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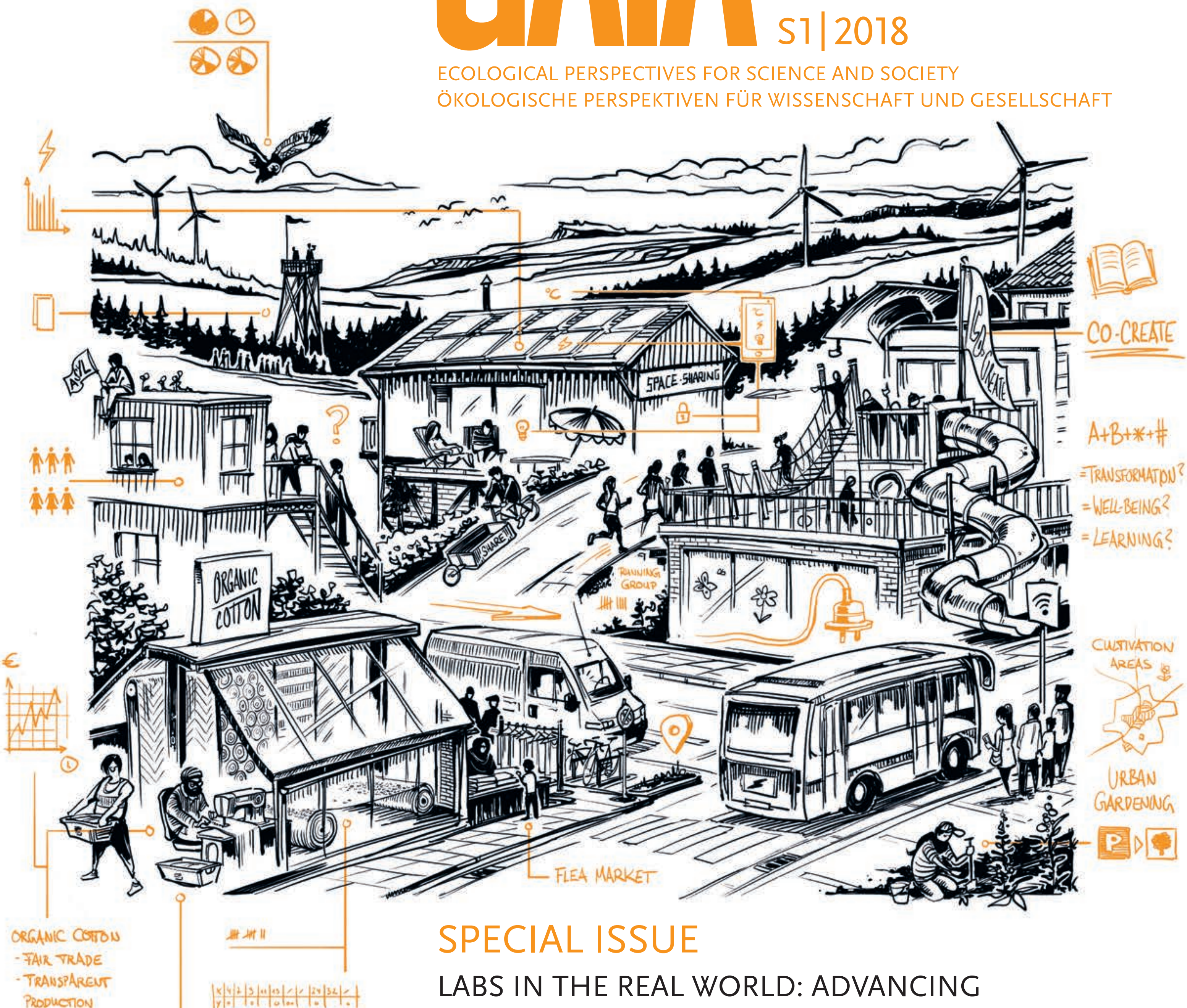

SPECIAL ISSUE

LABS IN THE REAL WORLD: ADVANCING TRANSDISCIPLINARITY AND TRANSFORMATIONS

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How Much of the Real-World Laboratory Is Hidden in Current Transdisciplinary Research?

The concept of real-world laboratories is difficult to distinguish from the concept of transdisciplinary research. Thus, the question has arisen: to what extent is the real-world laboratory truly novel? If transdisciplinary research is considered a process providing only socially robust knowledge and orientation (instead of solutions), then the real-world lab could be thought of as a model in which evidence-supported solutions can be tested and adjusted, and progress can be achieved.

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The appearance of real-world laboratories (RwLs) is the most recent step among many that trace the evolution of scientific approaches seeking to acquire scientific knowledge and changing behaviours of people and institutions toward sustainability by real-world experimentation (e.g., Sengers et al. 2016, Schäpke et al. 2017). Not only has the RwL concept rapidly gained attention in the theoretical discussion of transformative research, but it also has found its way very quickly into research practice (e.g., the *BaWü Labs*[1]).

Still, the RwL concept is new and in a finding phase; thus, several detailed methodological and conceptual points remain open (Grunwald 2016, pp. 203 ff.). Compared to adjacent approaches, such as intervention research (Krainer and Lerchster 2012), responsible research and innovation (RRI) (Owen et al. 2012) or other forms of experimental approaches in the field of sustainability transitions (Sengers et al. 2016), it remains questionable to what extent the RwL is really novel or instead relabels already existing approaches. In particular, transdisciplinary research (TDR) is discussed as overlapping with current RwL conceptions (e.g., Schäpke et al. 2017, Jahn and Keil 2016, Wagner and Grunwald 2015).

This development is critical, as the discourse on TDR is already characterised by a conceptual plurality and an accompanied confusion among a wider science-practice community that is challenged by the task to implement concepts that are conceived as “fuzzy” (Zscheischler et al. 2017). It may be argued that conceptual plurality counters dogmatism. However, we think a need for clarification cannot be denied.

Here, Jahn and Keil (2016) provided a worthwhile contribution for the discussion in their attempt to differentiate the RwL while integrating it into an ideal TDR process as they suggest to implement the RwL as the testing phase of results from preceding TDR processes. Ukowitz’s (2017) assumption of “bringing home” the RwL into the TDR concept that has been co-developed by Jahn et al. (2012) may not be entirely unjustified. However, there is good reason for the idea of Jahn and Keil, as it supports profiling both approaches.

In the following, we posit this idea of further developing the model suggested by Jahn and Keil (2016, p. 248) and placing RwLs as a fourth optional phase after the established three-phase TDR model. From our point of view, this supports not only an increased conceptual clarification, but it also releases TDR from the imperative of implementation.

We justify and guide our argumentation with, first, a brief comparison of the two concepts of the RwL and TDR based on a literature review; second, observations from research practice; and third, the aspects of scientific legitimacy and ethics of science.

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1 *https://mwk.baden-wuerttemberg.de/de/forschung/forschungspolitik/wissenschaft-fuer-nachhaltigkeit/reallabore*

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TABLE 1: Comparison of core characteristics of transdisciplinary research and real-world laboratories by a set of different dimensions.

DIMENSION	TRANSDISCIPLINARY RESEARCH	REAL-WORLD LABORATORY
normativity	complex *real-world problems* that are urgent and societally relevant as a guiding research principle (Pohl 2010, Hirsch Hadorn et al. 2006), linked to sustainable development (e.g., Scholz 2017)	*transformative research* (contribution to societal change toward sustainability) (Parodi et al. 2016, Schäpke et al. 2018, in this issue)
methodology	*mutual learning and knowledge integration* (close linkage to action research methods) (e.g., Carew and Wickson 2010, Jahn et al. 2012)	*experiments as research method; methods of action research and intervention science* (Parodi et al. 2016, Schäpke et al. 2018, in this issue); *transdisciplinary case study approach* (Schneidewind 2014)
reflexivity	*continuous formative evaluation* (Lang et al. 2012, Bergmann 2005), *impact assessment* (Hirsch Hadorn et al. 2006), *iterative loop learning* (Lang et al. 2012, Jahn et al. 2012)	*recursive learning cycles* (on research and impact) (Schäpke et al. 2017, Schneidewind 2014, Parodi et al. 2016, Gross et al. 2005)
beneficiary of results	*science and* (orientations for) *practice* (Lang et al. 2012, Wiek 2007)	*science and practice* (Schäpke et al. 2017, Schneidewind 2014)
infrastructure of research activities	*protected discourse arenas* (...) that promote learning/thinking (Scholz and Steiner 2015)	*laboratory* with spatial and content-related boundaries (...) a visible, addressable and accessible location (Parodi et al. 2016)
participatory level	*collaboration on equal footing* (Jahn et al. 2012) (e.g., mutual problem framing, project design, assessment)	*cooperation* as minimum standard (Parodi et al. 2016, Schäpke et al. 2018, in this issue)
scale	*multiscale* (local/global) (Scholz and Steiner 2015)	mainly *micro-scale* (household) and *meso-scale* (district and city) (Schneidewind 2014, Schneidewind et al. 2018, in this issue)
level of intervention	*socially robust orientation* (Scholz and Steiner 2015) or *design of practicable problem solutions* for society (Hirsch Hadorn et al. 2006)	*action-based implementation* (Schäpke et al. 2017, Jahn and Keil 2016, Schneidewind 2014)
transformation impulse	both *direct* (applicable solutions for real-world problems; Jahn 2008, pp. 35 ff.) and *indirect* (through learning and capacity building; Scholz 2017)	both *direct* (contribution to societal change towards sustainability) (Schäpke et al. 2017, Parodi et al. 2016) and *indirect* (contribution to better understanding of transitions, learning, and capacity development; Schäpke et al. 2018, in this issue)
knowledge types	*systems knowledge, target knowledge, transformation knowledge* (Becker and Jahn 2000, Pohl and Hirsch Hadorn 2008)	*target knowledge and transformation knowledge* (Schäpke et al. 2017, Jahn and Keil 2016)

Real-World Lab vs. Transdisciplinary Research

Different notions of the RwL presently coexist. One fraction describes it as a hybrid form of research that combines knowledge application with knowledge production (Schneidewind 2014, Ukowitz 2017). Others argue that the RwL may lack epistemic function and suggest regarding RwL as the implementing and testing phase of results from preceding TDR processes (Jahn and Keil 2016). Following that perspective, the RwL might be a suitable setting to support mutual learning between science and society, but it likely does not constitute a "new research mode" (Jahn and Keil 2016). At the other end of the discursive spectrum, mutual learning and research in RwL settings are merged as a social science research approach that transfers the laboratory research settings of natural sciences into a social sciences methodology (De Flander et al. 2014, p. 285).

In a currently published review article, Schäpke et al. (2017, see also Schäpke et al. 2018, in this issue) identify five characteristics of the RwL: 1 transformative research, 2. experiments as research method, 3. transdisciplinarity, 4. contribution to societal change, and 5. reflexive learning. In accordance with Parodi et al. (2016), further important qualities are the "normativity" of RwLs toward sustainability and the "interventionist character" of research(ers). Without doubt, this constitutes a useful base for a more precise definition of the RwL concept, but it remains elusive, as these characteristics themselves are not defined precisely.

In comparison to the RwL, TDR is traced back to a long phase of terminological discussions. The focus changed from "introspective" (TDR as an academic approach aiming at scientific holism) to a transboundary action-oriented research approach for tackling complex real-world problems. In the history of ideas, TDR recently displays its strong roots of Kurt Lewin's experimental action research (1946). The overlaps of TDR and RwLs seem obvious, as transdisciplinarity is named one of the five core characteristics of the RwL (Schäpke et al. 2017). However, it remains elusive in what dimensions the two concepts really differ. To discuss both concepts in comparison, we conducted a brief literature review to identify comparable characteristics, listed and sorted along a range of both core and conducive dimensions (see table 1). The investigated literature is not exhaustive, but rather exhibits a selection of articles that survey conceptual discussions of both approaches.

The comparison reveals multiple overlaps. Although the wording appears differently, shared conceptions often are underlying (e.g., in "normativity" and "reflexivity"). The dual claim of actionable and scientific knowledge production can be found as well as the claim to integrate "relevant" stakeholders of society in a joint research process with science. Both approaches also share the guiding principle of sustainability as their normative core, which means that they are dedicated to sustainable transitioning (Scholz and Steiner 2015). It must be noted that TDR reached out far beyond sustainability sciences and saw wide applications in public health research and in the arts and the humanities.

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Deviations can be identified even though commonalities abound. One major difference is the focus on the intervention and transformation of the RwL's research activities, whereas TDR implements a rather moderate approach. While TDR aims to support stakeholders through joint learning and negotiation processes to better address transformation processes (Scholz 2017), RwLs operate in a much more direct way by affecting real-world practices.

Another difference can be identified on the scale level whereas TDR covers all scale-levels (even though macro-scale studies remain scarce), RwLs take a strong stand to micro-scale and meso-scale settings (Schneidewind 2014).

A conceptual comparison along methodological aspects remains elusive. While methods of knowledge integration build the core methodology of TDR (Jahn et al. 2012, cf. Hoffmann et al. 2017), a respective approach within the RwL is still open (Schäpke et al. 2017). While Schneidewind (2014) acknowledges the "transdisciplinary case study" approach as a feasible contribution to construct a RwL (2014, p. 3), the core methodology of conducting a RwL appears to be experimentation in social contexts (e.g., Schäpke et al. 2017). Even though conceptual links exist, as processes of transdisciplinary (TD) knowledge integration might also occur in the RwL (Jahn and Keil 2016), knowledge production through experimentation differentiates the RwL from TDR. Eventually, whereas TDR claims to produce systems knowledge (which is predominantly a scientific domain), target knowledge, and transformation knowledge, there seems to be a focus on the last two in the RwL (Jahn and Keil 2016).

Our brief comparison shows that conceptual differences between TDR and the RwL are mainly gradual. The level of intervention and the transformation impulse are especially a matter of distinction. In addition, there seems to be a shift toward practice and a different underlying role of scientists in RwLs.

The Merging of Transdisciplinary Research and Real-World Lab in Research Practice

However, we observed this shift toward practice and an interventionist character already in today's TDR practice. This finding is based on our experience from scientifically accompanying and studying two funding programmes within the *FONA* framework of the German Federal Ministry for Education and Research (BMBF)[2] over a time span of seven years, including 22 transdisciplinary research projects (see Zscheischler et al. 2017, Zscheischler et al. forthcoming).

We observed that TDR in practice increasingly incorporates elements that can be named stand-out characteristics for RwLs. For example, many projects provided testing and implementation phases in their project designs although this was not explicitly required in the announcement. The emphasis on the implementation also may be one reason for another observation: the practical outcome of the projects seems to be of primary importance – oftentimes, at the expense of scientific relevant output. Meanwhile, some funding calls specifically demand such implementation phases in TDR projects (e.g., BMBF announcement *Stadt-Land-Plus*). The desire to provide useful transformation impulses and "successful solutions" on the part of research policy is understandable. However, the implementation imperative increasingly pushes science to a certain extent toward "solutionism" (cf. Strohschneider 2014). With this regard, it is also a responsibility of science policy to prevent the scientific system from over-functionalisation and to maintain its specific quality of performance. It should be avoided that the catchphrase "succeed or succumb" adds to "publish or perish" – at least for scientists who seek to aspire to the field of sustainability science. At this critical point, we suggest the RwL concept might be of specific value because it invokes the potential to lower mere utilitarian thinking on the TDR approach that is raised by science policy.

Real-World Labs and the Conceptual Clarification of Transdisciplinary Research

We argue that RwLs might support the step forward from developing knowledge for a transformation orientation toward testing, evaluating and adjusting practicable solutions. In this regard, we agree with Jahn and Keil (2016) that RwLs can be connected fruitfully as an implementation phase following a TDR process. Still, we are not as sceptical regarding epistemological constraints. We pose that a multitude of scientific questions can be addressed and answered in experimental "testing areas" such as the RwL (see also Lewin 1946, Schäpke et al. 2017, pp. 14 ff.). Thus, RwLs may support evaluating target and transformation knowledge that was generated in the preceding TDR process (see also Krohn et al. 2017). Social scientific issues on societal change, acceptancy, transferability and framing conditions for sustainability innovations especially may be addressed. What further research questions may potentially arise from the RwL needs to be investigated empirically and could be subject of corresponding meta-research.

In any case, the need to involve scientists in the RwL arises solely from the scientific value and vice versa. Thus, in accordance with Jahn and Keil (2016) we conceptualise the RwL as an optional fourth phase as addition to an ideal TDR process that inhibits the opportunity for scientific knowledge gain in the science feedback loop (see figure 1).

From our point of view, RwLs involve not only the opportunity to specify the definition of TDR, but in this context, RwLs also have the potential to release TDR practice from the increasingly observed burden to provide ready-tailored solutions and the corresponding implementation imperative. While the wording of "laboratory" has been criticised (Parodi et al. 2016), we think it also implies the experimental character of open-ended research, allow-

2 *Sustainable Land Management* (2010 to 2017): *http://nachhaltiges-landmanagement.de/startseite*
Innovation Groups for Sustainable Land Management (2013 to 2020): *https://innovationsgruppen-landmanagement.de/de*

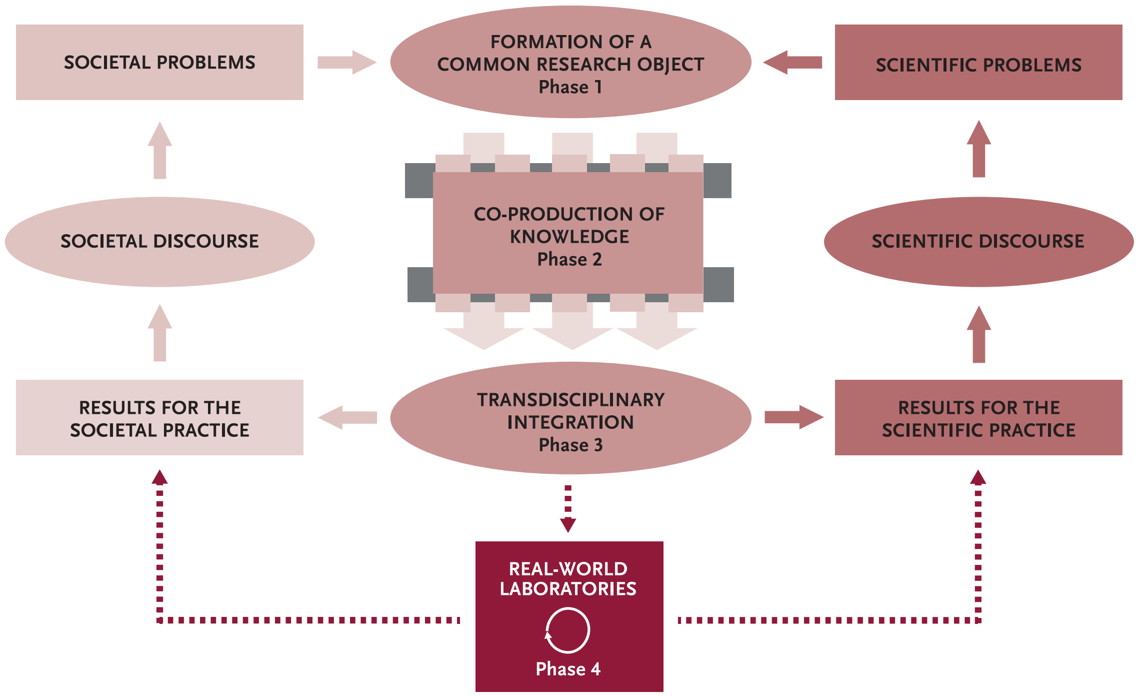

FIGURE 1: Model of an ideal-typical transdisciplinary research (TDR) process adapted from Jahn and Keil (2016). In contrast to Jahn and Keil, we suggest integrating RwLs as an optional (dotted line) phase in which knowledge and possible solutions resulting from a preceding TDR process can be tested. The two dotted arrows directing to the societal and to the scientific feedback loop illustrate assumed benefits for both discourses.

ing failure and a continuing search for new research questions and thus, suits well with an unachievable ideal state of sustainability.

We also suggest that the transition from a TDR process into a RwL (from phase 3 to 4) should go along with a significant responsibility shift in which the practice partners take the driver's seat of the ongoing process. Such a shift might also amplify the transformative impulse.

In any case, we argue that a RwL that succeeds a TDR process should not be mandatory. Instead, the potential (or urgency) for a RwL should be assessed during the course of the TDR process.

The Role of Science Must Be Critically Self-Reflected

Due to the interventionist character of the RwL, ethical concerns and legitimation questions also call an increased attention (see also Jahn and Keil 2016). With this backdrop, criteria for socially responsible research processes as suggested by Helming et al. (2016) gain importance. We additionally claim that our suggestion of integrating the RwL into a preceding TDR process, which accompanies a fair and inclusive negotiation and consideration of a real-world problem that involves all relevant stakeholder groups and the corresponding perspectives, might mitigate legitimation concerns and provide reflection not only on benefits and intended effects but also on harms and unintended consequences. Thus, it may reveal faulty designs of possible solutions before time-intensive testing leads to frustration among societal stakeholders. In addition, conflicts of interests and values can be made transparent, and uncertainties and individual risks can be assessed.

Our recommendation of a responsibility shift from science to practice at the step from TDR process to the RwL prevents scientists from falling into an "activist" role in which scientists become "normative agents of sustainable transitioning". In accordance to Scholz (2017), we make a plea for the "facilitating" role of scientists in which science acts as public good within a science-society relationship to avoid strongly normative lobbying and "solutionism" (see Strohschneider 2014).

Conclusion

The conceptual overlaps of the examined concepts are manifold and justify the question of the novelty of the RwL. Thus, it is not surprising that contemporary scientific programmes that claim to work transdisciplinary contain largely RwL characteristics even though they do not take the label (see also De Flander et al. 2014, p. 285). Despite scepticism about the novelty of the RwL, the concept offers potential for the discourse on TDR, especially on the issue of the "transformation impulse". If TDR is conceived as a process that provides only socially robust knowledge and orientation (instead of solutions), then the RwL could be conceptualised as an optional fourth stage in an ideal-type TDR model where evidence-supported solutions can be tested, adjusted, and make progress.

With this regard, we are not as sceptical regarding epistemological constraints as Jahn and Keil (2016) have argued. Furthermore, we argue that the concept of RwL can support the conceptual clarification of TDR and thus may counter the increasing trend of research policy to include more implementation requirements as mandatory parts for the funding of TDR projects.

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