

Academics for sustainable development; exploring consequences and dilemmas of transdisciplinary research approaches

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Bridging science and society is the crux of transdisciplinary (TD) research for sustainable development. TD research poses methodological challenges and supports recent trends toward greater disciplinary integration (Fahy & Rau, 2013), as it responds to the call for more engaging and interdisciplinary sustainability science (Franklin & Blyton, 2013). Such a research approach is increasingly argued to benefit from analytical treatment of social-ecological systems (e.g., Ahlström et al., 2020) in addition to understanding the role of social actors and related values in societal change processes (Söderbaum, 2009). As a result, the individual researcher is likely to face epistemological and methodological dilemmas when operationalizing TD research questions and projects.

While striving for a contribution to science and practice, TD researchers balance challenges of scientific knowledge creation with a high level of integration, while addressing the features of 'messy' societal problems as well as dealing with the urgency and persistence of sustainability challenges (Vermeulen & Witjes, 2021). The existence of multiple values and ideologies in TD research implies that knowledge is created through multi-actor debates serving as field validation of the research outcomes: a contribution to science and practice (Hessels & van Lente, 2008). While the balancing of knowledge creation and practice-oriented interventions is seen as key during the TD process (Bulten et al., 2021), it is the continuous feedback between the knowledge created and the result of the intervention that enables TD research to enhance the contribution to societal sustainability challenges. This gives the TD research an ethical and a political dimension (e.g. addressing questions like "what is the right thing to do?, who wins and loses from this action?"). Consequently, the balance between knowledge production and intervention development is a means supporting the main goal of TD research which is the contribute to societal challenges.

In TD research projects variations in purpose for utilizing co-production result in divergent conceptualizations of power and politics, as well as pathways to impact. Chambers et al. (2021) recently identified six modes of co-production: (1) researching solutions; (2) empowering voices; (3) brokering power; (4) reframing power; (5) navigating differences and (6) reframing agency. What should not come as a surprise to any TD researcher, is that no mode is ideal and each of

them holds both potential and poses challenges and risks. TD research projects may be capable of broadening research inputs by engaging with a plurality of voices, making room for alternative epistemologies, which in turn may manifest in opening up research outputs that ignite more diverse possible sustainable futures (Stirling, 2021).

The collaboration between academics and nonacademics in TD research forms the backbone of a process of co-development (Carew & Wickson, 2010) which results in knowledge production as well as interventions (Wiek et al., 2014). According to Norström et al. (2020), in order for the knowledge co-production process to be successful, it should be context-based, pluralistic, goal-oriented and interactive. To avoid major biases in finding the right balance between knowledge production and interventions, TD should be applied consciously and cautiously (Macintyre et al., 2021). Firstly, the development of research questions that serve a specific purpose, e.g. competitiveness, has ideological consequences (e.g., the choice for the sector or specific companies). Secondly, the role of the different research participants (i.e., academics, students and non-academics) has a direct influence on the independence of the research and critical orientation or interpretative analysis of the research outcomes. The objectivity of the researcher and the research results could be in jeopardy when also aiming for meaningful outcomes for practice, re-emphasising the ethical dilemma. Lastly, collaboration across disciplines and between academic and nonacademic actors is resource-intensive, resulting in TD research being costly. This may create friction in the collaboration between TD research members (Schaltegger et al., 2013). In practice, TD research leads to tensions, i.e., contradictory demands as perceived by the involved actors (Witjes & Vermeulen, 2021; Macintyre et al., 2021). This typically involves diverging interests between scientists and the more practice-oriented actors (Sellberg et al., 2021; Thompson et al., 2017). Thus, the collaborative setting in which TD research takes place plays a vital role (Laasch et al., 2020).

The collaboration for TD research depends on the focus and aim of the TD research project (Vermeulen & Witjes, 2021). While striving for a contribution to societal challenges, TD research can be diverse in its aims leading to a wide variety of TD research configurations. Some scholars have reflected on the implications of multiple knowledge systems (see e.g., Cash et al., 2003; Tengö et al., 2014; Polk, 2015) created by multi-actor collaboration in TD research, as well as the different roles that researchers can have in the collaboration. While TD researcher roles include acting as 'a facilitator', 'a self-reflective scientist', 'change agent', and 'knowledge broker' (e.g. Wittmayer & Schöpke, 2014; Milkoreit, et al, 2015; Cockburn, 2018; Sellberg, 2018), there is a lack of debate on how to handle these roles: what does TD research imply for a researcher, a PhD candidate, or how should researchers be trained? (see e.g., Care et al., 2021). These different roles require specific competences and attitudes, such as negotiation skills, ability to translate between disciplines, openness and so on. Enhancing the understanding of these personal aspects of TD research supports the goal of capturing real-world challenges experienced by TD researchers and promotes reflexivity (Sellberg, 2021).

This special issue contains explorations of TD as a research approach for supporting sustainability sciences and practice. The papers present examples of the inherent dilemmas and consequences when doing TD research. The content of the papers ranges from the development

of theoretical frameworks for assessing TD research processes to literature reviews and quantitative analyses that together provide a meta-perspective on how to better design TD research, acknowledging methodological challenges and tensions.

The first article by Biswas & Miller (2021) proposes a knowledge-making research agenda for the co-creation of sustainable energy transitions based on a deconstruction-reconstruction framework for social learning among stakeholders. The theoretical framework is operationalized through the knowledge architecture designed to facilitate a multi-stakeholder sustainable energy transition project underway in Sierra Leone. Observed tensions and barriers in the process of implementing the knowledge architecture are also discussed, with respect to the multi-stakeholder participatory setting of the project and the emerging challenges due to COVID-19.

Hakkarainen et al. (2021) review the concepts of co-creation, co-production, co-design, co-learning, and adaptive co-management in the context of natural resources management, which are all relevant to the current debate on collaborative knowledge production in TD research. An integrative understanding of the concepts to facilitate collaborative modes and enable transformative aims of research processes is presented. They propose three praxis recommendations which, together with the integrative understanding of the co-concepts, can enable the dissolution of potential epistemological and practice tensions, while strengthening the transformative aims of TD processes.

Arnold (2021) explores the research design process and specific tasks and roles of researchers in TD research. The findings show that in TD settings, researchers and lecturers better address poly-contextuality, the consciousness of innovation paradoxes, and the side-effects of ongoing interdependencies in comparison to other research fields.

The article by Jahn et al. (2021) offers an empirically grounded distinction of five research modes, based on a cluster analysis of 59 completed sustainability-oriented research projects. They show that the choice of research mode strongly depends on the funding context, with mission-oriented funding encouraging more collaborative modes. They identify three important tensions: the duality of science and society; imbalances in involvement and influence of different actor groups; and tensions between societal and academic outputs and impacts.

The purpose of the paper by Cockburn (2021) is to demonstrate the value of applied critical realism in enabling knowledge integration in TD research. She applies tools from applied critical realism to a case of place-based social-ecological research from South Africa. She discusses how they enable reflection on tensions related to philosophy, methodology and researcher positionality, identifying some of the challenges she experienced in putting these tools to work. For example, the identification of cross-cutting causal mechanisms through the retroductive analysis enabled for addressing key tensions, often occurring in TD research, i.e., moving from the context-specific empirical findings, to the development of generalisable patterns and findings.

Wardani et al. (2021) identify and explore strategic opportunities for enabling TD collaboration in planetary health. They found structural, relational, and individual factors enabling and constraining collaboration. Local research contexts and academia's disciplinary traditions pose structural

constraints, which need to be addressed at the project, organisational and individual levels. Their analysis reveals strategic opportunities for funding programs and researcher training that can be leveraged to increase capacity for relational work, further enabling collaboration in TD research. They also present evidence on methodological challenges for transdisciplinary planetary health research around issues of power.

Finally, Vinke-de Kruijf et al. (2021) consolidate learnings from 36 publications on TD research at the environment-health-development nexus. The novel planetary health lens guides the authors' synthesis that identifies structural constraints due to challenges in understanding local research contexts and academia's disciplinary traditions. These form key methodological tensions and future developments of TD research frameworks, that need to consider asymmetrical power dynamics and deep epistemological differences requiring relational efforts.

In sum, engaging in TD research should include acknowledging that researchers can and should take into account power dynamics between the actors in the TD collaboration. An ethical and political stance is demanded if the TD researchers are to reach a contribution to societal sustainability challenges. In order to do so, TD researchers need a set of skills: e.g., communicating and negotiating with actors, in addition to balancing interdisciplinary tensions, and the tensions between knowledge production and intervention development. It is thus important to critically explore these roles when executing the diversity of TD research and to effectively navigate trade-offs when co-producing solutions for sustainability. The articles in this special issue present reflections on methodological issues present in a wide variety of TD research projects, including the dilemmas and consequences of having to deal with multiple knowledge systems and the role of the TD researcher. The debate on methodological issues linked to the role of the researcher is usually not made explicit in the academic literature and therefore we contribute to this gap in the TD debate. Such insights will aid scholars in both positioning research findings in the scientific debate, and in the education of researchers for TD. In order for the field of TD research to further evolve, we call for increased and renewed attention to the general need for reflexivity, and for articulating explicitly the identified and experienced challenges with TD research. As such, we encourage colleagues to engage in the synthesized and systematic treatment of lessons learned when conducting the research, which can contribute to the philosophical and theoretical advancement of existing TD frameworks.

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