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Current Opinion in Environmental Sustainability

National Future Earth platforms as boundary organizations contributing to solutions-oriented global change research

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Increasing international commitment is emerging to harness research to contribute to solving grand societal challenges related to global change. Examples include global research programmes like Future Earth and concerted efforts in the form of the United Nations Sustainable Development Goals. During the last decade and a half, diverse concepts and design principles have also been developed for solutions-oriented sustainability research. However, a number of challenges have emerged related to this new kind of transdisciplinary research. We argue that these challenges, related to, for example, research culture and stakeholder engagement, suitable funding, necessary interaction and communication skills for the researchers and end-users of research, and reward systems, could be addressed in a systematic way by new types of boundary organizations, and that Future Earth has potential to develop its national platforms into such organizations. We propose that these platforms, typically operating under research councils and science academies, have just the right mandate to take on important roles as mediators and facilitators for solutions-oriented global change research. They can create the necessary long-term relationships between academia and society, bring attention to capacity-building needs, and break old disciplinary research structures by promoting a new research culture where stakeholders and scientists find each other around relevant research questions. On a science–policy level, they can bring funders, policymakers, and scientists together to discuss how to overcome the key obstacles in the path of such change. Successful examples of such Future Earth platforms and activities already exist in Europe. Future Earth is in a position to spearhead the transformation of research culture from local to global level.

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Current Opinion in Environmental Sustainability 2016, **23**:63–68

This review comes from a themed issue on **Open issue, part I**

Edited by **Eduardo S Brondizio, Rik Leemans** and **William D Solecki**

Received 15 June 2016; Revised 02 November 2016; Accepted 17 November 2016

http://dx.doi.org/10.1016/j.cosust.2016.11.011

Introduction

Humanity will be facing grand challenges in the future. Archetypes of these challenges include acceleration of climate change, erosion of biodiversity coupled with societies' increasing need for food, fresh water and energy supply. Large-scale scientific assessments have synthesised knowledge with regard to ecosystems (Millennium Ecosystem Assessment, MEA), climate change (Intergovernmental Panel on Climate Change, IPCC) and biodiversity (Intergovernmental Platform on Biodiversity & Ecosystem Services, IPBES). Simultaneously, a renewed commitment in the form of the new sustainable development goals [1] has emerged to promote sustainability. Thus, the discussion of sustainability in the Anthropocene [2] has never been more pertinent. Significant changes are also underway regarding how global change-related research is organized. The new global initiative, Future Earth, has brought together a large part of the existing global change research community and is gradually becoming operational.

Global change research[6] carries connotations of transdisciplinarity[7] and societal relevance with the aim of bringing the two together in a comprehensive process. However, many research communities are not yet familiar with how to engage stakeholders in research and with the sound methodologies for such research. In this review, we explore a range of challenges and success factors for boundary organizations advancing global change research and offer lessons learned on how such research can be co-designed and co-produced in an interactive process with researchers, knowledge users, and other stakeholders. We further supplement the literature with a small number of interviews with key stakeholders within existing national organizations.[8] Ultimately, we propose that the national platforms forming under Future Earth are well suited for advancing such work.

Challenges of solution-oriented sustainability research

The last decade has witnessed increasing call for the policy relevance of the science produced [3] and the emergence of altogether new fields of science to support this development. Transdisciplinary research[7] has increased rapidly but its methodologies and opportunities for solution-oriented sustainability are still relatively poorly understood outside of sustainability science and other related fields [4]. Knowledge exchange on transdisciplinary methodologies between the research communities of sustainability science and global change research has been limited as information has not been easily accessible [5].

In the literature, a variety of methodological and epistemological concepts and design principles have been developed for solutions-oriented and use-inspired sustainability research projects [5–11]. These studies have also considered the necessary competencies for researchers [12], explored the different ways to define effectiveness of science–policy interfaces [13••], and taken strides towards a framework for capturing the societal effects of participatory research [14,15••].

The challenges related to transdisciplinary research attempts outlined in literature are related to both *individual researchers and their skills* and to *institutional/organizational factors*. In terms of the former, sustainability science has evolved from mostly descriptive-analytical towards transformative research that aims at producing knowledge for actionable solutions [5,16,17••,18]. This type of solutions-oriented transformative research introduces new types of roles for the researchers [19]: reflective scientists, knowledge brokers, change agents, process-facilitators and self-reflexives. Scientists have not traditionally held these roles and this means they have to require new skills and new kind of practical and interpersonal expertise not only from researchers but also from the non-academic stakeholders to interact with both academic and non-academic stakeholders [20].

Also, institutional factors inhibit the advance of transdisciplinary research. The narrow financial resource base does not provide for the additional costs incurred by inter-disciplinarity and transdisciplinarity, and educational programmes to support the necessary skills for individual researchers are lacking. Many scientists interested in transdisciplinary research face a risk of losing in academic merit or career opportunities in the absence of innovative institutional support structures, incentives, and reward systems [5,7,10,11,15••,17••,21].

Science–policy boundary organizations as a solution

Boundary organizations have emerged as a potential solution to facilitate the science–policy gap and to support the facilitation of scientific knowledge into action. Boundary organizations are defined as institutionalized arrangements that link science and policy [22]. There are a number of boundary organizations that act in the field of environmental and sustainability research and policy, following different types of arrangements regarding their purpose (convergent vs. divergent) and primacy (science vs. policy) [23••].

In general, these organizations typically involve participants from different social worlds (e.g. policy and science), but often also professionals who serve a mediating role. According to Guston [22], participants on either side of the boundary determine the success of a boundary organization. They expect the boundary organization to

[6] By global change, we mean changes in the societies and the environment occurring and interacting on local, regional, and global scales. Changes take place, for example, in global trade, climate, employment, food–water–energy nexus, technology, cultures and lifestyles, industry, demography, and politics.

[7] By transdisciplinarity, we refer to research crossing disciplinary boundaries and conducted in collaboration with academic and non-academic operators with the aim of solving societally relevant sustainability problems. According to Pohl [33] transdisciplinarity may refer to (1) transcending and integrating disciplinary paradigms in order to address socially relevant issues; (2) including non-academic actors (i.e. participatory research and co-production of knowledge); (3) searching for a unity of knowledge by reorganizing the academic knowledge and by developing a general perspective beyond all disciplines.

[8] We supplement the review of articles with seven interviews of national boundary organizations that are relevant to the issues posed in this review. The interviews were conducted in 2015 and included the following organizations. The interviews were recorded, transcribed and analysed with thematic content analysis. The themes were related to the role of boundary organizations and their role nationally.1. Living with Environmental change (LWEC): network of 20 UK public-sector funders and users of environmental research.2. The Finnish Government's Analysis, Assessment and Research Activities Working Group at the Prime Minister's Office.3. ProClim, Swiss Forum for Climate and Global Change.4. Finnish Expert Panel on Sustainable Development, Sitra.5. BiodivERsA, Horizon2020 ERA-NET CO-FUND network of funders on biodiversity and ecosystem services.6. CGIAR Research Programme on Climate Change, Agriculture, and Food Security (CCAFS).7. Swedish Secretariat for Environmental Earth System Sciences (SSEESS).