Chapter 7

Transdisciplinary Research in Land Use Science—Developments, Criticism and Empirical Findings from Research Practice

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Abstract The particular importance of transdisciplinarity (TD) is emphasised against the backdrop of urgent complex real-world challenges and a changed societal demand for knowledge. It is no longer just a matter of producing new scientific insights, but also of achieving the solution-oriented goals and producing the action knowledge that support sustainable development and land management. Transdisciplinary research (TDR) projects have been supported in Germany over the past two decades. However, critical questions are increasingly being raised about the extent to which such projects have been successful. This chapter introduces the development of the TDR concept; describes the current criticism of TDR; and presents empirical findings from research practice. The results reveal a number of implementation deficits that can be traced back to a misfit with academic structures and a lack of knowledge.

Keywords Co-production of knowledge · Sustainable land management · Mode 2

7.1 Land Use Science—From Land Cover to Global Change Research

For a long time, the natural environment was predominantly an object of natural sciences and the belief that progress is a matter of technology development prevailed. The environmental crisis, arising ethical discourses on responsibility (Jonas 1984), the postulation of a risk society (Beck 1986) and the ensuing awareness of the increasing vulnerability of modern societies have modified society's opinion on progress and science (Gibbons et al. 1994; Nowotny et al. 2001). As a result, more integrative concepts such as “human–environment interactions” started evolving in the early 1970s (Crumley 2007 cit. in Palsson et al. 2013). This development was

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reflected in the emergence of new disciplines, such as ecological economics, environmental sociology and sustainability science (Costanza 1989; Catton & Dunlap 1978; Komiyama and Takeuchi 2006).

In this context, land use science also gradually developed an integrated socio-ecological systems perspective over the past two decades. While researchers initially focused on monitoring and modelling biophysical characteristics and land cover changes (Verburg et al. 2013), they now seek for a more integrative understanding. In addition, land use science has become an integral part of global change research and sustainability science (Braimoh and Osaki 2010; Meyfroidt et al. 2013), in which the urgency to change actions is often emphasised (Palsson et al. 2013).

This growing awareness of the decisive role played by human activities is especially reflected in the concept of the “Anthropocene”, which considers that human activities have become a major geological factor (Crutzen 2002). Jahn et al. (2015, p. 92) regarded the diagnosis of the “Anthropocene” as one of the most fundamental changes of perspective over the last one hundred years: “Society and nature are so closely interwoven that they can no longer be independently investigated”.¹

Since land use dynamics are simultaneously affected by biophysical, ecological, economic and socio-cultural drivers, data and knowledge generated from land cover analyses are insufficient for our understanding and for providing answers to many of the urgent questions posed by society. What is also required is knowledge about the actors involved, and their values, beliefs and motivations for decision-making. A “radical change in perspective and action” is required, as new research questions arise and necessitate new ways of thinking and action (Palsson et al. 2013).

This view has resulted in a new relation between knowledge and action (knowledge for action), and consequently a new role for science. Science is expected to provide not only more “systems knowledge”, but also knowledge about societal targets and opportunities for transformation. The evolution of the transdisciplinary research (TDR) approach in land use science can be directly related to these developments.

7.2 The Development of the Concept of TDR

The concept of transdisciplinarity (TD) can still be regarded as a relatively young one. Although the term “transdisciplinarity” was used by Jantsch (1970, 1972) and Piaget (1972) in reference books of philosophy of science back in the early 1970s, it rarely appeared until the 1990s (cf. Völker 2004). TD evolved from the concept of “interdisciplinarity”, which was further clarified after the organisation and quality of interdisciplinary research was unable to keep pace with the success generated by the dissemination and use of the term (ibid.). For this reason, Mittelstraß introduced the concept of “transdisciplinarity” at the “Bielefelder Symposium” in 1986, although its definition was almost identical to the term “interdisciplinarity” (e.g. Mittelstrass

¹Translated from the German “Gesellschaft und Natur sind so eng verwoben, dass sie nicht mehr unabhängig voneinander untersucht werden können,” p. 92.

2000). The term “transdisciplinarity” was used to elaborate the concept of “interdisciplinarity”, because the latter was previously inadequately explained and superficially used. Völker (2004) called it a “terminological rescue attempt”.²

The resulting notion of TDR as “perfected interdisciplinarity” persists to this day, which is especially apparent in regional differences between Europe and the US (Klein 2008). In the North American debate, the notion of TDR refers back to the “taxonomy of cross disciplinary research” after Rosenfield (1992) used the lexical morpheme “trans” to describe a collaborative research approach differing from interdisciplinarity where researchers “work jointly but still from disciplinary-specific basis”, transcending disciplinary boundaries by “using shared conceptual framework drawing together disciplinary-specific theories, concepts, and approaches to address common problems.” In contrast, the meaning of “trans” in the “European” concept is related to the North American concept of transdisciplinarity,³ but it is extended by the science-to-society transgression. Hence, the main difference between the two definitions lies in the involvement of non-academics, which is a distinguishing aspect of the “European” definition. Finally, these different meanings of TD and the relating confusion partly resulted in neologisms such as the “co-design” and the “co-production of knowledge” (e.g. Mauser et al. 2013). In addition, it can be claimed that these terms more clearly illustrate the core idea of TD as it is mainly understood today, namely an equal collaboration between science and practice in the development and design of a research project, and in the production and dissemination of knowledge.

This extended meaning of “transdisciplinarity” can be traced back to the diagnosis of Gibbons et al. (1994), and later Nowotny et al. (2001), who described a new type of knowledge production resulting from a changed relationship between science and society. According to the authors, this new mode of knowledge production (Mode-2) differs from the traditional Mode-1 by the context of application and the involved relation to societal problems. The heterogeneity and organisational diversity of societal responsibility was highlighted via the TDR approach. While Mode-1 science was characterised by academia having a monopoly on knowledge production, Mode-2 science also allowed the integration of further knowledge types from extra-scientific actors. Thus, the claim for the existence of a different type of knowledge production stressed not only the integration of different disciplinary perspectives but also perspectives from outside academia. In addition, the authors regarded the two modes of knowledge production as not mutually exclusive, but as complementary.

At around the same time that Gibbons et al. (1994) observed and described a “new production of knowledge”, the concept of “post-normal science” outlined by Funtowicz and Ravetz (1993) gained attention. Funtowicz and Ravetz consider science as in an ongoing process of change that is primarily shaped by the focused problem constellations and definitions. The demand for a new type of knowledge production is made plausible against the backdrop of new political challenges by a perceived global ecological crisis and new societal risks⁴: *“To characterize an issue*

²Translated from German “terminologischer Rettungsversuch”.

³Often referred to as “transdisciplinary team science”.

⁴In 1986, Ulrich Beck published his highly acclaimed book “Risk Society”.

involving risk and environment, in what we call ‘post normal science’, we can think of it as one where facts are uncertain, values in dispute, stakes high and decisions urgent.” (Funtowicz and Ravetz, 1993).

The authors argue that these challenges and problems are virtually impossible to explain by the dominating reductionist research approaches in science. Instead, systemic and synthesising approaches are required to tackle problems with a high degree of “unpredictability, incomplete control and plurality of legitimate perspectives.”

In this context, the authors postulate that science has a strong responsibility for societal development. They refer to the history of progress that has been successfully pushed by scientific knowledge. However, they also voice criticism: “...*After centuries of triumph and optimism, science is now called on to remedy the pathologies of the global industrial system of which it forms the basis.*” (*ibid.*)

Many aspects of “post-normal science”, such as “grasping complexity”, “dealing with uncertainty” or “accounting a diversity of perceptions” (e.g. Mobjork 2010; Pohl and Hirsch Hadorn 2008), have been adopted and incorporated in the discourse of TD.

To date, practical applications of TDR can be found in the field of integrated environmental or sustainability science, as well as in health science (e.g. Klein 2008; Bammer 2005). In fact, sustainability science appears to be the ideal designated field for TDR (Hirsch Hadorn et al. 2006; Scholz and Steiner 2015). In this field, TDR is based on the derivation of a changed perception of great challenges and political objectives such as the Sustainable Development Goals (SDGs); it is backed by politically motivated funding programmes⁵ for sustainability research.

Today, science is not only expected to understand and explain phenomena, but also to provide guidance for action. Hence, knowledge production is called on to handle normative orientation and interrelate “descriptive, normative and practice-oriented forms of knowledge” (Pohl and Hirsch Hadorn 2008). This differentiation into the above three types of knowledge was discussed by several authors, who divided topics into (i) systems knowledge, (ii) target knowledge, and (iii) transformation knowledge (Jantsch 1972; Wiek 2007; Zierhofer and Burger 2007; Schäfer et al. 2010). Systems knowledge refers to questions about characteristics and dynamics of a problem, considering complex human–environment interactions and diverse interpretations (Know what?). Target knowledge represents normative knowledge, and captures desired goals and the needs and direction for change (Know where?). Transformation knowledge incorporates support for the development of strategies for societal transformation processes and concrete action (Know how?).

A similar differentiation into knowledge types can also be found in the concept put forward by Max-Neef (2005), who outlined his idea of a “transdiscipline” by inter-relating the specialised disciplines taught by modern-day universities (see Fig. 7.1). Max-Neef distinguished between four different levels: At the basic “empirical” level

⁵In Germany, this is especially supported and funded by the Federal Ministry of Education and Research.

Fig. 7.1 The concept of a “transdiscipline” (based on Max-Neef 2005)

of his pyramid, he placed the basic disciplines that are capable of answering questions on “What exists?” The next level, called the “pragmatic level”, covers the “technological disciplines” that contribute to the question “What are we capable of doing?” This level was named pragmatic level, which is headed by the normative level, with disciplines based on the question “What is it we want to do?” He called the highest level the “value level”, with disciplines that ask and answer the question “What should we do, and how?” Transdisciplinarity based on Max-Neef (2005) results from coordination between all four hierarchical levels of this pyramid.

In the recent discourse, however, TD is less understood as a discipline in its own right,⁶ but rather as a problem-oriented research principle that integrates different disciplinary and sectoral viewpoints, as well as knowledge types, also from outside academia. In this regard, TD is also strongly linked with (participatory) action research approaches (see also Cornwall and Jewkes 1995).⁷

Nonetheless, the concept of a “transdiscipline” based on Max-Neef illustrates that the different knowledge types are reflected by highly specialised science (university) but must be united to tackle “real-world” problems. In addition, the concept of Max-Neef clarifies that Mode-1 science represents the basis for Mode-2 science, which can be regarded as complementary by the additional integrative capacity.

A milestone in the conceptual development of TD was the “td-net” conference in Zurich in 2000. Here, different epistemological and research-practical discussions were brought together for the first time. A key result of this conference was a common definition of TD, which was subsequently broadly disseminated.

⁶According to Mittelstraß (2005), the identity of disciplines is determined by certain objects of research, theories, methods and aims of research. He argued that transdisciplinarity is not a theory principle, but rather a research guiding principle and a form of organisation.

⁷Scholz (2011) provided a good overview of the differences and similarities between TD, action research, participatory research and community-based research.

The Zurich definition describes TD “as a new form of learning and problem solving involving cooperation among different parts of society and academia in order to meet complex challenges of society” (Häberli et al. 2001).

7.3 The Impact of TDR, Criticism and Open Questions

The increasing launch and funding of TDR projects over the last two decades (see Bergmann et al. 2005; Defila et al. 2008) sparked an ongoing debate on adequate evaluation approaches. A large part of the literature on TDR is now dedicated to questions about quality criteria, impact measurement and evaluation frameworks (e.g. Carew and Wickson 2010; Jahn et al. 2012; Klein 2008; Roux et al. 2010; Walter et al. 2007; Wickson et al. 2006; Zscheischler et al. 2018). Nonetheless, since Klein (2008) claimed that the evaluation of TDR is “one of the least-understood aspects”, this statement continues to be highly relevant.

Difficulties in identifying consistent evaluation criteria result from the high degree of context specificity of TDR, the non-projectable changes, the high degree of uncertainty and the comparability of various projects (Wickson et al. 2006). Non-linear interdependencies, multiple interacting drivers of change and long-time lags (Roux et al. 2010) require varying approaches and criteria compared to conventional research efforts. Consequently, several articles have discussed potential evaluation principles for TDR (e.g. Klein 2008; Loibl 2005; Spaeth 2008). Nonetheless, no generally accepted quality standards have been implemented to date.

This lack of quality standards is a major criticism against TDR (Goebel, Hill, Fincham and Lawhon 2010). Although the development of quality criteria, as a kind of guiding principle, makes a valuable contribution to supporting researchers who apply TD, greater effort needs to be made to prove the effects of TDR. The highly complex question of verifying societal effects becomes especially important considering the backdrop of an increasingly output-oriented, competitive science. Greater focus on the societal effects of TDR and a more outcome-oriented approach are regarded as important (Russell et al. 2008; Walter et al. 2007) to substantiate the added value of TDR. Until recently, there were few considerations of the effects and outcomes beyond the TDR process.

Beyond numerous plausible explanations justifying TDR, there is little knowledge about its (true) performance. Doubts and a critical attitude are reflected by the question of whether transdisciplinarity is simply a “word à la mode” (Lawrence 2004; Mittelstraß 2005). In this context, the broad interest in adequate evaluation approaches can be interpreted as a legitimacy crisis.

TDR is time-consuming, and requires a large amount of resources. Effect analyses that justify these higher levels of effort are lacking. The additional expense incurred by TDR has not yet been justified by an established improvement in results. This deficit can be linked to a lack of empirical findings (e.g. Lieven & Maasen 2007; Tress et al. 2007). The few empirical studies on TDR projects are dispersed over several disciplines, application fields and case studies.

7.4 The Role of Transdisciplinary Research in the Field of Land Use Science—Results from a Comparative Case Study in Germany

To narrow the aforementioned knowledge gap, I conducted a number of studies among researchers and actors from practice who address questions concerning sustainable land management (SLM) and apply TDR in Germany (see Zscheischler et al. 2014, 2017, 2018; Zscheischler and Rogga 2015). In the following, I synthesise the results and present some key findings.

7.4.1 Sustainable Land Management Can Be Seen as a Designated Field for TDR

The results show that SLM is regarded as a designated field for the TDR approach. This is evidenced by the discussions in the field of land use science (Zscheischler et al. 2014), by a review of the literature (Zscheischler and Rogga 2015), and from ontological analyses of “complex real-world” problems such as the question of “increasing land use competition” (Zscheischler et al. 2016).

Sustainable land management can be seen as an upcoming conceptual framework that includes different perspectives on land as an increasingly valuable resource with regard to global challenges, such as climate change, demographic change, value change, economic change, and loss of biodiversity. It includes a strong orientation for action under the normative goal of sustainability, integrating ecological with economic and societal demands, and in this regard, it integrates knowledge, sectoral viewpoints and values. As one of the major challenges linked to SLM, a deeper understanding of human-nature interrelations as well as spatial interdependencies of land use decisions is mentioned (Zscheischler et al. 2014). Land use and land use change are driven by actors with diverse interests and demands on different scales. Thus, SLM faces many challenges with respect to integrating these competing interests. In addition, the core concept of sustainability is normatively driven, and values play a guiding role when taking action.

Against this backdrop, TDR poses a rationalisation potential, and it can provide “socially robust” knowledge to tackle these very complex real-world problems. This relation between SLM and TDR is also supported by the results of a meta-synthesis. It can be shown that many case studies that have applied TDR are related to the “management” of natural resources or land use (Zscheischler and Rogga 2015).

7.4.2 TDR Plays an Increasing Role, and the Concept Is Being Consolidated

There has been a boost in publication output over the past decade, reflecting the increased importance of TDR for land use science. Over a longer period, the concept of TDR has been highly debated in terms of its epistemological, theoretical and ontological foundations; its methodological approach; and its function in science and practice.

A review of this literature shows that, while the concept of TDR can be considered as being in a “consolidating phase”, it has recently been used mainly to describe a collaborative process of knowledge production that involves multiple disciplines and stakeholders aiming at enhancing the capabilities to tackle highly complex real-world problems (Zscheischler et al. 2014; Zscheischler and Rogga 2015). In line with other scholars, three core features of TDR can be identified: (i) complex real-world problems, (ii) collaborations and (iii) evolving methodologies that can be differentiated into further key concepts.

In particular, the concepts of “mutual learning” and “knowledge integration” are broadly discussed, specifying the quality of TDR. However, despite the emphasis placed on the idea of “knowledge integration” in the context of TDR, it is depicted only inconsistently and vaguely.

Nonetheless, it should also be noted that the interpretation of TDR in its current form, as a participative, problem-focused and action-oriented research approach, is strongly driven by a Central European perspective. In fact, a large proportion of publications come from countries such as Germany, Switzerland, Austria and the Netherlands.

The results also show that the debate on TDR is dominated by theoretical and conceptual contributions.

7.4.3 Attitudes Toward the TDR Approach Are Appreciative

My empirical studies revealed that researchers who apply TD are generally appreciative of the TDR approach and have a positive basic attitude towards it (Zscheischler et al. 2017, 2018).

In contrast to scientists and practitioners with idealistic motives, other scholars considered TD primarily as an alternative way to attract external funding. Researchers in Germany are under increasing pressure to raise external funding. Thus, empirical findings have revealed that the primary reason for launching a TDR project is to attract external funding. This entails modifying the in design and wording of the project proposal to satisfy the call for proposals without any deeper methodological proficiency. As a consequence, some researchers also reported that they considered TDR to be something of a “necessary evil” to be fulfilled to secure funding and that

they sought to reach a TD threshold that had to be passed to obtain funding; others changed their minds during the course of projects.

Nevertheless, TDR appears to be welcomed as an opportunity to pursue and test the transformation measures intended to achieve sustainability goals. Scientists are highly motivated to contribute to more sustainable land use.

Practitioners exhibited motivations and interests that differed greatly to those of scientists. The involvement of practitioners in the research process was considered by scientists to be one of the main difficulties in TDR. Interview partners occasionally criticised practice partners. They complained about practice partner saturation, about their disinterest in integrated and abstract approaches, and their sole focus on solution-based results. The science partners therefore made a greater effort to involve stakeholders with an affinity for risk and an interest in experimentation.

7.4.4 Understanding of TDR Remained Vague

The studies (ibid.) showed that understanding of TDR among researchers who apply TD differs from the conceptual advancing discussion led by scientists who advocate TD in the literature. Although an increase in consistency is apparent in the TD literature, there is only a vague understanding of the concept itself among the relevant researchers.

In one of the very few empirical studies on TDR, Tress et al. (2005) demonstrated that 81 per cent of researchers who performed TD had only a vague understanding of the concept. Almost one decade later, this vague understanding still prevails, as shown by the results. Nonetheless, the analysis of 13 TDR projects (Zscheischler et al. 2017) indicates that a shared notion of TD as a form of “science-practice collaboration” starting with a “real-world problem” is common to all projects. Other central features of TDR, as discussed in the theoretical literature, such as “mutual learning” and “knowledge integration”, exhibit very little consideration, or none at all.

Moreover, TD appears to be conceived as an instrument of transfer, meaning the application of real-world problem solutions from academia to practice. In this context, empirical studies revealed a common understanding of TDR as an approach for harmonising research results with the requirements of practice, which is a rather “shortened” notion of TDR.

The general uncertainty among researchers with regard to the concept of TDR is also documented by the key terms used in project proposals – they are hesitant when asked about their understanding of TDR and the success of their project, or when this was openly discussed.

7.4.5 The Application of TDR Is Often Shortened

Furthermore, echoing this rather vague understanding of TDR, a shortened application of TDR resulting in multiple differences from the proposed ideal–typical concept was found (Zscheischler et al. 2017). The majority of the investigated projects showed no element of an ideal–typical co-design process for the initial phase. Instead, project issues and composition were strongly shaped by pragmatism, following the logic of temporary projects. “Feasibility” and “efficiency” preclude ideal–typical proceeding. Thus, individuals or core groups of a few people (mainly representing science) determined the project objectives and desirable partners from science and practice alone. Scientific and practice partners and the project objectives were mainly selected based on previous projects, pre-existing contacts and networks. This pattern can be observed in all projects, which thus stresses the importance of mutual trust and network reliance in the selection of project partners.

7.4.6 Multidisciplinarity Prevailed

Interdisciplinary collaboration that integrates conceptual frameworks and theory from different disciplines remained an exception; there was often no strategic planning or management (Zscheischler et al. 2017). Some scientists met, while other sub-projects remained separate from each other in the projects under investigation. Although dependencies led to greater exchange between sub-projects, there were attempts to avoid such dependencies owing to fears of a delay in project organisation.

The projects were shaped by a strong natural science orientation from the very beginning. When asked about interdisciplinary collaboration in their projects, interviewees often cited adjacent disciplines in the field of land-related ecosystem research, such as agricultural science, forest science and hydrology.

As such, alternating perspectives on sustainable land issues from the humanities and social sciences were marginalised. Social science contributions were generally recognised in principle, but were rarely placed at the heart of the project from an overall perspective. Thus, collaboration between methodologically and ontologically “distanced” disciplines remained rather additive. In most projects, social scientists were not only outnumbered, but also classified as “interface specialists” who routinely worked as transfer agents or science communicators.

7.4.7 Involvement of Practitioners Aims at Acceptance and Implementation

There were different roles played by actors from practice, and their incorporated knowledge bases. One emphasis was placed on the involvement of such actors for

the production of spatial development models and scenarios (“Leitbild” processes), for acceptance analyses, and for the testing of technical innovations at practitioners’ facilities or sites (Zscheischler et al. 2017).

The quality of the involvement processes under investigation differed widely, ranging from projects with highly intensive co-operation and co-creation of knowledge to projects that conducted information activities as participative measures only. The overall picture reveals that information and consultation events clearly outweighed more integrative approaches and methods. Stakeholder and public acceptance of science activities and implementation appeared to be the prevailing goal of stakeholder involvement. Smaller projects (in terms of the number of institutions and partners involved) reported a noticeably more intensive exchange of information and perspectives among project members. However, one of the largest consortiums (approximately 35 partners) experienced a very successful stakeholder dialogue process involving more than 60 actors from practice. Unfortunately, these activities remained unattached to the core item of the project, which led to frustration for both the dialogue moderators (in this case scientists) and their non-academic project partners.

As a general observation, many scientists consider their research entirely separately from the stakeholder process. Others displayed a rather limited conception of stakeholder involvement. As an example, specific work packages were outsourced to providers that had been termed “non-scientific project partners”. Another frequent expression of that scientific “services” mentality was the provision of testing areas by landowners.

Non-academic actors were frequently classified as “partners” (bound to the project through contracts) and “actors” (involved through interviews and surveys, focus groups or workshops). Practice partners from municipalities, public authorities, NGOs and so forth were often bound to the project via (co-funded) employment at their respective institution.

One observed strategy was that many projects implemented “regional coordinators” who were assigned to establish or strengthen multiple communication processes involving (a) science and practice, (b) horizontal cross-sectoral communication (e.g. land management-related local authorities such as planning, environment, economy), and (c) vertical actor-based communication (e.g. micro-level to macro-level actors). This demanding position was frequently occupied by novices from universities who started from scratch, often without the expert knowledge of regional networks and peculiarities. Thus, project coordinators emphasised that the success of participative action depended strongly on the personality of “regional coordinators”.

Instead of a strategic concept of knowledge integration, the composition of objectives and results in the form of summaries and in the manner of multidisciplinary research was observed.

7.4.8 Challenges and Barriers to Applying TDR Are Often Underestimated, but Need Professionalisation

Most of the few empirical contributions found in the literature are dedicated to barriers and facilitators of applying TDR. An examination of the material and the results from participatory observation during many events leads to the assumption that the implementation of TDR remains a difficult challenge; therefore, the practice of TDR cannot keep pace with the progress of the theoretical discourse. Most mentioned barriers and challenges generally result from a lack of resources (time, labour) and problems that arise from habitual, mental and cognitive differences among people who are part of heterogeneous research teams, i.e. differences in ontological models, expectations, levels of commitment to and engagement in the process, and levels of skill and experience. In a small number of cases, the lack of the capacity to adapt to a changing context (personnel issues) is noted. Communication is widely considered to facilitate the transdisciplinary process and is therefore accepted as a strategy to overcome interpersonal differences. In this regard, the implementation gap appears to be twofold, characterised by both operational and cognitive inconsistencies.

The observed gap between theory and practice can be attributed to the short history of the TDR concept. As evident from the statistical distribution of the literature sample (Zscheischler and Rogga 2015), the publication output merely started to increase during the past decade. Another reason can be identified in the heterogeneity of the concept. In fact, over the stretch of the last two decades, the (mainly normative) debate on TDR revealed a highly fragmented discourse that led to multiple understandings.

Finally, the demands for the application of TDR in a real-world setting may be underestimated on a regular basis. According to our investigations and others (cf. Tress et al. 2007), researchers' struggles to implement TDR do not depend on their professional experience with the concept, but might rather be justified by a lack of opportunities for reflection within respective projects.

7.4.9 Scholarliness Runs the Risk of Falling Behind

The results also indicated that scholarliness runs the risk of falling behind in TDR projects (Zscheischler et al. 2017, 2018). There were difficulties in balancing scientific claims against practical orientation in TDR projects. Coordinating scientists appear to have been particularly affected, and they complained about a lack of time to conduct their own research activities and write publications. Moreover, the pressure to publish hampers scholars' openness to a time-intensive transdisciplinary process. In this regard, extra-academic organisations (often spin-off companies) have appeared to be better positioned to assume the coordination of transdisciplinary projects. However, such projects have tended to deprioritise scientific aspects, and risked becoming pure consulting projects.

Additional proof of this finding is that junior scientists put their academic career opportunities at risk by assisting in TDR projects. Many doctoral students tasked with co-ordinating parts of a project had failed to complete their dissertation by the time the project had come to an end. This finding corresponds with results from a comparative study published by Lange and Fuest (2015), who investigated similar projects. Moreover, the scientific quality of doctoral theses evolving from TDR projects is thought to be relatively low. Consequently, some professors have little motivation to supervise such theses.

In addition, the results from a survey (Zscheischler et al. 2018) show a strong “practice tendency” of the perception of TDR success among scientists. Scientists seem to consider TD research mainly as a research form that prioritises practical outcomes.

7.4.10 The Science-Practice Benefits Equilibrium Is Off-Balance

One objective of our study was to assess the extent to which TDR contributes to the goals of SLM and keeps its promises. Since many conceptual papers on the evaluation of TDR have shown that it is virtually impossible to prove a direct impact, we asked researchers and practitioners about their perspectives on TDR project success.

The results (see Zscheischler et al. 2018) showed that there is a clear conceptual deficit regarding success dimensions and criteria when asking about the success and benefits of recent TDR projects in the form of an open question. Nonetheless, a quantitative survey, which asked respondents to rate prescribed criteria, indicated that there is a kind of basic shared “success profile” among all project participants. This “success profile” highlights criteria with a high relevance to practice, whereas typically scientific success criteria were rated as less important. This assessment indicates a significant imbalance within the science-practice benefits equilibrium, as advocated in the literature, which leans toward the practice-oriented side of the TD ideal.

As shown (Zscheischler et al. 2018), many criteria are simultaneously important and that must be considered for the successful execution of TDR projects. It can be assumed that a deficit in fulfilling one criterion cannot be compensated by overperforming in another.

Our results show that the “output performance” and “process quality” of projects are important for the overall success perception of a project, while personal benefits for “career opportunities” seem to have no influence. This finding underlines the assumption of a high degree of idealism among participating scientists.

In general, the results revealed that the overall success assessment of TDR is rather moderate. On the one hand, this finding can be traced back to the often sub-optimally realised TDR process (see Zscheischler et al. 2017). On the other hand, the study revealed both high and vague expectations.

7.5 Conclusion and Outlook

The results highlight that TDR is an approach with a high potential for complex land use issues, where normative discourses, conflicting interests, sectoral and disciplinary viewpoints, and different knowledge types are increasingly integrated in the search for sustainable solutions. Scientists who apply TD mainly have an appreciative attitude towards the concept, when asked about their opinion on TD. However, in spite of this acknowledgement, a crucial gap between the theoretically described “ideal type” of TDR and its “real-world” application was identified. This gap is accompanied by a vague understanding of what TD precisely constitutes among researchers who apply TD. The simplified conceptualisation of TD, meaning an instrument of transfer that harmonises research results with requirements from practice, may help explain the observation of a prevailing multidisciplinary and an often-found low level of involvement of practitioners. In this context, it emerged that the benefits, especially regarding the scientific knowledge gain, are rarely reflected on, and therefore go unnoticed. As a social innovation in the academic system, it can be argued that TDR is currently undergoing an upscaling process, risking “rhetorical mainstreaming”. It will therefore be important in future to assure the quality of TDR processes, and to narrow the misfit between prevailing academic structures and increasing professionalisation and profound knowledge among researchers who apply TD. And yet TDR methods and the underlying theoretical foundations are rarely taught at university. Greater consideration of these methods and foundations in higher education would make a significant contribution to the better adoption and quality of TDR processes and outcomes.

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