

## Conclusion

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A wide range of scientific communities, international organizations and policy makers have documented the unprecedented sustainability crisis that humanity faces today. This crisis is most clearly visible through the excessive depletion and degradation of natural resources that accompany the pro-growth economic policies throughout the world, but this degradation also has a strong impact on the social, environmental and economic well-being of present and future generations. The role of science in this new landscape is far from trivial. On the one hand, the rapid spread of the institutions of scientific research in Europe in the seventeenth and eighteenth centuries is widely considered as the root that led to the industrial revolution and the subsequent growth in population, changes in global lifestyles and consumption patterns, which resulted in substantial (and globally disproportionate) improvements in human well-being (Mokyr, 2002). On the other hand, after centuries of triumph and optimism, science is now called on to remedy the pathologies of the global industrial system. Whereas it was previously understood as steadily advancing the certainty of our knowledge and control of the natural world, studies of science in society (Funtowicz and Ravetz, 1993; European Commission, 2009) show that nowadays science is increasingly seen as having to cope with many uncertainties in dealing with complex socio-ecological systems, value-based choices and the existence of a plurality of legitimate perspectives. In response, new styles of scientific activity are being developed.

As shown throughout this book, the challenge of strong sustainability cannot be addressed through the classical reductionist, analytical worldview which divides systems into ever smaller elements, studied by ever more esoteric specialisms. Indeed, sustainable development calls not only for changes in the configuration of socio-ecological systems, but most noticeably for transformations in the core values and worldviews that drive individual actions and organizations (Jaeger and Tåbara, 2011, p. 206). Science can contribute to such changes, but only if the sustainability challenges are addressed in an open, exploratory and learning mode. New modes of organization of research and new research partnerships between scientific and extra-scientific expertise are required, together with a new generation of scientists aware of the challenges of strong sustainability. After over a

decade of experimentation with new modes of organization of scientific research for sustainability, sustainability science emerged as a new mode of organization of research characterized by a transdisciplinary and interdisciplinary research effort within an explicit ethical perspective on strong sustainability.

In spite of the growing recognition of the urgent need for the further development of sustainability science, this book has highlighted major epistemological and institutional barriers for changing the way in which science is organized and funded. As shown through the detailed analysis of promising sustainability science approaches in ecological economics, earth system science and transition approaches in science, technology and society studies, the tendency to shift back to more classical reductionist and specialized approaches for providing policy advice is still widespread. Moreover, scholars typically do not immediately acknowledge the evidence that contradicts the well-established mono-disciplinary theories. Even after contradictory evidence has been acknowledged, improved theories do not emerge immediately or easily. Likewise, methodological practices do not always or immediately change in response to either theoretical developments or methodological innovations. Further serious obstacles arise from career incentives in higher education institutions, the dominance of mono-disciplinary peer review of research projects and promotions, and the lack of training opportunities for transdisciplinary research.

While there are no simple solutions to these challenges, universities and funding agencies worldwide have repeatedly demonstrated their capacity to overcome institutional and epistemological barriers by promoting exposure of scientists to multiple methods and disciplines in training, workshops and roundtables, and by supporting interdisciplinary and transdisciplinary research programmes and networks that increase familiarity with sustainability research. Therefore, it seems worthwhile for the scholarly and policy communities to recognize the institutional and methodological barriers and strive to lower them by providing greater institutional and financial support. The institutional and structural arrangements that undermine trust amongst researchers by pitting different disciplines and methods against each other in competition for resources and status are more difficult to address. Career incentives that reward individual research more than collaborative research clearly discourage collaboration. However, reversal of these incentives is not impossible, as can be seen by the current situation where the amount of collaborative sustainability research varies across countries. Explicit recognition of and support for interdisciplinary and transdisciplinary research for governing the transition to strong sustainability might encourage coordinated efforts to alter institutional and structural arrangements more systematically and rapidly.