to develop to a strategic action plan to move society toward a more sustainable trajectory between humanity and the biosphere. This will require several steps: (1) workshops

that identify and clarify the interdisciplinary questions that are most critical (e.g., the NRC climate-change roundtable), (2) engagement of members of academic societies through white papers in key journals and through joint symposia in participating societies (e.g., the white paper on the Psychology of Climate Change produced by the American Psychological Association), (3) workshops and meetings that engage academics and practitioners in redefining and implementing promising strategies (e.g., the transition town movement; the Ecological Society conference on water-ecosystem services, drought and environmental justice; guidebooks and training sessions for effective communication), and (4) workshops and meetings that engage academics with practitioners and educators to develop and disseminate education and communication strategies that are effective in conveying appropriate information and concepts to various stakeholders, including students, practitioners, landholders, urban residents, and policy makers (e.g., the Ecology and Education Summit planned by various educational and ecological societies).

This grand-challenge question and associated strategy for study, dialogue, and dissemination build on a breadth of disciplinary and interdisciplinary findings that are often either accepted or highly debated within a discipline but not well recognized among other disciplines that would benefit from this understanding. Here we provide a few examples of disciplinary findings or hypotheses that are actively debated but have important implications for the development of Earth Stewardship.

- Resources held in common are more likely to be used sustainably when the boundaries of the resource system are clearly defined, users are engaged in monitoring and deciding how the resources should be used and receive benefits that are proportional to their efforts and inputs, users can organize to manage resources and resolve conflicts, etc. (Ostrom 2007). (political science)
- Science that is most likely to influence policy must be credible (good science), salient (timely and problem-relevant), and legitimate (unbiased and respectful) (Cash et al. 2003). (sustainability science)
- Despite increases in food production, 60% of Earth's ecosystem services (benefits that society derives from ecosystems) are being degraded in ways that often reduce human well-being (MEA 2005). (ecology)
- Human behavior related to environment is more strongly influenced by local social norms than by economic incentives, guilt, or motivation to do the "right thing". How are influential social norms shaped? (environmental psychology)
- The relative importance of innate vs. learned processes and power dynamics at multiple scales influences the optimal strategy for implementing Earth Stewardship. (political science and psychology).

Development of a science of Earth Stewardship will require the insights and collaborations of many disciplines. These include economics, psychology, sociology, political science, ecology, climate science, information science, geography, education, and philosophy. It will also require engagement of practitioners in fields related to each of these disciplines as well as environmental health, architecture, planning, transportation, agriculture, fisheries, and religious studies. Finally, incorporating these concepts in formal and informal education is essential to implementing Earth Stewardship.

Development of a vigorous research agenda in Earth Stewardship will build upon the above disciplines and provides opportunities to integrate and transform them through intellectual

engagement in questions that require their input but cannot be addressed by any single discipline or pair of disciplines. It also focuses on societally relevant fundamental research that goes beyond the false dichotomy between basic and applied research. Engagement of practitioners in the design and implementation of research will foster a dialogue between users and researchers that should facilitate both research relevance and successful implementation by users.

### **Representative references**

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