

## RESEARCH ARTICLE



# Science with society: Challenges of early-stage researchers engaging with transdisciplinary research in sustainability science

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## Abstract

The ongoing social and ecological crises create urgency in academia and elsewhere to devise actionable problem-solving knowledge to tackle sustainability challenges. Transdisciplinary research (TDR) represents a problem-solving methodology for sustainability problems. TDR requires researchers to get out in the real world and engage with other societal actors to jointly produce such problem-solving knowledge for research to have a societal impact. This radical process of doing “science with society” instead of “science for society” is becoming more urgent and relevant. However, a transdisciplinary (TD) researcher faces challenges: often, institutions have limited readiness for facilitating TDR, a researcher has to juggle the roles of an academic and changemaker simultaneously and needs new ways of doing science. The research process requires enough manoeuvring space to incorporate reflexivity, adaptiveness, and emergence based on the research context. The research uses case studies, interviews, reflections, and document analysis from two finished and one ongoing TDR PhDs in sustainability science and connects them with the TD literature. Based on previous and ongoing TDR by early-stage researchers (ESRs), this article identifies and discusses six TDR challenges ESRs in sustainability sciences might face.

## KEYWORDS

early-stage researcher, higher education, sustainability science, transdisciplinary PhD, transdisciplinary research

## 1 | INTRODUCTION

The planet suffers from the ecological crises of climate change and biodiversity loss, while people suffer from injustices, food insecurity and inequalities (IPBES, 2019; IPCC, 2019; World Bank, 2020). Due to these urgent challenges, knowledge creation needs to connect with implementable and legitimate solutions. Transdisciplinary research (TDR) aims to generate such problem-solving knowledge. TDR introduces a more collaborative research process for solving real-world sustainability challenges by bringing together science and other societal actors (Fam

et al., 2018; Gibbons et al., 1994; Hadorn et al., 2008; Lang et al., 2012; van Breda et al., 2016; Witjes and Vermeulen, 2021, Witjes et al., 2021).

This TDR promise of societal change might attract some early-stage researchers (ESRs). For this article, ESR refers to individuals in the first four years of their research career (including PhD candidates). They, therefore, have limited experience organising, conducting, and executing research and research projects. However, TDR brings additional challenges compared to other research approaches. Even though transdisciplinary (TD) literature discusses challenges while making sense from various sources and forms of knowledge to co-

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create solution-oriented understanding and implement them, only a few papers connect TDR challenges to ESRs (discussed in Section 2.2). Using experiences of TD ESRs, we identify and discuss challenges ESRs face and ways to navigate them.

This article addresses two questions: (i) what research challenges could TD ESRs face? And (ii) what can ESRs learn from the experiences of the previous TD ESRs to understand and navigate these challenges? We use two completed PhD projects and one ongoing PhD project as case studies to identify such challenges. This article briefly introduces TDR and then explores TD literature focusing on sustainability science ESRs. Then it draws upon the PhDs to highlight challenges and lessons learned from ESRs' perspectives. The primary audience of the article is TD ESRs engaging in sustainability sciences. However, the challenges identified are not unique to TD ESRs or their teams. This article provides valuable insights to practitioners in sustainability sciences, especially those curious about TDR, and research funding agencies, who demand societal impacts. This article also contributes to the TD literature by linking TD ESRs to sustainability science.

## 2 | TDR IN SUSTAINABILITY SCIENCES

The first section highlights some of the key TD ideas in sustainability science. The second section focuses on TD literature that links to sustainability science ESRs.

### 2.1 | Perspective on TD and sustainability research

van Breda and Swilling (2019, p. 824) characterized the TDR approach not as “a new science per se, but rather a new way of doing science.” For example, doing “science *with* society” instead of “science *for* society” manifests the co-production of knowledge between science and society. Gibbons et al., (1994, p. vii) called this process Mode 2 knowledge production, which guides not only what is produced “but also how it is produced; the context in which it is pursued, the way it is organised, the reward system it utilises and the mechanisms that control the quality of that which is produced.” TDR aspires toward knowledge creation that is non-hierarchical, heterogeneous, transient, participatory, socially accountable and reflexive, directed to solve real-world problems (Gibbons et al., 1994). TD methodology is pluralistic and evolving, borrowing and integrating from a fusion of disciplines (Wickson et al., 2006). Koskinen and Mäki (2016) link TD integration of knowledge as a contributor to pluralistic philosophies of science. Hadorn et al. (2008, p. 19) viewed the aim of TDR to: “(a) grasp the relevant complexity of a problem (b) take into account the diversity of life-world and scientific perceptions of problems, (c) link abstract and case-specific knowledge, and (d) develop knowledge and practices that promote what is perceived to be the common good.” Simply put, the TDR “pushes scientific research to leave the academic arena with an exclusive academic research culture and aims to search for direct contribution to societal transition by applying co-production of knowledge with non-academic stakeholders” (Vermeulen & Witjes, 2021, p. 27).

Given that TDR involves incorporating knowledge and experience from different perspectives, including non-academic, there is a need to develop the relationships and shared understandings necessary to find shared solutions (Lang et al., 2012). Lang et al. (2012) proposed a three-phase research process. Phase A includes problem framing and team building, phase B includes co-creation of solution-oriented transferable knowledge and phase C has re-integration and application of such created knowledge that involves science and society. Similarly, Witjes and Vermeulen (2021) synthesise the proposals for organising the research process by various TD scholars by identifying a six-step TD process, which is: 1. research and strategy, 2. problem exploration and structuring, 3. system understanding, 4. search and compare solutions, 5. choose, decide and prepare for application, and 6. synthesis and feedback with overall vision and strategy. The authors associate multiple challenges with these steps, which include: perception of joint-problem framing across disciplines (where identification of knowledge needs and research questions is ideally made with non-academic stakeholders), making sense of various forms of knowledge toward a shared understanding, communicating with diverse stakeholders with multiple interests, applying knowledge co-created to problem solving and navigating the traditional academic system (Witjes & Vermeulen, 2021).

To contribute to a just and sustainable future, researchers increasingly need to investigate “complex problems that lack definition, have multiple value judgements, lack solutions and resist all attempts to resolve them”, characterized as wicked problems (Brown et al., 2010, p. 4). They identify that TDR allows the inquirer and the decision-maker to find solutions together, suitable for tackling such wicked problems. Highlighting the need for strong sustainability over weak sustainability, Pelenc et al. (2015) proposed a TD approach to implement strong sustainability (for strong versus weak sustainability, see Dobson, 1996, 1998; Ekins et al., 2003; Neumayer, 2003; Roome, 2012). TDR challenges the limited academic engagement with the real-world by proposing a radical and democratic approach to science. The idea of co-creating systemic, targeted, or transformative knowledge by engaging societal actors and questioning traditional academic ontologies is increasingly popular. However, it is often limited to a niche of TD practitioners.

Scholars have identified characteristics and principles for successful TDR processes. Lang et al. (2012, p. 29) identified three characteristics: (i) the inclusion of various knowledge communities for well-rounded incorporation of essential knowledge; (ii) incorporating knowledge production beyond problem analysis includes diverse goals, norms and vision, and increasing legitimacy, ownership, and accountability for understanding and solving problems and proposing design principles to integrate them and (iii) they identify challenges in the TD process and propose coping strategies. Witjes and Vermeulen (2021, pp. 42–45) synthesized eight principles:

1. Abductive reasoning: reinterpretation and reconceptualization through the research process guided by hunches, prior academic and non-academic knowledge

2. Open-minded, multi-actor reflection: collective critical reflection to find solutions for practice and science operating from outside the comfort zones of disciplinary boundaries
3. Iterativeness: critically reflecting on the societal challenge (individually or in a group) to search for the unknown to constantly adapt the process for better outcomes
4. The triple focus: focus on the content, process and implementation encompassing the academic and non-academic components of the research
5. Understanding the bigger problem: using tools like system thinking and multiple actor collaboration to grasp the complexity and wickedness of societal challenges for transformation
6. Multi-level learning: learning from multiple actors using various knowledge sources
7. The long-term full system perspective: understanding and outcomes should have a long term system and sustainability perspective
8. The orchestrated approach: the ability to choose between pragmatic and orchestrated approaches depending on the problem's complexity, wickedness, and urgency.

Multiple interpretations, understandings and conceptualizations of TD exist in the literature proposing plural epistemologies. Having a good grasp of theory facilitates the TDR process. However, a researcher must contextualise this knowledge in practice, guided by TD principles.

## 2.2 | TD process for ESRs

This section discusses research that explicitly links TDR with ESRs. TDR requires ESRs to (1) engage with (interdisciplinary) academic literature; (2) combine this knowledge with a sector, situation, or practice to create change and (3) design the research to make it relevant, credible, legitimate, and effective (Willets and Mitchell, 2016). Vermeulen and Keitsch (2021) recognise the added societal responsibility to produce socially relevant and implementable knowledge of TD ESRs on top of academic responsibility. However, there is no additional time and resources required for the later part. In addition, ESRs need additional TDR competencies, capabilities and skills to generate societal impact. Such capacities and skillsets for societal change can come at the cost of academic excellence, causing a trade-off (Rogga & Zscheischler, 2021). For academic robustness in TDR, Gaziulusoy and Boyle (2013) proposed an iterative and reflexive heuristic for reviewing and integrating literature across disciplines encompassing visions, values, and norms. However, depending on the researcher's value, time and resources, some might prefer one over the other. Academic robustness could therefore be compromised for prioritizing change-making activities.

For instance, compared to conventional PhD, community engagement or implementing identified solutions for TDR might take time away from focusing on publishing, which is vital for an academic career. Furthermore, Wickson et al. (2006) discussed the hardships of

getting TD work peer-reviewed in a context of a not well-established community of peers. Traditional publication outlets focused on the knowledge produced without much importance on the context, process, use of such knowledge etc. (see Gibbons 1994, discussed above), often stripping the TD process. To facilitate TDR, many authors suggest institutional reforms. Felt et al. (2013) identify the necessity of change in knowledge production regimes for TDR to facilitate the additional role of enabling social impact. Based on TD PhD experiences, Rogga and Zscheischler (2021) made a case for new academia to enable interchanging roles of scientists and practitioners by introducing a doctorate program in TDR, especially in sustainability sciences. Sellberg et al. (2021) presented a triple-S heuristic giving attention to science, society and self for a flourishing TDR practice in academia. Witjes and Vermeulen (2021) discussed institutional TD strategy, portfolios or readiness and its influence on TDR. Manathunga (2016) identified supervisory actions to facilitate TD PhDs. Institutions' ability to nurture, support and adapt to TDR is crucial.

Scholars have many suggestions to facilitate TDR. Mitchell and Willets (2009) show the difficulties of assessing or monitoring progress in a TD process and, given limited time and resources, question the practicality of TD ESR to have a societal impact (2016). Kemp and Nurius (2015) proposed a multiple-year training for the TD ESR to build qualities and competencies that enable successful TDR. Such "TD readiness" development involves training covering TD orientation, critical reflection, dialog, multi-level theoretical architecture, methodological pluralism and team science skills (see Kemp & Nurius, 2015). Similarly, Schrot et al. (2020) found a lack of training causes TD ESRs to use only a small set of existing tools and methods. They recommend lectures on participatory approaches, excursions, hand-on courses, TD mini-projects and toolkits, and even introducing TD elements in the master's studies. Wickson et al. (2006, 1056) proposed six quality criteria for TDR for PhDs: "from clear goals to responsive goals, from adequate preparation to broad preparation, from appropriate method to evolving method, from significant results to significant outcomes, from the effective presentation to effective communication and from reflective critique to communal reflection."

We find diverse interpretations of TDR challenges and multiple ways to tackle them in the literature. Balancing societal impact without losing academic focus, ensuring the right skillset for TDR, and adaptability to navigate academia as required by context is central to TDR practice. Later, we discuss the challenges and how ESRs navigate such challenges.

## 3 | MATERIALS AND METHODS

This article presents two completed PhD projects and one ongoing PhD project as illustrative case studies to provide reflexive insights into ESRs' TDR challenges. The research design was guided by that proposed by Denzin and Lincoln (2017) that encompassed a combination of qualitative approaches, including case study, personal experience, introspection, interviews, observation, and textual analysis.

First, we analyzed the two PhD theses, using thematic coding to identify the key challenges and potential coping strategies mentioned in each thesis. These findings were shared with the authors to validate them. Second, we used online semi-structured interviews to interview the authors to learn about their long-term reflection on the TDR process, later integrated into the discussion section. Last, we interviewed the host organizations of the two PhDs to understand the challenges of hosting TD ESRs using semi-structured online interviews. The four interviews conducted in English lasted for forty-five minutes to an hour and centered around TDR challenges. A third illustrative case study in the form of a mid-way reflection of an ongoing TD PhD of the primary author is provided. This account is based on observations, journal entries and reflections on the research process. Data from the thesis, transcribed interviews, notes and reflections were analyzed to find TDR challenges in the three PhDs to identify six cross-cutting challenges.

The diversity of TDR methodologies and principles used in the illustrative cases justifies the case selection. The three PhDs use a variety of TDR processes (methodologies, disciplinary knowledge, etc.) in diverse geographical, institutional and research contexts. All PhDs were driven by the TDR principles of co-creation, problem-solving and integration of science with society. All demonstrate the significance of context and reflexivity in TDR. These PhDs are fairness-driven and solution-oriented. Based on these diverse factors, we argue that the chosen TDR projects provide a basis for sound contextual knowledge for other ESRs to learn from the key TDR insights. Even though TDR is context-specific, insights from one research can be helpful for others (Hadorn et al., 2008). ESRs' TD projects, like the ones discussed, have provided critical insights and enriched the TDR literature (see: Muhar et al., 2013; Rogga & Zscheischler, 2021; Sellberg et al., 2021; van Breda et al., 2016).

## 4 | FINDINGS

The first three sections present findings from the PhDs, and the last section brings the hosts' perspectives on TDR challenges.

### 4.1 | Illustrative case I - action research in the Netherlands

This section presents the insights from Luz de Lourdes de Pesqueira Fernández's (2014) PhD thesis *Friendly Outsider or Critical Insider? - An Action Research Account of Oxfam's Private Sector Engagement* as the first case study. Her PhD project follows her action research-based exploration at Oxfam Novib (Oxfam) to explore two things: non-governmental organizations' engagement with the private sector and the role of action research in a scientific inquiry.

Pesqueira's research involved working *with* and *for* Oxfam. Over 2 years, she spent 3 days a week with Oxfam on her PhD research and one day a week for Oxfam's research activities. Pesqueira worked only one day at the university instead of a conventional PhD working

5 days. Working with and for the "object of research" provides a relationship-building opportunity to co-create an epistemological community and create embeddedness. In traditional research practices, this closeness to the "subject of the research" could be seen as bringing biases and hindering objectivity. However, her reasoning for this active engagement follows the TDR goals of useful knowledge co-creation and solving real-world problems (de Pesqueira Fernández, 2014, p. 17). Pesqueira describes that participatory paradigm enhances a democratic dialog: "co-researchers and co-subjects collaborate to define the questions they want to explore and how they should be explored...the research, then, is not done by researchers on other people, but by people mutually researching each other" (de Pesqueira Fernández, 2014, p. 18). Pesqueira justifies this process as an epistemology of inquiry that generates various knowledge: experimental, presentational, propositional, and practical, in a reflexive process. Nevertheless, Pesqueira also warns about the possibility of being less critical during the engagement and participatory process if one remains unchecked by themselves or their supervisor (de Pesqueira Fernández, 2014, p. 170).

Pesqueira's dissertation uses the first-person perspective instead of a more traditional thesis approach of a passive voice. The first-person narrative allows her to capture the richness and complexities of social interaction, observation, pictures, creativity, reflexivity, and her feelings beyond the scope of the traditional scientific medium. Pesqueira states that "traditional scientific outlets are not broad enough to adequately capture problematisation of social practices, nor the reflexivity involved in action research" (de Pesqueira Fernández, 2014, p. 21). Pesqueira argues that storytelling is central to research validity even at the cost of being viewed as "unsystematic" by a conventional social scientist (de Pesqueira Fernández, 2014, p. 7). One example of where the journal format captures the reflexive, collaborative, self-assessment of the impact-oriented process is found early in the thesis:

The meeting lasted approximately 90 minutes and was much more formal and demanding than the meeting with SOMO had been. By the time this meeting took place, I had become more aware of the complexity of what I was trying to achieve. Establishing research collaboration with another organisation is actually a demanding process in which questions and approaches must be jointly defined and in which expectations that are relevant for both groups must be met. Besides this, the process also requires dealing with various practical issues related to time frames, financial and technical resources, information access, and confidentiality. (de Pesqueira Fernández, 2014, p. 15).

Throughout the thesis, Pesqueira reflects on being an outsider at the university and Oxfam. Pesqueira often defends her methodological approach to action research. And reflects, "but even if I was convinced that this was an appropriate way to carry out the research, I occasionally found myself questioning the robustness of the approach,

as well as fearing criticisms from colleagues in academia” (de Pesqueira Fernández, 2014, p. 57). Conversely, at Oxfam, her research was sometimes perceived as too impractical i.e. too academic, making it harder for practitioners to relate. Pesqueira reflects on presenting her analytical framework and conclusions to the team at Oxfam, and she writes, “most people found it difficult to follow my presentation, arguing that the discussion was too abstract” (de Pesqueira Fernández, 2014, p. 87). Elsewhere, she reflects on a remark from an academic colleague about her analysis seeming “like the work of a consultant than a scientist” (de Pesqueira Fernández, 2014, p. 99). Having to please two camps that value different (useful versus scientific) knowledge, finding legitimacy for her research approach becomes an ongoing challenge.

One central dilemma in Pesqueira's research is captured in her thesis title “Friendly Outsider or Critical Insider.” In building the epistemic community and maintaining legitimacy, there is a constant need for balancing her two roles (de Pesqueira Fernández, 2014, p. 59). Finding a balance becomes central to her research process. Pesqueira describes this process as “a tension between belonging – being part of the group, securing trust, and becoming involved – or remaining on the sidelines and not being completely part of the world of practice or academia.” (de Pesqueira Fernández, 2014, p. 60). This tension directly relates to another challenge, which Pesqueira considers a cognitive gap between the two groups. To bridge this gap between the scientists at the Utrecht University and practitioners at Oxfam, Pesqueira communicates and facilitates “to make someone else make sense of the sense one makes of the world” (de Pesqueira Fernández, 2014, p. 99). This process involves communicating her knowledge by writing a report for Oxfam and scientific publications in journals for academia separately. This challenge stems from two factors: (a) traditional academic rigidity with limited space for this messy, iterative research process and (b) explorative research and rigorous academic work that needs to be practical, problem-solving and actionable. Pesqueira reflects on these challenges in her concluding chapter. She questions how much theory is relevant for practice, how much practicality must be incorporated in theory, and where the boundaries begin and end. She reflects on the challenges of finding a balance between being flexible and fixed. Monitoring and defining the success/progress of the research project is not straightforward. She reflects on whether the research is credible to someone who did not participate in the knowledge production process. Despite these challenges, Pesqueira action research benefits Oxfam from a critical reflection of their work while working with them and for them. Her thesis and two published articles (Pesqueira & Glasbergen, 2013; Pesqueira & Verborg, 2012) during her PhD project enhance academic understanding of the NGOs' engagement with the private sector.

## 4.2 | Illustrative case II - emergent transformational Design in Burundi

The second case study is Lauren Rosenberg's PhD project on the Burundian speciality coffee sector's sustainability challenges.

Rosenberg submitted her PhD thesis titled *Turi kumwe (we are together): A transdisciplinary exploration of the Burundian speciality coffee sector and its sustainability challenges* to the Faculty of Economics and Management Science at Stellenbosch University in 2017. Rosenberg's thesis focuses on the fuzzy intersection of trade, development, and social justice (Rosenberg, 2017, p. 4) based on a lived-in experience working at Long Miles Coffee Project (LMCP) as a Farmer Relations Officer in Burundi. Rosenberg follows the emergent transformational design methodology (ETD) (see van Breda et al., 2016) Section 2.2), a context-driven TD method. Rosenberg acknowledges the ETD process as an enabler that created 26 full-time employment opportunities for young Burundians during her PhD and contributed to academic knowledge on the speciality coffee sector and TDR (see: [Rosenberg, 2021; Rosenberg et al., 2018]). Rosenberg's research epitomises the Mode 2 knowledge production or “science with society” (Gibbons et al., 1994).

From the onset of the thesis, context plays a central role in unfolding her emergent research. Rosenberg's lived-in experience and work with the coffee company allow emergence, enabling her to co-create transformational knowledge to understand sustainability in the Burundian coffee sector. Rosenberg reflects, “the voices of producers in the literature surveyed thus far are relatively quiet, overpowered by the noise of policy and regulatory documents that expound on the details of certification standards whilst simultaneously competing and debating with each other as to which way is the best way to measure impact” (Rosenberg, 2017, p. 9). In a later chapter, she further reflects, “I have come to understand that sustainable coffee is a learning process embedded in a particular place, not a list of requirements to meet” (Rosenberg, 2017, p. 35).

Lived-in experience enables her to create an epistemic community to unfold the ETD process and evolution of her open research agenda based on the community's needs. Two initial reflections capture her openness, “the day I flew to Burundi and didn't know what was next” and “I wanted to create something that far outlived the duration of the PhD project” (Rosenberg, 2017, p. 14). Reflecting on uncertainties of the process with honesty and admittance of naiveté and hopes are rare in a traditional PhD thesis. Such uncommon lived-in experience for a PhD can take a toll on the researcher emotionally and physically. She reflects how adjusting and readjusting to navigating culture shock and research challenges shaped her and, thus, the unfolding of the research. She reflects on research and legal challenges associated with being a foreigner in Burundi, “we spoke for several hours, and I was mostly preoccupied with listening to what was being translated and taking notes as best I could. We went to sleep, only to be woken up some time in the middle of the night by the police chief and his two guards carrying large guns: they had come to arrest me as I was a foreigner who was staying in the community without permission.” Researching in a foreign context can expose one to misunderstandings and uncomfortable circumstances despite the best interests. Such challenges also shape problem framing, team building and knowledge co-creation.

Like Pesqueira's central dilemma, Rosenberg mentions “participating insider” and “observing outsider” as part of her TD challenge. Her

research involves navigating these roles, often with uncertainty and intuition. She views her co-workers as co-researchers (Rosenberg, 2017, p. 16) as the research was *with* the community and not *on* the community. This enables her to generate transformative knowledge “rooted in the skills and need of the local culture” while building trust to experiment with interventions that are “provisional, safe-to-fail social experiments that can be adapted to suit changes in the context” (Rosenberg, 2017, p. 17–18). The lived-in experience enables three qualities central to the ETD research: the “logic of hunches...of making connection between things based on intuitive reasoning despite the extremely fallible insight of the researcher” (abductive logic), “creating with that which the context offers...a shift in function of something during evolution” (bricolage and exaptation) and “immersion allows for emergence – opportunities and events that could never have been planned or predicted apart from experience of the context” (allowing for emergence) (Rosenberg, 2017, p. 18–19).

Solving real-world problems is usually not the goal of traditional academic research. Instead, the focus is on a disciplinary or interdisciplinary understanding of the problem, hoping such knowledge leads to change. Thus, such co-created knowledge faces challenges when communicating with academia. Like Pesqueira, Rosenberg struggled to find a place in academia for integrating her research and knowledge. Unlike traditional research, where there is distance and “objectivity” between the researcher (subject) and the researched (object), TDR (tries to) dissolve such divisions. Rosenberg uses a journal format in the first introductory and last concluding chapters with a first-person narrative to capture her research, where she herself, at times, is the “object” of inquiry. She describes it as *writing-in* (highlighting situated partiality, reflexivity and rigor, insights into the complex emotional process) as opposed to *writing-up* (distanced position, producing impartial knowledge) (Rosenberg, 2017, p. 192). Comparing her work with other colleagues or relevant authors in the field, she reflects, “my evidence seemed far too anecdotal to matter to anyone apart from the LMPC farmers, LMPC and the community of coffee buyers it works with” (Rosenberg, 2017, p. 194).

Furthermore, she reflects on the evaluation of the TD PhD project compared to disciplinary PhDs. While visiting a university not necessarily versed in ETD methodology, Rosenberg experiences another dilemma. She recalls, “I experienced a violent collision with the established norms of higher education (inquiry-driven and validated by deductive and inductive logic) at Utrecht University whilst writing this thesis that frequently contributed towards a feeling of isolation and confusion” (Rosenberg, 2017, p. 197). In her concluding chapter, Rosenberg reflects on the insider/outsider dilemma, producing academic knowledge versus solving real-world:

I continuously chose to put the formal academic outputs of this research process as a second priority as I was working off the hunch that if the first priority was to contribute towards solving problems in the real-world of the research, the necessary academic outputs would automatically be generated. I was only partially correct in this hunch. It was, and remains, an extremely

risky decision to prioritise problem-solving in the real-world above academic outputs as currently TD doctoral research is not evaluated on the quality of real-world intervention but on the quality of a specific type of written documentation (publications and dissertations) of the real-world intervention. (Rosenberg, 2017, p. 198).

### 4.3 | Illustrative case III—TDR in transboundary waste

This section reflects on challenges in the early phases of TDR (project design, problem exploration, systemic understanding and solution creating) based on ongoing research on the transboundary movement of European waste to China and Nigeria. This section uses the first-person narrative to provide context, process, reflection and present challenges from the author of this article.

I valued and engaged in interdisciplinary learning but only got exposed to TDR during the first-year PhD workshops. Perhaps, it was also my previous impact-oriented experiences working with non-profit sectors that made TDR attractive. Even though my PhD’s research questions were fixed, there was methodological flexibility in conducting the research. I dived into the TD literature, and my supervisor, who is versed in TDR, provided support and guidance when necessary.

My institution is based on Europe, and my research is in the Global South. I straddle between these two and their multiple realities for research and life. This also shapes my evolving positionality as a researcher. To overcome physical, cultural, and epistemological distances, we decided on exploratory fieldwork early on. The plan was to see what was going on, be open and pay attention to what emerged. Both TD literature and my supervisor encouraged “learning by doing.” I was navigating uncharted territory in Nigeria and China, even though there was support from local partners. But there were several challenges. After immigration problems, I was picked up three hours late from the airport, and there were conflicting messages about whether to drive in the night to another city because of security reasons. All this in a few hours of arrival. However, I stayed open and navigated using hunches. But I soon realized hunches, which depended on prior experiences, worked best in familiar environments. I was an outsider, and I wanted to fit in.

I am unsure how much I have “fitted in” upon reflection. There is no matrix to measure it. In China, I built a social network of colleagues. But my research progress was slow. China was one of the biggest e-waste importers until the national import ban in 2018. I did two “field visits” in 2 months, limited to interviews without facility tours. The university connection facilitated both visits. My planned visit to Taizhou and Guiyu, cities famous for e-waste recycling, were never approved by the local government. Visits without government support and speaking with residents through a translator only provided simple anecdotal glimpses. I interacted with researchers I met during conferences but still lacked opportunities to connect with

essential stakeholders. Most of my limited interactions suggested that e-waste import is strictly prohibited and is no longer a problem. Of course, things would have been better if I had spoken Mandarin and had more connections to navigate the socio-political spaces. The “exploratory” seemed to be missing from my exploratory fieldwork.

My second fieldwork was in Nigeria, shortly after the China visit. Although it was August, I was cold and shivering with fever on my second day in Nigeria. With mosquitoes in my hotel room, fear of yellow fever was constantly on my mind until I got vaccinated. I could not spend my research time being sick. I was in Nigeria, one of the leading European e-waste receivers, for only one month. Luckily, I soon recovered. Support from the host university, a weeklong internship at the Basel Convention Regional Centre and an academic conference introduced me to more stakeholders. A month's stay in Nigeria led to 12 interviews, six field visits, and numerous engagements with various stakeholders. In terms of the TDR process, I “fitted in” more than in China. It led to future research plans and consortiums, later adapted online due to the COVID-19 pandemic.

The embeddedness of researcher(s) allows relationship building, emergence and progress in research. Despite embeddedness in Nigeria, one challenge was to incorporate the informal sector, which plays a central role in waste management in Nigeria. The informal sector is already marginalized in society, and voices, if heard at all, are often represented by others, not themselves. Our research initially aimed to research *with* them as integral stakeholders instead of *for* them. However, establishing any connection, let alone trust, and creating safe spaces, was challenging without embeddedness in the informal sector. Planned follow-up research visits for better embeddedness could not occur due to the Covid-19 lockdowns. Online research restricted in-person visits, more conducive to relationship building. We compromised by working with stakeholders online who worked closely with the informal sector and represented their voices.

In our research, socially useful knowledge creation involved continuous negotiation among actors with unequal power or diverging views together (for example, government and the informal sector view each other as a nuisance). Otherwise, it would lead to unjust or unrealistic solutions. I had to facilitate trust-building by creating safe and creative spaces for my research to progress. So, I took the *Art of Hosting* workshop and hoped to design safe co-creative spaces. Online was a challenge to reach participants without reliable internet, but it also meant I could ask my colleagues to support me for a few hours irrespective of where they were based. Co-creation created legitimacy but was time and resource-consuming, dragging the research longer than planned. I had to learn new skillsets that I could not easily learn in a university, like hosting workshops, writing scientific findings for stakeholders, etc. Chambers et al. (2021, p. 983) put the compelling promise of co-creation for “developing solutions through legitimate processes that draw on diverse and credible expertise with, by and for those best placed to use them” but also warns about the unique challenges and trade-offs.

Navigating embeddedness in new socio-cultural reality presented challenges, some more easily navigable than others. For instance, I could quickly adapt to the varied sense of time; for example—meeting at nine meant meeting at half-past nine or ten, and one-hour drive

meant 2 hours. Others were difficult. In parts of Nigeria, where kidnapping is common, my movement was restricted due to security reasons. During the field visit to the public market in Computer Village in Lagos, some locals questioned, threatened, and surrounded the car of the research team with us inside until a “tax” was paid. Exposure to inhuman conditions around me triggered strong emotions. Both pleasant and unpleasant experiences developed embeddedness and cultural competence. I learned that embeddedness, a critical ingredient to building trust, could occur in planned and unplanned situations if one is open. Lunch breaks and the local extreme traffic jams were also opportunities for embeddedness.

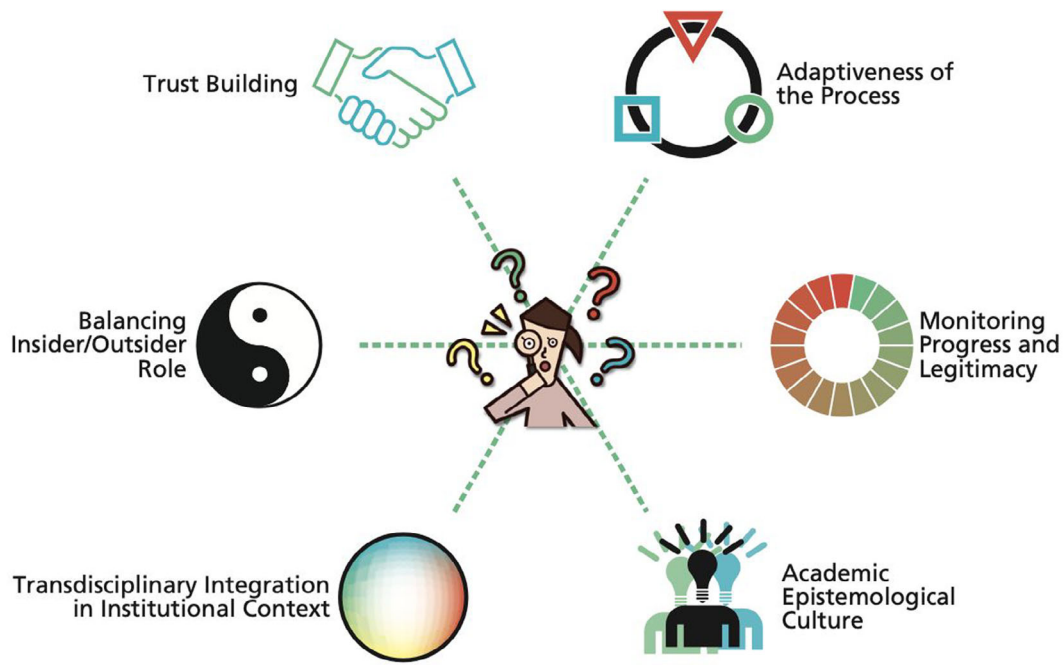
We constantly adapted the research as dictated by the context. Primarily our research focused on e-waste flows (illegal but ongoing) from the EU. As research progressed, we incorporated second-hand imported goods and their domestic usage. We found that problem-solving circular strategies like reuse can exacerbate the same problem. Varied socio-political contexts led to nuanced and diverse interpretations of the same phenomenon. For instance, some viewed imported second-hand goods usage in Nigeria as an enabler for digitalization and transformation. Others saw second-hand imports as a loophole to dump waste and hurt Nigerian ingenuity and innovation. We learned that the Nigerian government was creating an extended producer responsibility (EPR) system for e-waste. We then adapted our research to co-create knowledge useful for future Nigerian EPR. We sought tools for consensus-building and public deliberation to add sociopolitical legitimacy to our research. We decided to set up an online petition addressed at the governments of Nigeria and the European Union based on our research. The petition outlined the problem and the potential co-created solutions addressing how the governments could (try to) solve the e-waste problem while empowering the informal sector.

#### 4.4 | Perspectives from the host institution

In doing sustainability science *with* society, it is necessary to incorporate practitioners' perspectives on TDR. We conducted two separate interviews with LMCP and Oxfam, who hosted the two completed PhDs. LMCP is a small and young social entrepreneurship venture aiming to provide quality coffee for the roasters while improving farmers' lives. Oxfam is a major international non-profit organization focusing on alleviating global poverty operating in 20 countries.

Even though these are vastly different organizations, they were clear about their expectations from hosted researchers and the critical academic perspective an academic researcher would bring to their practice. These expectations were solely based on the host's needs, which meant navigating these and creating values for the hosts would be challenging for a TD ESRs, especially if not aligned with their research goals. From these interviews, clear communication about expectations was important and must be incorporated in the relationship-building process.

There was a consensus that working in the sustainability field is not always a clear path. One interviewee described being on board with a host organization as “sitting in the backseat of the car”, where



**FIGURE 1** The six often interconnected challenges faced by a TD ESR engaged in sustainability sciences [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

the researcher is part of the journey but might not have the control to take over and steer the car. Furthermore, the journey might be pleasant and unpleasant, in which case openness is essential. For TD ESR, openness and agility were necessary qualities to work and integrate with a small disruptive institution or a large multinational institution. During the interview, terms like “go with the flow”, “operating from an insecure place”, and “not part of a controlled experiment” were frequently used. At the same time, the process of working together was often compared to the act of “dancing together.”

While it was clear from the interviews that academic background helped bring some legitimacy to the researchers and their TDR, the practitioners were more interested in creating useful knowledge and change-making for themselves. Maintaining academic legitimacy meant adding value to the institution by fulfilling hosts' needs critically. Fulfilling these needs involves solving a real-world problem, but these are usually not part of the research assessment. As the focus is on change-making and not necessarily knowledge creation, academic outputs are not part of the hosts' needs. Unless the needs and roles of both the researcher and the host are clear, TDR remains challenging and might compromise legitimacy. The interviews reveal how joint problem framing and solving, as acknowledged widely in the TD literature as the crucial first step, was not the case from a host institution's perspective. In both cases, critical (academic) eyes to get things done for the host organization were their primary motivation to work with academia. Even though the host organization valued academic criticality, academic work was secondary to their needs. In one case, the academic research was seen as a “weekend task” for the PhD.

One role of the TD ESR to navigate the seemingly disconnected reality between academia and practice is to act as the connector. Such

a role needs the skillset and capacity to create critical knowledge for academia and useful knowledge for the practitioners, which bring several challenges like integrating, teamwork, relationship building, facilitating, navigating politics and uncertainty of the co-creation process. Having an open and equal collaborative process from the start helps facilitate clearer roles and goals and enable the researcher to navigate challenges and be the connector between academia and practice.

## 5 | DISCUSSION

The illustrative case studies identify six challenges faced by the TD ESRs in sustainability science presented in Figure 1. TDR challenges are often classified as inherent (challenges arising from the nature of TD process), institutional (systemic challenges emerging from institutions structures and processes), teamwork (emerging from working within academic and non-academic actors) and emergent (emerging from project-related uncertainty) (Gaziulusoy et al., 2016). These challenges are interconnected, overlap, and influence each other. We will discuss the challenges in the research context and link them to the literature as needed. We find experience, TDR design, TD mindset, toolkits, peer-learning and team support essential to navigate these challenges.

### 5.1 | TD integration in the institutional context

Successful TDR depends on the institution's capacities to enable and host the process. Well-integrated institutions might have existing



project portfolios, practitioners, or an open attitude (Witjes & Vermeulen, 2021). The institutional context was highlighted in the interviews. Stellenbosch University's strong history of ETD enabled Rosenberg's project. As a visiting researcher at another university without ETD integration, she feels "isolation and confusion." Pesqueira reflects that a combination of her supervisor's openness to TDR and a fully-funded PhD by the Mexican government enabled TD research. Even with some TD integration, Pesqueira constantly defended her action research as scientifically legitimate to her academic peers. She created multiple outputs of the same research to fulfill academic, practitioner and societal expectations, often requiring double and triple work. Having additional responsibilities was also shared by Rosenberg. To enable TDR, an institution must be opened to a plurality of epistemologies (including non-academic), have training and support for ESRs, and integrate non-academic output or social impact as evaluation criteria, especially in sustainability sciences. The is systemic challenges beyond one ESR to overcome, and TD scholars have called for institutional change (see Section 2.2), which takes time. For TD ESRs in institutions without much TD integration, some ideas to navigate this challenge includes inviting TD researchers in their PhD committee, seeking out, engaging and learning from TD networks and advocating TD integration at the institution whenever possible.

## 5.2 | Academic epistemological culture

All PhD cases highlight the institutions' narrow and rigid epistemological rigidity without TD integration. In the illustrated cases, we saw that non-academic actors could produce a variety of knowledge, practice can also shape theory, knowledge can be partial and reflexive and sometimes not necessarily true or legitimate for everyone. Pesqueira and Rosenberg reflect limited spaces for anecdotes, reflections, uncertainties, biases, hunches, reflexivity, and emotions in academia—which can be central to knowledge co-production. They talked about "slimming down" the slow, messy, uncertain, and often hunch driven TDR process to fit traditional academic publishing to meet the publishing requirements. They both mentioned process, context, and role of epistemic community, all important in TDR, were stripped down to focus on "data" and "results" to participate in the "publishing game." As discussed earlier, learning new rules to playing such a "publishing game" might create a trade-off between societal impact and science. Without TD epistemological culture, an ESR needs to plan and even "play the game" to navigate this institutional challenge.

## 5.3 | Adaptiveness of the process

Guided by an open and adaptive plan and operating from hunches are often seen in some cases as non-scientific. However, openness and adaptability are central to the TD process. Hertz and Mancilla Garcia's (2021) view intuition or tacit knowledge as an alternative tool to understanding the socio-ecological phenomenon. In PhDs, the research and its strategy evolved with context and uncertainties. Reflecting, integrating uncertainties and adapting became part of

TDR. It helped navigate challenges like: how much social impact can a project have? How much ownership/control of the project is too much to enable co-creation? Answers are often context and intuition-driven. Adaptiveness requires ESRs to be open to integrating theories from diverse disciplines but also to revisit theories based on practice. Wickson et al. (2006) talked about TD praxis where theory and practice co-evolve and thus integrate or resonate. Knowledge is created in the past and often static, but the reality is dynamic, so ESRs should be open to the limitation of knowledge. In all cases, ESRs depended on adaptiveness to make sense of the complex dynamic real-world problem. Pesqueira talks about being flexible and fixed. Being flexible requires both learning and unlearning, learning about various theories and letting go of them to make sense of reality and learning by doing.

## 5.4 | Balancing insider/outsider role

Balancing insider/outsider roles is a central challenge in the TD literature and the illustrative cases. Being "too academic" for societal actors and "not academic enough" for academic actors discussed in both completed PhDs. In all cases, the embeddedness of the ESR in the epistemic community and finding a way to balance these roles was considered crucial to navigate this challenge. Both Pesqueira and Rosenberg spent most of their PhD with the hosts, which enabled community building. Both PhDs reflected that embeddedness and balancing act should be purposefully built in the research design. Some suggestions included having clear roles and boundaries to be identified collectively with room for adaptiveness during the team building and problem framing phase. Such clear roles enable the ESR to facilitate and connect academia and practice. Whitmayer and Schöpke (2014) identified multiple functions of a researcher in process-oriented sustainability transition, including change agent, knowledge broker, reflective scientist, self-reflexive scientist and process facilitator and recommend complementary integration of roles for navigating challenges. Multiple ESR functions create various roles within the insider and outsider roles. For instance, Rosenberg finished her dissertation, fulfilled her duties at LMCC and created 26 full-time jobs as part of her TDR. van Breda et al. (2016, p. 159) proposed a "reflexive 'double-loop' learning experience" to navigate the researcher's academic and society role. Witjes and Vermeulen (2021) addressed this dilemma by introducing the triple focus (content, process, and implementation), open-minded multi-actor reflection and orchestrated approach (see Section 2.1).

## 5.5 | Monitoring progress and legitimacy

Progress and legitimacy are systematically measured using publication and citations etc., in academic. However, academic engagement with society lacks such a framework even though societal engagement is increasingly seen as important. Compared to a traditional ESR, measuring the progress and legitimacy of a TD ESR might not always be straightforward. Mitchell and Willetts (2009) (see Section 3.1) discuss this difficulty of assessing TDR. For a TD ESR, there are challenges associated with measuring societal progress. They can take longer than the duration of

research. Some solutions might have unintended consequences. The measuring framework should also encapsulate varieties of ideas of the progress of the (non-academic) stakeholders. Such a framework should accommodate spaces for openness and adaptiveness inherent in TDR. We found that such frameworks were missing in all cases. Both completed PhDs mentioned feeling unsure whether they were doing enough or doing the right thing during research.

## 5.6 | Trust building

van Breda et al., 2016 discussed how “TD epistemic communities” emerge from the process of the ESR carefully building relationships with societal actors, vital to TDR. Building such a community requires time, resources, capabilities, openness, emergence etc. Both Pesqueira and Rosenberg worked with and for the host organization, which enabled the emergence of an epistemic community. Trust building with the Nigerian informal e-waste sector was impossible due to physical distance and lack of contact in the ongoing PhD. This also barred the ESR to have an “insider” perspective, which is critical in the other two cases, hurting the inclusivity of the research and the outcomes. The research still focuses on the informal sector, but ironically without their engagement, as planned. Trust building, a continuous and challenging process, is central to TDR. With limited experience, establishing and then gauging “good enough trust” is challenging. Trust cannot be measured; one has to rely on hunches. Sometimes they work, sometimes they don't. Additionally, a TD ESR must also facilitate trust-building, among others.

## 6 | CONCLUSION

This article explored the challenges of doing TDR from the perspective of the ESR. TDR is increasingly seen as a societal problem-solving path in the context of social and ecological crises and might attract future ESRs. However, ESRs, with limited prior experiences face challenges when doing TDR. This article identifies and discusses six significant challenges based on three PhDs (two completed and one ongoing). These challenges are (i) institutional TD integration, (ii) academic epistemological culture, (iii) adaptiveness of TDR, (iv) balancing roles, (v) monitoring progress and legitimacy and (vi) trust-building. These PhDs use diverse academic ideas and have unique contexts, yet the insights and learnings from their experiences can be useful to other TD ESRs.

We recommend the following to navigate the challenges. *Start small.* The challenges can be intimidating. Get your feet muddy and manage expectations. An ESR project is one process of a longer TD journey enriched by smaller experiences. *Ask for help.* TDR is not an individual undertaking. Ask your supervisor, people in your network or the TD researcher community who have more experience. Although TD research styles and tastes are different, there is a shared understanding of working with societies to solve social problems. *Borrow ideas from everywhere.* Explore literature and research from other disciplines that could make sense and shape your research. Consider going beyond

disciplinary walls. *Build communities and share experiences.* It can bring diverse epistemologies and enable pathways for TDR integration in academia. We discussed the importance of epistemic communities for TDR for navigating multiple project-specific challenges. Similarly, TD communities can help researchers navigate TDR challenges. We encourage past ESRs who learned by doing to share their experiences with others, not only your results. We recommend supervisors and TD teams to promote and facilitate peer learning. PhD dissertations are not always easy to find and reading a dissertation can be daunting. We encourage TD PhDs (and experienced researchers) to share their reflections or thesis chapters as academic papers, blogs, podcasts making their work easily accessible to the community. *Balance is essential.* The TD ESR needs to juggle academic, social-stakeholder, facilitator, researcher, organiser, and creator roles to connect academia, society and oneself. It is crucial to know when to be flexible and when to be fixed. We suggest deliberately designing TDR projects to facilitate the various roles of the ESRs. Last, challenges are part of the process and provide learning opportunities. Like in Zen, the obstacle is the path.

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