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SPECIAL FEATURE: EDITORIAL

Sustainability Science and Implementing the Sustainable Development Goals

Sustainability science and implementing the sustainable development goals

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Introduction

Sustainability science probes interactions between global, social, and human systems, the complex degradation mechanisms of these systems, and the concomitant risks to human well-being. By identifying and addressing complex challenges that are not typically considered in traditional academic disciplines, this transdisciplinary science provides the way forward to a sustainable global society. After the 10-year anniversary of the establishment of *Sustainability Science*, this science can no longer be considered a new discipline. Given this decade of development of the sustainability science approach, now is the right time to consider what has been learned from this scholarly exchange on research and methodologies and to apply this knowledge to the current sustainability challenges and to the attainment of the United Nations Sustainable Development Goals (SDGs) (United Nations 2015).

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SDGs are innovative tools for global governance of sustainability. They differ from the traditional legal approach for addressing global problems, which focuses on the adjustment of national legal systems to meet international agreements and compliance with international law. The SDGs were created through a participatory deliberation process without considering compliance. Rather, the SDGs adopt a new approach, which we refer to as governance through goals (Kanie and Biermann 2017). These goals combine efforts to eradicate poverty and increase the development of poor countries while decreasing the human footprint on the environment. They offer a more inclusive and diverse approach by mobilizing a broad spectrum of actors in both developed and developing countries. Progress toward attainment of the goals will be measured by periodic review of indicators and the application of other qualitative methods that aim to provide incentives for further action. In many countries, serious sustainable development problems dominate policy discussions, but a little progress has been made on complex, global environmental problems such as climate change. Moreover, in many cases, social progress comes at an environmental cost. As the SDGs are not a product of science but rather of politics, understanding the interlinkages between various goals and targets will be a challenging area of research. Thus, the inherent synergies, trade-offs, and complexity of such an effort require that sustainability science informs the development of relevant policies.

New metrics will be required to monitor implementation of the SDGs, such as the inclusive wealth index (IWI), which includes natural, human, and manufactured capital in national accounts (UNU-IHDP and UNEP 2012, 2014; Urban Institute and UNEP 2018). The SDGs and progressively inclusive accounting methods are responses to the narrow focus on economic growth that creates inequality and undermines sustainability. As such, research is needed to assess how measuring wealth inclusively can support

SDG implementation. SDG 8 promotes sustained, inclusive, and sustainable economic growth and full, productive, and fair employment for all. The inclusive growth concept, though not quantified in an individual metric, is considered as growth in inclusive wealth (Dasgupta et al. 2015), i.e., translating economic growth into broad-scale improvements in the living standards of all citizens worldwide.

The aim of this special feature (SF) is to consider the potential contributions of sustainability science, and of the concept of inclusive wealth to understanding how major targets can be achieved. Articles in this SF provide perspectives and approaches on how the scientific community can best contribute to SDG implementation through scenario analysis, stakeholder partnerships, regional analyses, and ultimately policy impact.

Categorizing the ten articles in this SF

Figure 1 loosely categorizes the ten articles in this SF by their spatial scales of study (vertical axis) and focus on either single or multiple goals (horizontal axis). While three articles (Velis et al. 2017, Neumann et al. 2017 and Sarawat et al. 2017) focus on specific SDGs such as SDGs 6 and 14, the remaining seven articles discuss multiple SDGs and their interlinkages on different spatial scales.

Focus on multiple SDGs and their interlinkages

Stafford-Smith et al. (2016) (1, Fig. 1) stress the importance of interlinkages and interdependencies among the SDGs for effective implementation. The authors identify three areas of interlinkages: across sectors (e.g., finance, agriculture, energy, and transport), across societal actors (local authorities, government agencies, private sector, and civil society), and among low, medium, and high-income countries. Using a global sustainability science and practice perspective, this article provides seven recommendations to improve these interlinkages at both global and national levels. The following three articles introduce innovative methods to support planning and decision-making for SDG implementation. Collste et al. (2017) (2) illustrate the use of the new system dynamics based iSDG family of models as a planning tool that can guide policy makers and ensure coherent policies regarding 17 SDGs. They applied their model to Tanzania and analyzed the impacts of substantial investments in photovoltaic capacity, focusing on three SDGs: SDG 3 regarding healthy lives and well-being, SDG 4 regarding education, and SDG 7 regarding energy. Khalili et al. (2017) (3) present a strategic framework and application of a graphical multi-agent decision-making model to improve relevancy and quality of sustainability decision-making processes. The authors apply this framework in two case studies of Shandong and Guangdong province in China. Shahrier et al. (2017) (4) introduce an intergenerational sustainability dilemma game, in which participants are made to consider the impacts of their decisions on imaginary future generations, as a policy tool. The game is applied to two types of Bangladeshi study areas (urban and rural).

Yonehara et al. (2017) (5) highlight the crucial role of evaluation in achieving the SDGs and propose a framework

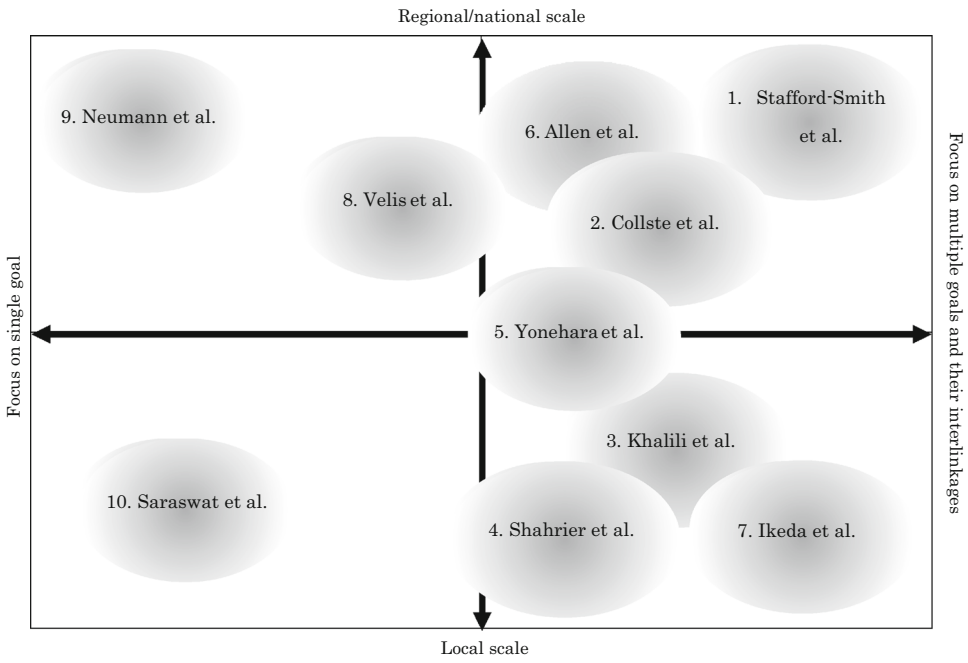

Fig. 1 Placement of the ten articles in this SDGs SF

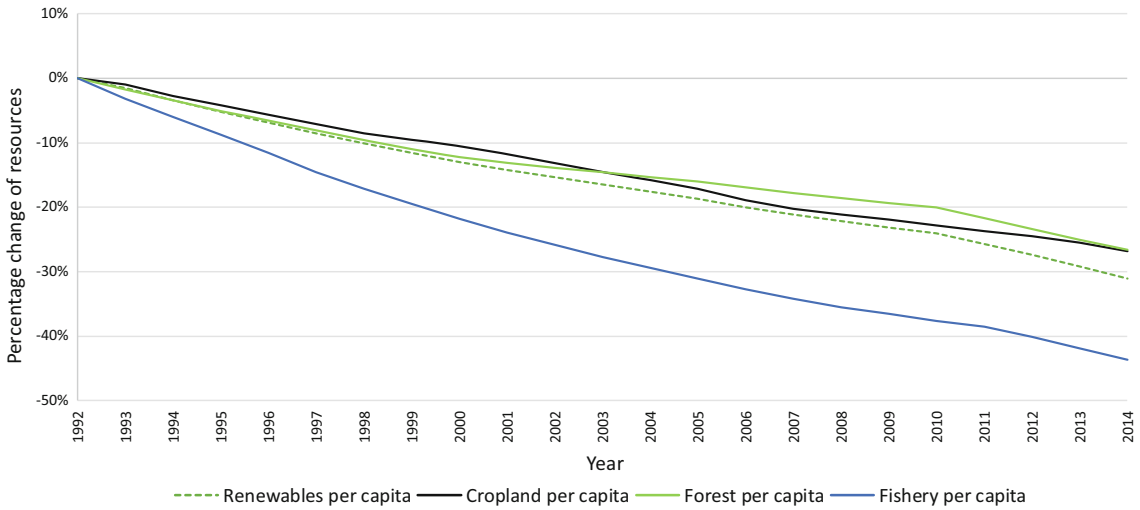

Fig. 2 Percent change in natural capital. Data in this graph show renewable natural resources in natural capital from 1992 to 2014. *Source*: Urban Institute and UNEP (2018)

for SDG evaluation. The authors propose that the SDGs' 15-year time frame can be divided into three 5-year phases: a planning phase driven by proactive evaluation and "evaluability" assessment; an improvement phase characterized by formative evaluation and monitoring; and a completion phase involving outcome and impact evaluations.

Allen et al. (2017) (6) present the recent experience of the United Nations in undertaking an indicator-based assessment for the Arab Sustainable Development Report. The approach first takes a thematic "snapshot" of the progress and trends across 56 sustainable development indicators over 2 decades. Then, a nested, integrated conceptual framework is applied for an in-depth exploration of interlinkages and dynamics among the SDGs.

The IWI is a stock-based, comprehensive indicator used to evaluate sustainability based on the wealth of nations. Ikeda et al. (2017) (7) downscale the IWI to a prefectural scale in Japan, where depopulation, an aging population, and an excessive burden of environmental regulations have led to a reduction in sustainability.

Focus on single SDG and its implementation

Velis et al. (2017) (8, Fig. 1) review the synergies and trade-offs between groundwater and human development. This article summarizes various groundwater sustainability issues at different scales. Neumann et al. (2017) (9) focus on SDG 14 (conservation and sustainable use of oceans, seas, and marine resources) and argue for a strong sustainability concept and the integration of constraint functions to avoid depletion of natural capital in coastal areas. Saraswat et al. (2017) (10) also focus on water, but explore scenarios for integrated urban water management through 2030 in Kathmandu Valley, Nepal, by quantifying water demand and supply under different scenarios.

Current SDG challenges

Multiple approaches are required to solve the global sustainability problem. Natural capital, the value of nature, has decreased over time and is now being substituted by human and physical capital. Though inclusive wealth has increased over time, natural capital has been neglected, and the value of global renewable energy, cropland, forestry, and fishery stocks has been decreasing from 1990 to 2014 (Fig. 2). Cross-scale and cross-stakeholder collaboration, creation of synergies through implementing multiple SDGs, policy integration, coherence, and inclusiveness are all necessary to overcome these negative trends and for successful achievement of SDGs.

The SDGs represent a novel, goal-based approach to global governance, which is distinct from prevailing laws and regulations. This special feature provides hope for future transformations but also indicates the magnitude of challenges ahead and the importance of research to meet them.

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