EPFL

The politics of participation in transdisciplinary sustainability research: an analysis of knowledge, values and power at the science-society interface

Présentée le 20 février 2020

à la Faculté de l'environnement naturel, architectural et construit
Laboratoire de relations humaines-environnementales dans les systèmes urbains
Programme doctoral en architecture et sciences de la ville

pour l'obtention du grade de Docteur ès Sciences

par

Livia Bianca FRITZ

Acceptée sur proposition du jury

Dr E. Cogato Lanza, présidente du jury
Prof. C. R. Binder Signer, Dr S. Hostettler, directrices de thèse
Dr F. Schneider, rapporteuse
Prof. A. Stirling, rapporteur
Dr O. Ejderyan, rapporteur

■ École
polytechnique
fédérale
de Lausanne

2020

Acknowledgements

Abstract

Problem. In the field of sustainability, scholars and policy-makers herald the transformative power of participation in transdisciplinary (TD) research. The increasing use of TD in science policy is rooted in the expectation that involving practitioners in the research process produces 'socially robust' knowledge and fosters the desired societal change. However, there is a strong discrepancy between these expectations, ideal-typical conceptions of TD, and a limited understanding of the complex interactions that forge participation in knowledge production practices.

Aim. This thesis aims to enhance understanding of the complex processes that shape participation practices and their outcomes in TD sustainability research.

Methods. This thesis links social theories and literature from sustainability research, Science and Technology Studies, and development research with empirical enquiries into the making of participation. Qualitative and quantitative methods are combined in order to draw a rich picture of researchers' and practitioners' perceptions of participation processes and outcomes.

Results. *To begin,* this thesis offers a novel perspective on participation as a relational space that is dynamically forged through the interplay of structures and processes. *Secondly*, it identifies structural and actor-related elements that constitute participation spaces, including: (in)coherence with reference systems, resources, timing, expectations, trust, values and power relations. The empirical analyses show that funding bodies, researchers, and practitioners exercise 'power over' actor selection, as well as agenda and rule setting, leading to the exclusion of some knowledges and values. Throughout TD processes, 'power over' intersects with 'power with' and 'power to', highlighting trade-offs between the epistemic and societal goals of participation. Unpacking processes also shows how partly incommensurable values with regard to sustainability shape knowledge production, and how the latter can perpetuate dominant discourses on society-nature relations. *Finally*, this thesis reveals diverse participation-effect pathways as well as feedback effects. Researchers' and practitioners' diverging perceptions of pathways come with contrasting roles and responsibilities they ascribe to themselves and to others.

Conclusions. The results demonstrate that participation processes in TD sustainability research are not only a matter of techniques and methods, but also of political endeavours that must be placed in a broader socio-political context. The value negotiations and power relations that form them, the multiple purposes for which they are mobilised and their role in the governance landscape demonstrate the importance of the politics of participation. Fostering conceptual clarity and empirical knowledge of the dynamics that shape participation in and the effects of TD research, this thesis feeds into a critical sustainability scholarship that is aware of power dynamics and is reflexive towards its own practices. It provides researchers and practitioners with theoretically and empirically-grounded analytical perspectives and guiding questions on the role of structures, actors and power relations in TD practice. These tools allow for unravelling the deep-rooted challenges of participation and support researchers and practitioners in making their assumptions about pathways to societal change visible and negotiable.

Keywords: participation, relational space, transdisciplinary research, co-production, power, worldviews, theories of change, systems approach, science policy, sustainability

Zusammenfassung

Problemstellung. Im Nachhaltigkeitsbereich preisen politische EntscheidungsträgerInnen wie Forschende das transformative Potenzial von Partizipation in transdisziplinären (TD) Forschungsprozessen. Vermehrt findet TD Eingang in die Wissenschafts- und Förderpolitik. Dies beruht auf der Erwartung, dass die Partizipation von Praxisakteuren in Forschungsprozessen die Produktion von *gesellschaftlich robustem* Wissen erlaube und so den Beitrag von Forschung zu Nachhaltigkeitstransformationen stärke. Diese Erwartungen, die von einer idealtypischen Konzeptualisierung von TD ausgehen, gründen häufig auf einem unzureichenden Verständnis der komplexen Interaktionen, die Partizipation in der Forschungspraxis durchziehen.

Ziel. Das Ziel dieser Dissertation besteht darin zu einem besseren Verständnis der komplexen Prozesse, welche Partizipationspraktiken und deren Effekte in der TD Nachhaltigkeitsforschung formen, beizutragen.

Methodik. Diese Dissertation verknüpft soziale Theorien und Literatur aus der Nachhaltigkeits-, Entwicklungs- und Wissenschaftsforschung mit qualitativen und quantitativen empirischen Untersuchungen.

Ergebnisse. Erstens zeigt diese Dissertation die normativen Annahmen, die gängigen Partizipationskonzepten zugrunde liegen, auf und erarbeitet eine differenzierte Perspektive auf Partizipation, welche in einem *relationalen Raum* von Strukturen und Akteuren prozessual geformt wird. Zweitens legt sie die strukturellen und akteursbezogenen Faktoren offen, die in die Konstitution von Partizipationsräumen involviert sind. Die empirischen Analysen zeigen wie Fördergeber, Forschende und Praxisakteure Macht über Akteursauswahl, Agenda-Setzung und die Festsetzung von Abläufen in Partizipationsräumen ausüben, was den Ausschluss einiger Wissensformen und Werthaltungen nach sich zieht. Es wird deutlich, dass solche Formen von *power over* in TD Prozessen mit *power with* und *power to* überlappen und Zielkonflikte zwischen epistemischen und gesellschaftlichen Zielen entstehen können. Es wird dargelegt, wie nachhaltigkeitsbezogene Werte Eingang in Wissensproduktion finden, aber letztere Gefahr läuft hegemoniale Diskurse über Gesellschaft-Natur-Beziehungen zu reproduzieren. Drittens zeigt die Untersuchung der gesellschaftlichen Wirkmächtigkeit von TD, dass diverse Wirkungspfade mit Partizipation assoziiert werden und Feedbackeffekte entstehen können. Diese Pfade nehmen Forschende und Praxisakteure unterschiedlich wahr, was auf unterschiedliche Rollenverständnisse hindeutet.

Fazit. Die Ergebnisse legen nahe, dass Partizipationsprozesse in der TD Nachhaltigkeitsforschung nicht nur eine Frage von Methoden und Techniken sind. Die Werteaushandlungen und Machtbeziehungen, welche Partizipationsprozesse durchziehen, die verschiedenen Ziele, für die sie eingesetzt werden und ihre Rolle in Gouvernanzstrukturen deuten auf die Notwendigkeit hin, Partizipation politisch zu denken. Die konzeptionelle Schärfung und empirische Fundierung der Dynamiken und Effekte von Partizipationsprozessen tragen zu einer kritischen Nachhaltigkeitsforschung bei, welche offen ist gegenüber Machtdynamiken und so reflexiv agieren kann. Sie liefert Forschenden und Praxisakteuren theoretisch und empirisch fundierte analytische Perspektiven und Leitfragen zur Rolle von Strukturen, Akteuren und Machtverhältnissen in der TD Praxis. Diese unterstützen Forschende und Praxisakteure darin, ihre Annahmen über Wege zu gesellschaftlichem Wandel sichtbar und verhandelbar zu machen.

Schlagworte. Partizipation, Expertise, relationaler Raum, transdisziplinäre Forschung, Ko-Produktion, Macht, Werte, Systemperspektive, Wissenschaftspolitik, Forschungsförderung, Nachhaltigkeit

Résumé

Problématique. Dans le domaine de la durabilité, les décideurs politiques comme les chercheurs louent le potentiel transformatif de la participation dans des processus de recherche transdisciplinaire (ici appelée « la TD »). La TD est de plus en plus présente dans les politiques scientifiques et de financement. Ceci repose sur l'hypothèse que la participation de praticiens (décideurs politiques, entrepreneurs, représentants des associations etc.) dans les processus de recherche, permettra la production d'un savoir *socialement robuste* et renforcera ainsi la contribution de la recherche aux transformations vers la durabilité. Cette hypothèse part d'une conceptualisation par idéal-type de la TD, basée souvent sur une connaissance insuffisante des interactions complexes qui traversent la participation dans les pratiques de recherche.

Objectif. L'objectif de cette thèse est de contribuer à une meilleure compréhension des processus complexes qui forment les pratiques de participation et leurs effets dans la recherche TD sur la durabilité.

Méthodologie. Cette thèse croise des théories sociales et la littérature de la recherche sur la durabilité, le développement et la science (*Science and Technology Studies*) avec des enquêtes empiriques qualitatives et quantitatives.

Résultats. Premièrement cette thèse met en évidence les hypothèses normatives qui forment la base des concepts courants de participation et propose une perspective différenciée sur la participation, construite dans un *espace relationnel* de structures et d'acteurs. Deuxièmement elle fait apparaitre les facteurs structurels et ceux concernant les acteurs impliqués dans la constitution d'espaces participatifs, au titre desquels par exemple l'(in)cohérence avec les normes et règles établis dans les champs de référence des acteurs, les ressources disponibles, les attentes des différents acteurs, la confiance entre les acteurs, les valeurs et les relations de pouvoir. Les analyses empiriques démontrent comment les agences de financement, les chercheurs et les praticiens exercent du pouvoir sur le choix des acteurs, influent la mise à l'agenda et déterminent le fonctionnement des espaces de participation, ce qui entraine l'exclusion de certaines formes du savoir et de valeurs. Il apparaît clairement que de telles formes de *power over* se chevauchent dans les processus TD avec des formes de *power with* et de *power to*; des conflits d'objectifs peuvent émerger entre des objectifs épistémiques et sociaux. Nous démontrons comment les valeurs concernant la durabilité entrent dans la production du savoir mais que celle-ci risque de reproduire des discours hégémoniques sur les relations entre *société et nature*. Troisièmement l'étude sur l'impact sociétal de la TD montre que diverses trajectoires d'effet sont associées à la participation et que des effets de *feedback* peuvent se produire. Les chercheurs et praticiens perçoivent ces trajectoires différemment, ce qui indique différentes compréhensions des rôles et responsabilités qu'ils s'arrogent et imputent à autrui.

Conclusion. Les résultats suggèrent que les processus de participation dans la recherche TD sur la durabilité ne sont pas uniquement une question de méthodes et de techniques. Les négociations sur les valeurs et les rapports de pouvoir, qui traversent les processus de participation, les différents objectifs pour lesquels ils sont mis en place, et leur rôle dans les structures de gouvernance, indiquent la nécessité de penser la participation par le politique. L'affinement conceptuel et le fondement empirique des dynamiques et effets des processus de participation contribuent à une recherche critique sur la durabilité, qui est ouverte aux dynamiques de pouvoir et peut ainsi agir de manière réflexive. Elle offre aux chercheurs et praticiens des perspectives

analytiques théoriques et empiriques, et des questions clés concernant le rôle des structures, acteurs et relations de pouvoir dans la pratique TD. Ces outils appuient les chercheurs et praticiens dans leur démarche de rendre visibles et négociables leurs hypothèses sur les voies vers les changements sociétaux.

Mots-clés. Participation, expertise, savoir, espace relationnel, transdisciplinarité (TD), co-production, pouvoir, valeurs, perspective systémique, politique scientifique, politiques de financement de la recherche, durabilité

This thesis is composed of the following publications - four published articles, two published book chapters, two articles in press, and one submitted manuscript:

Fritz, L.; Binder, C.R. 2018. Participation as Relational Space: A Critical Approach to Analysing Participation in Sustainability Research. *Sustainability 2018, 10*, 2853.

Fritz, L. 2018. (De-)Constructing participation in transdisciplinary sustainability research: A critical review of key concepts. In: Engelschalt, J., Maibaum, A., Engels, F., Odenwald, J., (Eds.): *Schafft Wissen–Gemeinsames und Geteiltes Wissen in Wissenschaft und Technik*, Proceedings of the INSIST Conference, 7–8 October 2016. Munich: Social Science Open Access Repository, 106–125.

Fritz, L.; Schilling, T.; Binder, C.R. 2019. Participation-effect pathways in transdisciplinary sustainability research: an empirical analysis of researchers' and practitioners' perceptions using a systems approach. *Environmental Science and Policy 2019, 102, 65-77.*

Fritz, L.; Meinherz, F. 2020. The politics of participatory sustainability assessments: An analysis of power. In: Binder, C.R., Massaro, E., Wyss, R. (Eds.): *Sustainability Assessment of Urban Systems.* Cambridge: Cambridge University Press, 87-122.

Fritz, L.; Binder, C.R. 2020. Whose knowledge, whose values? An empirical analysis of power in transdisciplinary sustainability research. *European Journal of Futures Research.*

Fritz, L.; Meinherz, F. 2020. Tracing power in transdisciplinary sustainability research: an exploration. *GAIA - Ecological Perspectives for Science and Society.* In press.

Meinherz, F.; **Fritz, L.**; Schneider, F. 2020. How values play into sustainability assessments: challenges and a possible way forward. In: Binder, C.R., Massaro, E., Wyss, R. (Eds.): *Sustainability Assessment of Urban Systems.* Cambridge: Cambridge University Press. 65-86.

Meinherz, F.; **Fritz, L.**; Schneider, F. 2020. Vom Öffnen und Verschließen von Alternativen: Implikationen der gesellschaftlichen Einbettung nachhaltigkeitsrelevanter Wertvorstellungen. In: Lindner, R; Decker, M.; Ehrensperger, E.; Heyen, N.; Lingner, S.; Scherz, C.; Sotoudeh, M (Eds.): *Gesellschaftliche Transformationen: Gegenstand oder Aufgabe der Technikfolgenabschätzung?* Baden-Baden: Edition Sigma/Nomos. In press.

Binder, C.R.; **Fritz, L.**; Andreas Balthasar; Ralph Hansmann; Zilla, Roose *(submitted).* Increasing the relevance of science for practice and practice for science: quantitative empirical insights. *Submitted to Science and Public Policy.*

Table of contents

List of Tables

List of Figures

Glossary

BMBF	Deutsches Bundesministerium für Bildung und Forschung (German Federal Ministry for Science and Education)
DFG	Deutsche Forschungsgesellschaft (German Research Foundation)
ISC	International Science Council
ICSU	International Council for Science
MWK	Ministerium für Wissenschaft und Kultur (Ministry for Science and Culture; Lower Saxony, Germany)
NGO	Non-Governmental Organisation
NRP	National Research Programme
OECD	Organisation for Economic Co-operation and Development
PAR	Participatory Action Research
PRA	Participatory Rural Appraisal
PI	Principle Investigator
PNS	Post Normal Science
SDG	Sustainable Development Goal
SNSF	Swiss National Science Foundation
STS	Science and Technology Studies
TD	Transdisciplinarity, transdisciplinary
TDR	Transdisciplinary Research
ToC	Theory of Change
UN	United Nations
WfNE	Wissenschaft für Nachhaltige Entwicklung (Science for Sustainable Development); funding programme
WGBU	Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderung (Government's Scientific Advisory Council on Global Change)
ZiFoNE	Zivilgesellschaft und Forschung für Nachhaltige Entwicklung: Transdisziplinarität fordern und fördern (Civil society and research for sustainable development: challenging and promoting transdisciplinarity); project title

PART I: SYNOPSIS

1   Introduction

This introductory chapter sets the scene for an enquiry into the politics of participation in transdisciplinary sustainability research. It introduces three facets of the current debate on knowledge production in the context of sustainability transformations. It begins with a look at why and how transdisciplinary approaches have gained momentum in both science practice (1.1.) and policy (1.2.), and identifies persisting challenges and debates (1.3.). This leads me to argue, in section 1.4., that discrepancies between high expectations and increasing policy relevance on the one hand, and a limited understanding of the complex processes and deep-rooted challenges of participation in transdisciplinary sustainability research on the other require greater attention. Based on this general problem statement, the overall objectives and structure of the thesis are introduced.

1.1   Sustainability: Complexity and Normativity Challenging 'Traditional' Ways of Knowledge Production

Over the past three decades, scholars and policy-makers alike have increasingly questioned 'traditional' disciplinary research's ability alone to provide the kind of evidence needed for boosting transformation processes towards sustainability (Kates, 2011; Miller et al., 2014). The United Nations (UN) Agenda 21 of the Rio Declaration[1] in 1992 already calls for the linking of scientific knowledge with 'local' and 'indigenous' forms of knowledge (United Nations, 1992). The recent UN resolution "Transforming our world: the 2030 Agenda for Sustainable Development" is the latest example in this series of international policy documents that highlight the pivotal role of science for sustainable development[2] (United Nations, 2015). In the face of complex and highly inter-connected sustainability problems such as those reflected in the 17 Sustainable Development Goals (SDGs) of the Agenda 2030, the call for new approaches to science and the production of knowledge has gained traction.

This questioning of the capacity of 'traditional' ways of scientific knowledge production is due, on one hand, to fundamental uncertainties about the future of the planetary system. On the other hand, it reflects challenges and tensions between the normativity

---

[1] In particular Chapters 35.5. and 35.7. allude to the need for linking scientific and traditional, indigenous knowledge (United Nations, 1992).
[2] Science, technology and innovation are cross-cutting issues. SDG 17, and in particular targets 17.6, 17.7, 17.8, are dedicated to technology (United Nations, 2015).

and value-loadedness of sustainability and scientific claims of 'objectivity' (Grunwald, 2004). It therefore concerns the very nature of the 'object' of investigation: sustainability.

Sustainability is a normative concept. A plethora of interpretations and conceptions exist (Kates et al., 2005; Kemp and Martens, 2007; Martens, 2006), and the pathways towards its realisation are contested. These pathways unequivocally involve political struggles and the negotiation of interests (Avelino et al., 2016; Brand, 2016; Stirling, 2014). Promising a more desirable state of the world, the notion of sustainability offers a vision for society and its relationship with the natural environment. Different definitions of sustainability can be traced back to different such visions and reflect what is considered valuable in society and nature (Frame and Brown, 2008; Funtowicz and Ravetz, 1993; McCool and Stankey, 2004).

Accepting that sustainability is a fundamentally normative concept poses important challenges for conducting research. Sustainability science, which seeks not only to understand the *"fundamental character of interactions between nature and society"* but also to enhance *"society's capacity to guide those interactions along more sustainable trajectories"* (Kates et al., 2001, p. 641), is hence intertwined with the values that underlie the desired visions for society and its relationship with the environment. The controversies that have permeated the historical debate on a suitable relationship between science and values, however, illustrate that engaging with values is no easy task for researchers[3] (e.g. Churchman, 1979; Davydova and Sharrock, 2003; Fleck, 1980; Putnam, 2002; Ziegler and Ott, 2011).

The normativity of the notion of sustainability thus contrasts with the predominant image of science as being outside of the social world, allowing it to operate in value-free and objective ways (Potthast, 2015). This tension has led certain observers to conclude that *"sustainability poses challenges to the scientific system and methodology"* (Spangenberg, 2011, p. 277). These scholars consider the rethinking of science-society-policy relations as indispensable for responding to the "grand challenges" of climate change, environmental degradation and growing inequalities within and across societies (European Commission, 2015). A core aspect of this re-conceptualisation concerns the opening-up of research processes by including societal actors beyond the traditional scientific sphere (Cornell et al., 2013). Approaches to participation in knowledge production suggest that the notion that science holds a monopoly over the production of factual, trustable knowledge that should 'speak truth to power' (Hoppe, 1999) fails in contemporary societies facing multiple sustainability crises. These are characterised

---

[3] A historical vantage point shows that the embedding of science in societal contexts and the relationship between politics, science and society has, for decades, been of interest to philosophers and historians of science (Bloor 1991).

by complex, ill-structured problems (Jonassen and Hung, 2008) with a high degree of uncertainty, inevitable trade-offs and incommensurable values at times (Kates 2016). In such cases, science cannot claim to hold the truth, nor can polity monopolise power (Hoppe, 1999).

Ideas on how this rethinking and opening up of research looks or should look like are diverse, and range from citizen panels and conferences to transdisciplinary research (Cornell et al., 2013). Conceptually, these debates are crystallised in notions such as: (i) 'post-normal science', which argues that cases in which *"facts are uncertain, values in dispute, stakes high and decisions urgent"* demand extended forms of knowledge production (Funtowicz and Ravetz 1993); (ii) 'mode 2' knowledge production which, unlike the classical 'mode 1' knowledge production, contends that non-academic rationales increasingly frame both the production and validation of knowledge (Gibbons et al. 1994), and; (iii) the 'triple-helix model', which examines science-university-industry relations (Leydesdorff and Etzkowitz 1998) along with others.

In the field of sustainability, this entanglement of politics, society and science has gained momentum and policy relevance under the umbrella of transdisciplinarity (TD). First used some 40 years ago by Erich Jantsch, a physicist and early complexity researcher, at an Organisation for Economic Co-operation and Development (OECD) conference, the notion has gained prominence notably relative to environmental and sustainability-related topics (Jahn, 2008). Its rise in popularity following the UN Rio summit (1992) and the official birth of sustainability science around 2000 (Kates et al., 2000) came with diverse conceptualisations of TD. Hirsch Hadorn et al. (2008: 27) describe TD as a *"fuzzy and contested field"* that is formed by various lines of thinking and heterogeneous conceptions of science and expertise. Broadly speaking, two branches can be identified: a sociological actor-orientated approach and a philosophy of science approach (e.g Mittelstraß, 1989). These two branches mainly differ with regard to whether the integration of practitioners and their expertise is considered a defining feature of TD (Defila and Di Giulio, 1998, p. 115).

In this thesis, actor-orientated approaches of TD are of primary interest because, as will be made clear shortly, they have become particularly policy-relevant and have been implemented in numerous funding programmes. Therein, most scholars (e.g. Defila and Di Giulio, 2015; Hirsch Hadorn et al., 2008; Jahn et al., 2012; Lang et al., 2012; Mauser et al., 2013; Novy et al., 2008; Scholz et al., 2006) concur that TD research (TDR):

(1) starts from *lifeworld* problems and creates solution-orientated[4] and/or socially robust knowledge;
(2) integrates different scientific disciplines (i.e. is interdisciplinary), and;
(3) includes practitioners and their expertise in the production of societally-relevant knowledge and fosters a process of mutual learning.

It is in this third feature of TD knowledge production that the *participatory claim* becomes apparent. By virtue of their practical and issue-specific expertise[5], practitioners[6] participate in knowledge production processes (Defila and Di Giulio, 2018). In contrast to researchers, who are 'certified' experts (Collins and Evans, 2002), practitioners can be considered 'non-certified experts' (Collins and Evans, 2002). In other words, while they may have academic training, research is not their main occupation. Depending on the context of the issue at hand, practitioners participating in TD sustainability research are thus heterogeneous actors such as policy-makers and politicians, public service providers, private sector actors or third sector actors.

In an attempt to guide the implementation of the aforementioned key features in research processes, ideal-types of what a TD processes *ought* to look like have been developed. While these differ in terms of the terminology used (Jahn et al., 2012; Lang et al., 2012; Scholz and Steiner, 2015a), they all concur that TD describes reflexive, recursive research processes that are (i) rooted in societally relevant problems, (ii) facilitate mutual learning by both researchers and practitioners, (iii) co-produce knowledge, and (iv) reintegrate this knowledge into both research and practice (Zscheischler, 2017). Concomitantly, ideal-typical TD processes are frequently distinguished in three inter-linked phases: (i) the problem framing and development phase (framing of the problem, choosing the appropriate sustainability approach, defining goals, setting up the team); (ii) the knowledge (co-)production phase (applying (participatory) methods for knowledge generation), (iii) the 'bringing results to fruition' phase (re-integrating results in research and practice and in some cases implementing

---

[4] Some scholars refrain from using the notion of 'solutions' due to concerns about transferring responsibilities to science (i.e. providing solutions for complex problems) that the latter cannot or should not assume (Jahn et al., 2012).
[5] Unlike in other participatory processes, in this conception expertise appears as the key criterion for involvement. It, however, does not neglect the fact that participants – even when invited due to their expertise – bring interests and values into the process. It simply means to say that these values and interest do not constitute the legitimation of their involvement (Defila and Di Giulio, 2018). Such a conception differs from participatory processes, in which the principal justification for involvement is an actor's 'stake' in an issue (Reed et al., 2009). Throughout this thesis it will become clear that in practice the differentiation of such criteria for involvement can be difficult to uphold.
[6] While there is strong agreement on participation as a key element of TD sustainability research, a myriad terms are used to designate those participating in knowledge production, including notions such as future users (Defila and Di Giulio, 2015), stakeholders (Polk and Knutsson, 2008), practice actors and partners form practice ("Praxisakteure"), lay people, and civil society actors. Attempts to assemble the heterogeneous scholarship can be found in comprehensive volumes by Hirsch Hadorn et al. (2008) and (2012) and in Fam et al. (2016).

findings) (Bergmann et al., 2005; Jahn et al., 2012; Lang et al., 2012; Pohl et al., 2007; Schneider and Buser, 2018).

Throughout these ideal-type process phases, both inputs by researchers and practitioners and benefits for them appear as symmetrically distributed (see e.g. Lang et al., 2012). Accordingly, design principles that should support the realisation of ideals, such as mutual learning, come with an 'egalitarian impetus' (Jahn et al., 2012, p. 3) and call for 'shared control', 'co-leadership' and interactions between researchers and practitioners on 'equal footing' (Lang et al., 2012; Luthe, 2017; Scholz and Steiner, 2015b). These models and ideal-typical conceptions will be revisited in a review of the state of art in section 2.1.

This section has illustrated how the current rethinking on science-society relations and the questioning of traditional ways of knowledge production are inextricably linked to the nature of the concept of sustainability. More specifically, its complexity and normativity pose challenges for scientific knowledge production. TD approaches have been put forth as a promising answer to how to deal with the value-laden, normative nature of sustainability. As this section has shown, these proposals have resulted in the development of methodologies, principles and models of what this 'new' approach to knowledge production ought to look like. In the next section, we will turn to science policy, and look at how these 'new' approaches have been integrated in research funding and fuel narratives on the role of science in societal change.

1.2 The Increasing Policy Relevance of Transdisciplinary Knowledge Production

> *"I, the ISC and the scientific community are dead serious about transformation, and stand ready to engage with the worlds of policy, business and civil society in actions aimed at tearing down the roadblocks on pathways to global sustainability. Today's event demonstrates that. With the political will to collaborate, I have hope: for our planet, our science, our future.* **United in science, building and deploying knowledge together, we can succeed"** (Daya Reddy (2019 emphasis added), ISC President at the UN Climate Action Summit 2019)

In his recent speech at the UN's Climate Action Summit in 2019, Daya Reddy, President of the International Science Council (ISC), takes up the current policy discourse regarding the role of science as an actor of change, actively working towards socio-ecological transformation and greater sustainability. He makes the notion of collaboration between different actors - including scientists, policy-makers, businesses

and civil society – his focal point and urges them to jointly build and deploy knowledge to combat the climate crisis.

Such discourse increasingly found its way into science policy. In response to 'grand' societal problems (European Commission, 2019) and the challenges they pose for both research and governance, science policy and research funding programmes under the umbrella of 'responsible research and innovation' increasingly ask and incentivise researchers to co-create or co-produce knowledge with actors beyond the scientific realm (Schneider et al., 2019a; Van der Hel, 2016), thus extending knowledge production to policy-makers, businesses, civil society actors or individual citizens.

At the regional and international levels, this call to diversify the actors involved in knowledge production is reflected, for instance, in the "Science with and for Society" programme of the European Commission's Horizon 2020 (2019), and worldwide initiatives such as Future Earth - a 10-year international research initiative which *"take[s] on high-impact, transdisciplinary, sustainability research topics, steer[s] research funding, and bring[s] sound science to global policy, business and public discourse"* (Future Earth, 2019).

In a recent report on the role of science in implementing the SDGs, the then-International Council for Science (ICSU) identifies the need for TD approaches (International Council for Science, 2017, p. 223) and reiterates Future Earth's call for *"partnerships with policy-makers and other societal actors to co-design and co-produce new knowledge and solutions"* (International Council for Science, 2017, p. 224). Again, in its current action plan, the successor institution of the ICSU - the ISC - urges the science system to respond *"to pressures for greater interdisciplinary and transdisciplinary collaboration. […] There is increasing recognition of the need for change in scientific systems, including the reform of academic incentives, funding systems, processes of scientific publication, and scientific norms in the private sector"* (International Science Council, 2019, p. 31).

In addition, at the national level, throughout Europe, research funding bodies, including public funding agencies and private donors (e.g. philanthropic foundations), have introduced funding schemes that call for the integration of different actor groups in research processes. These include: the programme "Science for Sustainable Development" ("Forschung für Nachhaltige Entwicklung", FONA) by the German Federal Ministry for Science and Education (BMBF); the BMBF funding priority programme "Socio-Ecological Research" (SöF); the "Science for Sustainable Development" programme by the Volkswagen Foundation and the Ministry of Science and Culture of Lower Saxony (DE); the "ProVISION" programme by the Austrian Federal Ministry of Science and Research; the Austrian "Cultural Landscape Research Programme" (KLE, "Kulturlandschaftsforschung") (AUT); the Swiss Priority

Programme Environment (CH, 1992-2000); the National Research Programmes by the Swiss National Science Foundation (CH); and MISTRA Innovation (SE).

Such developments in science policy are reminiscent of what some scholars have called a 'participatory turn' (Bäckstrand, 2003; Chilvers and Kearnes, 2015, p. 13; Jasanoff, 2003), a 'participatory return' (Wynne, 2007, p. 100) or a 'deliberative turn' (Dryzek, 2000), respectively. In the German context, these developments have culminated in the emblematic and much debated call by the Government's Scientific Advisory Council on Global Change (Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderung, WGBU) for a new *"social contract between science and society"* (WBGU, 2011). In order to join forces for the "great transformation", the advisory council argues that scientists must engage in "transformative" research that actively supports the societal transformations towards greater sustainability (WBGU, 2011).

One of the core narratives underpinning these discourses and policies is that the knowledge co-produced as such increases the transformative capacities of science. This builds on the assumption that the participation of societal actors not only in decision-making about sustainability but also in the production of knowledge with regard to it make it possible to continually 'test' new knowledge. This testing theoretically should make the knowledge produced socially robust and ensure that it is relevant for societal actors and, thus, more likely to guide their actions (Demeritt, 2010). The promotion of knowledge co-production or co-creation is therefore intertwined with an impact imperative in science policy, hotly debated for instance with regard to the United Kingdom's Research Excellence Framework (Chubb and Reed, 2018; Demeritt, 2010). As I will show in greater detail in the state of the art in section 2.3, with the increasing policy uptake of TD approaches, scholarly efforts to assess and demonstrate the presumed societal impact of TDR have intensified.

While we have seen that the expectations of scientists (1.1.) and policy-makers (1.2.) with regard to these 'new' approaches to knowledge production are high, it remains to be seen to what extent these expectations are met in concrete terms. We will turn to this aspect and some of the debates surrounding these approaches in the next section.

1.3   Persistent Criticism and Challenges

Although TD and similar approaches under different headings have seen growing recognition in research practice and policy, this upward trend has also been accompanied by criticism and controversial debates. These revolve around concerns of a politicisation of science (Rohe, 2015; Strohschneider, 2014; Weingart, 1983), the fear of an increasing utilisation and impact imperative in academia that interferes with scientific freedom and the open-endedness of scientific enquiry (Demeritt, 2010; Jacob, 2009; Slaughter

and Leslie, 2001), and a de-politicisation of society by attributing a transformative role to democratically non-legitimised scientific actors (Strohschneider, 2014; Weingart, 1983). They are furthermore criticised to resemble "political manifestos" (Shinn, 2002, p. 610), to lack a coherent "intellectual project" (Shinn, 2002, p. 604) and to be based on a "romanticized appeal of the higher rationality of lay knowledge" (Weingart, 1997, p. 611).

These different facets of criticism emanate from the critics' different standpoints and assumptions about the appropriate science-society relations. A closer look at the German debate exemplifies several of these aspects. Most prominently, the president of the German Research Foundation (DFG), Peter Strohschneider (2014), in reaction to the call for transformative and TD research mounted a defence of what he considered proper science. He voiced concerns and criticism that a transformative understanding of science bears the risk of reversing the functional differentiation between science and society and of leading to de-politicised 'solutionism', which assesses research based on the criterion of utility for some kind of (allegedly shared) normative goal rather than on scientifically sound principles. He feared these developments would substitute epistemology with praxeology, politicise science and undermine its very fundamentals, while at the same time de-politicising democratic decision-making and substituting it with democratically non-legitimatised expert communities, thus eroding democratic principles (Strohschneider, 2014). Such contestations of TDR are embedded in wider debates about the appropriate roles of science in political decision-making and societal deliberation.

Responses to such criticism have stressed on the one hand the quest for complementing, rather than substituting 'traditional' science and the attempt of supplementing the pursuit of excellence with that of relevance, while acknowledging the tentative nature of knowledge when addressing complex problems (instead of 'solutionism') (Grunwald, 2015). On the other hand, they have led to wider debates on epistemology and epistemological values regarding science-society relations, with proponents of TD arguing that all research, also allegedly 'non-normative' technological or basic research, is unavoidably embedded in the wider political economy of research funding and agenda setting. Rather than predefining solutions, by acknowledging this, TDR approaches open up spaces for deliberation and democratic decisions on desired societal developments and futures (Grunwald, 2015; Schneidewind and Wissel, 2015).

Such controversial debates - exemplified on the criticism by the German DFG president - indicate that despite the growing policy relevance of TDR and similar approaches, they remain contested. The process of "re-thinking science" (Nowotny et al. 2001) has not led to a broader consensus, beyond specific communities. These ongoing debates offer a glimpse of the institutional environment and science-society relations within which TDR functions. They point to tensions between conflicting norm systems (e.g. regarding what 'good' science is) that researchers who use these types of practices are

likely to encounter, and which affect TD practices' potential to live up to their own principles (Healy, 2019).

Practically speaking, opening up research - from the scientists' standpoint – presents numerous challenges in terms of TD scholarship. Many of these have to do with the fundamentals of the academic system, which are perceived as contradictory to participatory and TD practices. Tension with the following dominant structures are widely reported in TD scholarship: integrative and participatory approaches vs. disciplinary academic career paths; the need to communicate results to practitioners in a comprehensible and targeted format vs. the academic requirement of publishing work in ultra-specialised, high-ranking scientific journals; the time-consuming nature of participatory processes vs. time constraints in third-party funded projects (Cornell et al., 2013; Cvitanovic et al., 2015, p. 28; Robinson and Tansey, 2006; Schmidt and Pröpper, 2017; Siew et al., 2016; Talwar et al., 2011; Wiek et al., 2012; Wuelser and Pohl, 2016).

Other common challenges include imbalanced ownership between researchers and practitioners, conflicting expectations, goals, temporalities and quality standards, as well as time and financial resource constraints due to the aforementioned structural incoherencies (Lang et al., 2012; Pohl et al., 2010; Polk, 2014; Scholz and Steiner, 2015b). Additional challenges include bringing scientists with different disciplinary cultures and epistemological values as well as practitioners from diverse socio-political contexts together to jointly address potentially contested real-world issues (Raymond et al., 2010; Rosendahl et al., 2015). These challenges point to the complexity of participation processes in TD practice, a point that will be explored in detail in the state of the art section 2.2.

In TD scholarship, researchers attempt to address these ongoing challenges through the development of integrative tools, toolboxes and knowledge integration techniques (Bergmann et al., 2012; Jahn, 2008), design principles that orient TD practices (Hegger et al., 2014; Lang et al., 2012; Pohl et al., 2007), and management handbooks that offer practical guidance on how to design and implement TD processes in diverse research consortia (Defila et al., 2006). In so doing, the challenges are generally framed as methodological, technical and/or management problems that can be tackled through careful process design and implementation. Throughout this thesis, I argue that in addition to this interpretation the tensions observed should be framed as 'political' issues, i.e. as the result of often tacit negotiations and struggles over whose ways of seeing and engaging with the world, and whose criteria for relevance and modes of action count. The next section will look into the details of why such an endeavour is important, and how we will go about it in this thesis.

Starting situation: In the face of complex, value-heavy sustainability problems, we observe the growing relevance of TD approaches in research policy and practice, as well as high expectations with regard to these approaches. At the same time, challenges in applying and implementing these approaches in research practice are ongoing.

1.4 Overall Objective and Thesis Structure: Contrasting High Expectations with Complex Realities

In the previous sections, I argued that, faced with value-laden and normative sustainability issues, scientists increasingly are calling for opening-up knowledge production and developing models and methods for doing so. These calls have entered science-policy making and are expected to have a societal impact. Despite their popularity, there are profound challenges in implementing such approaches. This section brings together these three interlinked strands of discourses on TD sustainability research to formulate the problem statement and the general objective of this thesis.

Returning to sustainability research's quest to contribute to socio-ecological transformation, we have seen that researchers and policy-makers have high expectations of TDR. These expectations are rooted in the assumption that including practitioners and their expertise in research processes produces 'socially robust' knowledge, facilitates societal learning (Garmendia and Stagl, 2010; Lang et al., 2012), empowers certain ideas and actors (Marshall et al., 2018; Scholz and Steiner, 2015b), fosters trust in research results and commitment to the measures and policies derived thereof (Gross and Hoffmann-Riem, 2005) and, consequently, engenders the desired societal change (de Jong et al., 2016; Polk, 2014). Many TD scholars, like participation scholars in other fields, tend to have the strong normative ideal that participation, if done the 'right' way, is valuable and something 'good' (Metzger et al., 2017).

The challenges introduced in the previous section, however, suggest that the participation of diverse actors in TD knowledge production does not necessarily live up to these ideals or produce the desired outcomes. The design of the participation process and the context within which it is situated are important for how actors relate to it and for the values and expertise included in or excluded from it (Bieluch et al. 2016). With the scholarly interest and focus that has been put on ideal-types, methodological advancements and the output and outcomes of participation, the messy amalgam of factors shaping participation processes remain largely obscure, hidden away as it were in a 'black box'. Similar observations have been made for interdisciplinary processes and team research (Callard and Fitzgerald, 2015; Mountz et al., 2003).

Consequently, the dynamics and complex interactions between different actors and contexts that form these knowledge production processes have remained widely unexplored. Fairly little is known about how negotiations, norms, values, and power struggles create and shape these processes in TD practice. Thus, a discrepancy between the positive connotations of participation in TDR and a limited understanding of the underlying causes of persisting challenges in TD practice can be observed.

Exploration of its practice must move beyond the investigation of methods and techniques of TDR and enquire into the complex processes that constitute it. Critically investigating real-type participation processes in all their complexity and exploring *"the precarious roads of practice"* (Scholz and Steiner, 2015c, p. 522) seem all the more pressing given the increase in research funding programmes that require participation (Schneider et al., 2019a; Van der Hel, 2016). This implies tracing how researchers and practitioners make sense of and translate these concepts and corresponding funding requirements into practice (Schikowitz, 2019).

Analogous to opening the 'black box' of scientific practice and studying the 'making' of science (Bourdieu and Wacquant, 1992; Latour, 1999), such enquiries into the 'making' of participation practices in TDR might reveal the origins of some of the issues underlying researcher-practitioner interactions beyond ideal-types. In such an interpretation, TD processes are seemingly not only intellectual endeavours, but exchanges that - as MacMynowksi (2007, p. 4) puts it, with regard to interdisciplinarity - *"begin and end with a meeting of values, worldviews, and claims"*. Bringing these heterogeneous actors together involves confronting different norms, values, perspectives and interests. As Nowotny et al. (2001, p. 211) observe with regard to the space between scientific and the practice fields, which they call the 'agora' and in which TDR can be located: *"The agora, therefore, is not an empty or an anarchic place; [...] Of course, it would be naïve to claim the agora is devoid of power structures and power struggles. Power certainly matters"*.

The **overall goal of this thesis** is to illuminate the complex processes and dynamics that shape participation processes and their effects in TD sustainability research. This thesis argues that, in the case of TD knowledge production in the field of sustainability, opening the black box is likely to bring to the surface the tensions, negotiations and power dynamics involved in participation processes for at least three reasons: (i) they consist of social interactions between heterogeneous actors with diverse ethical and epistemological values (Rosendahl et al., 2015), (ii) are embedded and enmeshed in established structures, norms and discourses in academic and practice fields in general (Felt et al., 2016) and (iii) deal with controversial, value-laden, issues (Scholz, 2017; Wuelser and Pohl, 2016).

This thesis aims at enhancing our understanding of these structural and actor-related elements that shape the making of participation in TD sustainability research and its societal effects. To arrive at such an enhanced understanding, it proposes to approach participation processes in TDR empirically, and to learn about how they are constituted in practice (Woolgar and Lezaun, 2013).

Thus, this thesis explores how a shift in conceptual perspectives on participation can address missing dimensions in the current understanding of participation in TD knowledge production in the field of sustainability. This follows Irwin's (2006, p. 310) proposal to consider participation and the new "scientific governance" as "*a legitimate object of study in itself",* and joins emerging critical scholarship that sees participation as constructed (Hegger et al., 2012), co-produced (Chilvers and Kearnes, 2015) and relational (Klenk and Meehan, 2017).

Fostering conceptual-analytical clarity on and empirical knowledge of the various elements that dynamically forge participation, this thesis provides a nuanced basis for discussing the transformative power of TD knowledge production. In unpacking the very practice of participation, which underpins various approaches to researching and governing sustainability issues, it adds to an emerging critical and transformative sustainability science that acknowledges power dynamics and is reflexive towards its own practices.

This is a **thesis-by-publication**, i.e. it has been mainly written in scientific articles. It consists of three parts:

PART I provides an introduction to the work conducted as part of the thesis, contextualises and synthesises its results and draws overarching conclusions. **Chapter 2** briefly reviews the main literature strands in TD sustainability research and neighbouring fields in which this thesis is situated. It identifies research needs in terms of models, processes and effects of participation at the end of each sub-section ("current state and trends" section). **Chapter 3** then sets the theoretical stage and introduces the theoretical assumptions that framed the research goals and questions, including (i) the notion of social fields and the co-production of science and society, (ii) feminist critique of knowledge hegemonies and (iii) the quest to open the 'black box' of TD knowledge production in order to see participation 'in the making' and the 'politics' involved ("preparing the grounds" section). The research goals and questions related to models, processes and effects of participation, and the three corresponding research modules they are addressed in are presented in **Chapter 4** ("research goals, questions and modules" section). These include de-and reconstructing participation, unpacking processes of participation and linking the processes and effects of participation in TD sustainability research. **Chapter 5** provides a brief overview of the research approach

and methods chosen to address the research questions and goals presented ("research approach, methods and materials section). **Chapter 6** recaps the main findings from Manuscripts I-IX (see table 1) and synthesises them in three main modules, thus answering the main research questions. This chapter also discusses the main findings' contribution to TD sustainability scholarship and points to the practical relevance of the findings for TD researchers and practitioners. **Chapter 7** closes with conclusions and thoughts regarding the politics of participation in TD sustainability research and outlines future research avenues.

PART II assembles the nine articles that comprise this thesis, which are presented as they have been published or submitted. It includes the following publications: four published articles, two published book chapters, two articles in press, and one submitted manuscript (see table 1). The doctoral candidate's contribution is described prior to each article.

PART III provides appendices to the manuscripts as well as supplementary material to the methods section.

Table 1. Overview of manuscripts

	ARTICLE
I	**Fritz, L.**; Binder, C.R. 2018. Participation as Relational Space: A Critical Approach to Analysing Participation in Sustainability Research. *Sustainability 2018*, *10*, 2853.
II	**Fritz, L.** 2018. (De-)Constructing participation in transdisciplinary sustainability research: A critical review of key concepts. In: Engelschalt, J., Maibaum, A., Engels, F., Odenwald, J., (Eds.): *Schafft Wissen–Gemeinsames und Geteiltes Wissen in Wissenschaft und Technik*, Proceedings of the INSIST Conference, 7–8 October 2016. Munich: Social Science Open Access Repository, 106–125.
III	**Fritz, L.**; Schilling, T.; Binder, C.R. 2019. Participation-effect pathways in transdisciplinary sustainability research: an empirical analysis of researchers' and practitioners' perceptions using a systems approach. *Environmental Science and Policy 2019*, 102, 65-77.
IV	**Fritz, L.**; Meinherz, F. 2020. The politics of participatory sustainability assessments: An analysis of power. In: Binder, C.R., Massaro, E., Wyss, R. (Eds.): *Sustainability Assessment of Urban Systems*. Cambridge: Cambridge University Press, 87-122.
V	**Fritz, L.**; Binder, C.R. 2020. Whose knowledge, whose values? An empirical analysis of power in transdisciplinary sustainability research. *European Journal of Futures Research.*
VI	**Fritz, L.**; Meinherz, F. 2020. Tracing power in transdisciplinary sustainability research: an exploration. *GAIA - Ecological Perspectives for Science and Society*. In press.
VII	Meinherz, F.; **Fritz, L.**; Schneider, F. 2020. How values play into sustainability assessments: challenges and a possible way forward. In: Binder, C.R., Massaro, E., Wyss, R. (Eds.): *Sustainability Assessment of Urban Systems*. Cambridge: Cambridge University Press, 65-86.
VIII	Meinherz, F.; **Fritz, L.**; Schneider, F. 2020. Vom Öffnen und Verschließen von Alternativen: Implikationen der gesellschaftlichen Einbettung nachhaltigkeitsrelevanter Wertvorstellungen. In: Lindner, R; Decker, M.; Ehrensperger, E.; Heyen, N.; Lingner, S.; Scherz, C.; Sotoudeh, M (Eds.): *Gesellschaftliche Transformationen: Gegenstand oder Aufgabe der Technikfolgenabschätzung?* Baden-Baden*:* Edition Sigma/Nomos. In press.
IX	Binder, C.R.; **Fritz, L.**; Andreas Balthasar; Ralph Hansmann; Zilla, Roose *(submitted)*. Increasing the relevance of science for practice and practice for science: quantitative empirical insights. *Submitted to Science and Public Policy.*

2 Current State and Trends

For decades, questions of participation have been a subject of interest in various academic fields and public debates. The main area, however, where questions of participation spark interest is political participation in governance and decision-making via more or less direct mechanisms. As such, participation is one of the key normative elements of democratic systems (Verba et al., 1995) and closely tied to questions of deliberation. While discourses within the broad field of political science can be considered the mother discourse on participation, the notion of participation has spread to other societal and academic fields. Thus, participation does not only refer to taking part in decision-making by expressing views and opinions on a policy problem (Gabriel 2013), but is also associated with other processes such as knowledge production. In the latter case, societal actors appear as holders of specific knowledge on a matter of concern and are asked to bring their expertise to the table.

In the following depiction of the state of the art, emphasis is put on this second strand of literature on participation – participation in knowledge production, research and bordering fields. The focus here is on TD literature in the field of sustainability as a core discourse on participation in knowledge production in sustainability research (sections 2.1.-2.3.). Trends in the neighbouring fields of development research and Science and Technology Studies (STS) are briefly touched upon (section 2.4.). Critical reflections are provided and research needs identified for each strand of research. These provide the basis for the research goals and questions developed in section 4.

Within sustainability research, several inter-connected strands of research on TD can be identified, each of which looks at participation from a different angle. In the following section, three broad strands that are relevant in terms of contextualising the arguments developed in this thesis are briefly outlined[7].

2.1 Models: Conceptions and Reflections on Ideal-types of TDR in Sustainability Research

Firstly, a considerable body of literature elaborates on different ideal-types of TDR. They address the question of what TDR should be and how such research and collaboration processes should be governed (Bergmann et al., 2012; Jahn, 2008; Scholz and Steiner, 2015c, 2015a). Lang et al. (2012), for instance, set up much-cited principles

---

[7] This section is partly based on Manuscripts I, II and III, which can be found in Part II of this thesis.

for guiding TDR from problem-framing to implementation. From their standpoint, an ideal-typical TD process consists of problem-framing, knowledge co-production and re-integration of knowledge into the research and practice fields. Throughout these phases, participation takes the form of equal input from practitioners and researchers (Lang et al., 2012, p. 28). Participation is hence ideal-typically thought of as a symmetrical process along the three research phases in which researchers from different disciplines and practitioners input their knowledge, mutually learn, and benefit from the output (Zscheischler, 2017). In terms of practical implementation, some scholars have expressed concerns about watering down the concept by referring to it *"in an inflationary manner for labelling any interaction between scientists and practitioners"* (Scholz and Steiner, 2015b, p. 654). These scholars are working towards promoting TD as a distinct approach and towards developing more clear-cut demarcations to related concepts, such as participatory research or the Triple Helix model (Scholz and Steiner, 2015b). Concomitantly, scholars have been working to create distinct quality criteria (Bergmann et al., 2005; Jahn et al., 2012; Wickson et al., 2006) so as to the ensure the quality and enhance the legitimacy of these knowledge production practices in academic discourse and beyond.

In order to support the practical implementation of ideal-type TD, design principles for researcher-practitioner interactions in TDR allude to the notion of 'shared control', 'co-leadership' and interactions between researchers and practitioners on 'equal footing' (Lang et al., 2012; Luthe, 2017; Scholz and Steiner, 2015b). This assumes 'symmetry of enlightenment' between researchers and practitioners, and implies balanced power relations between heterogeneous participants (Maasen and Lieven, 2006).

2.1.1   Normative Models of Participation

Such ideals manifest in popular conceptualisations of participation in terms of the extent of practitioners' influence on collaboration, and hence the (implicit) quest for power redistribution to the 'powerless' as represented in Arnstein's (1969) much-cited ladder of participation. Her ladder, in which each rung corresponds to the degree of power transferred to citizens, appreciates the intrinsic value of participation and expresses the idea that "the more participation, the better" (see Chilvers and Kearnes, 2015). The underlying conception of participation is often not made clear in TD literature. Those scholars who do clarify their conception frequently allude to Arnstein's ladder. For example, Stauffacher et al. (2008) develop a functional-dynamic model to analyse practitioners' participation in TDR along the axes of information, consultation, cooperation, collaboration and empowerment. Schneider and Buser (2018) rely on intensities of involvement to assess the degree of stakeholder interaction, which is the most promising for different types of research projects[8]. Defila et al. (2006, p. 216) and

---

[8] Notably, both Stauffacher et al. (2008) and Schneider and Buser (2018) stress the dynamic nature of intensities of involvement throughout TD processes. Schneider and Buser (2018) further nuance the

Boeckmann (2005) have developed models of participation specifically for knowledge production: With slight variations, both teams of authors depict participation as a continuum ranging from practitioners being the object of research to being active partners who shape the process. Both establish an indirectly proportional link between the number of participants involved and the intensity of their involvement. Furthermore, the extent to which practitioners influence problem definition, the choice of knowledge production approach(es) and related decisions have been suggested as the decisive criteria in distinguishing 'participatory' and 'consulting' approaches to TDR (Mobjörk, 2010).

These models are particularly useful for categorising and comparing different forms of participation. However, they provide little guidance as to how to go about analysing the complex processes that produce these different forms in the first place. I argue that the ways in which participation is conceptualised and understood in TD ideal-types has repercussions on empirical perspectives applied to understanding participation practices in 'real-type' TDR.

Critical reflection and research needs:

In the field of sustainability research, ideal-typical images of participation and guiding principles for realising them in TD knowledge production prevail, while critical perspectives are widely lacking. The normative assumptions underlying ideal-typical conceptions of TD in general and participation in TD in particular are insufficiently transparent and must be made explicit. The corresponding conceptual perspectives seem to give rise to somewhat static, one-dimensional accounts of forms of participation, but are unsuited to critical investigations into how power, values and negotiations shape the form and outcomes of participation processes. The conceptions presented, which have their roots in the field of planning and decision-making, constitute a useful framework for thinking of forms and degrees of participation in research. However, they are deficient in terms of explaining why participation processes unfold differently in different socio-political and academic contexts. Moreover, they do not sufficiently reflect the epistemic goals pursued with sustainability-oriented knowledge production.

In order to better understand and tackle the obstacles to fulfilling participation ideals and TD principles in practice, we need critical perspectives that can address the contextual embeddedness of participation processes and the role of the more engrained structures, norms and discourses that shape these processes.

---

notion of intensities and show how depending on the project design and goals different intensities are effective.

2.2 Processes: Case Studies and Reflections on Real-type TDR in Sustainability Research

A second strand of literature focuses on real-type TDR and associated participation practices. Numerous articles report on experiences and observations made at the level of single projects or of a small set of case studies, i.e. adopting a micro-level perspective (e.g. Binder et al., 2015; McKee et al., 2015; Schmidt and Pröpper, 2017; Stauffacher et al., 2008; Steelman et al., 2015; Tötzer et al., 2011; Vilsmaier et al., 2015). Methodologically, many of the empirical insights into TDR are thus based on analyses of individual cases, in which the respective scholars have been involved themselves, while more aggregated analyses are scant (Zscheischler and Rooga, 2015). Only in recent years, increasingly comparative studies of several cases have been undertaken (Enengel et al., 2012; Schneider and Buser, 2018; Tejada et al., 2019; Wolff et al., 2019). Most of the case study analyses describe participation as one element in the process among others. Many of these reflections are partial because they are presented from the researchers' standpoint, while those of practitioners are seldom taken into account. Only a small - though growing - number of authors (e.g. Binder et al., 2015; Bracken et al., 2015; Di Giulio et al., 2016; Schmidt and Neuburger, 2017; Schmidt and Pröpper, 2017) explicitly explore the expectations, goals, experiences and reflections of practitioners with regard to the TD process and/or its (desired) outcomes. Insights gained in these studies point in similar directions: practitioners' perception and expectations of participation tend to differ from those of researchers. Moreover, they do not necessarily correspond to researchers' assumptions about these perceptions and expectations. Considering practitioners' standpoints means grasping the societal and organisational contexts of practitioners', which helps us in better understanding the processes and the challenges encountered therein.

Many of these empirical investigations reveal discrepancies between the ideals of TD - its theoretical conceptions and rhetoric - and the reality (Zscheischler and Rogga, 2015). For instance, with regard to the core principles of 'shared control' and 'co-leadership' (Lang et al., 2012; Luthe, 2017; Scholz and Steiner, 2015b), Brandt et al. (2013, p. 6), in a systematic literature review, found that while practitioners were involved in most of the projects in their sample, few researchers transferred decision-making powers to the practitioners involved. Similarly, with regard to the core principle of joint problem-framing and shared problem-understanding, Wuelser and Pohl (2016) found that unlike ideal-typical TDR, participation in the problem-framing phase of the ten projects studied was low. According to findings by Di Giulio and Defila (2016, p. 201) this is not necessarily seen as a problem and corresponds to the preferences of the practitioners interviewed, who welcomed a more traditional division of labour between research and practice. In connection with the normative assumptions that underpin the ideal-typical conceptions briefly outlined above, empirical reports and critical scrutiny of the

conflicts, negotiations and power imbalances that manifest themselves in and shape these participation processes are largely absent (see e.g. for some recent developments Bréthaut et al., 2019; Rosendahl et al., 2015; Schmidt and Neuburger, 2017). A literature-based review of the factors that shape participation in real-type TDR will be given in section 6.2.

Increasingly, empirical studies are also enquiring into TD interactions and knowledge integration at the level of funding programmes, thus complementing empirical investigations at the project-level (de Jong et al., 2016; Hoffmann et al., 2017a, 2017b; Van der Hel, 2016).

Critical reflections and research needs:

In connection with the prevailing conceptions of participation (see section 2.1), the question of why participation unfolds one way or another in TD practice is under-researched empirically speaking. More specifically, there is little systematic knowledge of the amalgam of factors that dynamically form participation processes in sustainability research and in knowledge (co-)production more generally. Predominantly descriptive accounts of the form of participation are provided (Bell et al., 2012), for instance on the number of participatory events organised in a project and the formats used. Participation is described as the product of the intentions of those who set up the process (i.e. mostly researchers) (Felt et al., 2012). Systematic consideration of the perspectives of practitioners involved across a large sample of research projects is scant. Their perspectives represent blind spots in the TD landscape. Despite the richness of case studies, these single accounts are not systematically assembled. Hence, knowledge regarding the constitution of participation remains under-theorised. Empirical reflections tend to centre on the project entities themselves (Klenk and Meehan, 2017), while the issues' and actors' contexts - including their structures, hierarchies, norms, discourses, and actor relationships - are overlooked. For example, the ways in which values with respect to sustainability or discourses on appropriate science-society relations affect participation processes in TDR remain largely unexplored.

There is a need for empirical enquiries into the amalgam of context-embedded factors and dynamics that tacitly shape participation processes as practiced and perceived by researchers and practitioners in TD sustainability research.

2.3 Effects: Towards an Assessment of the Societal Impact of TDR in Sustainability Research

With the growing maturity of the field of TD as well as the increasing use and policy relevance of such approaches, the role of TDR in societal transformations is receiving growing interest from scholars. A need to analyse and demonstrate the extent to which assumptions about the societal effects of research-practice interactions in TD sustainability research are justified has emerged (de Jong et al., 2016; Hansson and Polk, 2018; Van der Hel, 2016).

This third branch of literature aims to assess the output and societal effects of TDR beyond academic impact metrics. Widely adopted approaches to identifying and measuring the societal effects of research commonly differentiate outputs, outcomes and impacts[9] (Morton, 2015; Shirk et al., 2012; Walter et al., 2007; Wiek et al., 2014). In such conceptions, practitioners' participation is often seen as an input factor[10], whereas societal effects (outcomes and impacts) designate the desired endpoints that are eventually attained by generating outputs (Shirk et al., 2012; Walter et al., 2007; Wiek et al., 2014; Wolf et al., 2013)

Attempts have been made to capture the societal effects of TDR ex-post (Blackstock et al., 2007; Newig et al., 2019; Spaapen et al., 2007; Walter et al., 2007). These efforts revealed important epistemological and methodological challenges in measuring the societal effects of TDR projects, largely echoing issues identified in impact studies more generally (Watermeyer, 2014). For instance, the time between the conduction of a research project and the eventual unfolding of an (intended) societal effect is not easily predictable. A societal effect can take several years to unfold (Buxton, 2011; Stokols et al., 2003; Watermeyer, 2014). Assessments after longer periods of time, on the other hand, come with other challenges, notably participants' fading and distorted memories (Talwar et al., 2011; Walter et al., 2007; Wiek et al., 2014). Furthermore, cause-and-effect relationships between research and societal effects are difficult to establish, and become increasingly difficult to attribute over time (Morton, 2015). The greater the time-lag between the realisation of a research project and a societal effect, the more

---

[9] The notion of 'outputs' refers to tangible or intangible products that result from project activities and that lead to first-order effects or outcomes, such as the enhancement of practitioners' capacities (Shirk et al., 2012; Wiek et al., 2014). Second-order effects or impacts describe "long-term and sustained changes" (Shirk et al., 2012) or "structural changes and actions" (Wiek et al., 2014) (Manuscript III).

[10] In Walter et al.'s (2007) ex-post evaluation of the impact of TDR, for instance, participation appears as one potential influence factor, without further operationalisation of the concept. A more elaborate conception of participation in impact-focused studies is Wiek et al.'s (2014, p. 124) differentiation in nature and quality of participation in TDR.

difficult it is to attribute an observed change to an individual research project and/or its TD process (Morton, 2015; Penfield et al., 2014; Wiek et al., 2014).

Research in related fields has shown that participatory practices create effects that are strongly linked to the interactions and relations of the actors involved (Darby, 2017; Evans, 2016). Similarly, Spaapen and Van Drooge (2011) proposed to concentrate analytical perspectives on processes by examining 'productive interactions' between researchers and practitioners. As part of such process-oriented perspectives on the effects of collaborative research processes (Currie et al., 2005), formative evaluations which are carried out during ongoing TD processes have been identified as promising tools (Hellström, 2015; Wiek et al., 2014). These studies suggest that the forms and features of collaborative research processes affect their potential for producing relevant results and contributing to societal effects. The process features addressed with regard to this are amongst others the intensity of researcher-practitioner interactions (Schneider and Buser, 2018; Walter et al., 2007; Wiek et al., 2014), the timing of practitioner involvement (Lux et al., 2019) and the knowledge integration methods used (Newig et al., 2019).

These varying facets of emerging scholarship on the societal effects of TDR point to the need for further empirical insights into the interrelations between effects, process features and qualities (Lux et al., 2019) and the dynamics of participation processes (Hansson and Polk, 2018). Relying heavily on the outputs-outcomes-impacts conceptual chain for interpreting societal effects does not allow to adequately represent the iterative and dynamic nature of TD approaches that mark a deliberative rupture with linear research logics (Carew and Wickson, 2010; Klenk and Meehan, 2017). Increasingly, theories of change (ToCs), which have their origins in the evaluation of social and development programmes (Weiss, 1997), are also proposed for thinking about change relative to research projects (Douthwaite et al., 2003; Oberlack et al., 2019; Paina et al., 2017; van Drooge and Spaapen, 2017; Vogel, 2012). Including practitioners' perspectives of the role of participation processes in impact pathways is essential for such endeavours (de Jong et al., 2016; Hansson and Polk, 2018; Spaapen and Van Drooge, 2011).

Critical reflections and research needs:

Despite high expectations placed on practitioners' participation in TDR, methodologies and conceptions that acknowledge participation as a dynamic process and grasp the complexity of pathways connecting practitioners' participation in TDR to societal effects in a systemic, interrelated manner are lacking. So far, the integration of the procedural and dynamic nature of participation in both the planning and the analysis of (potential) effects has been insufficient. Likewise, empirical investigations into how process features (such as timing, form and intensity of practitioner involvement) are

linked to the practical usefulness and societal relevance of results are largely missing. Empirical investigations of how different kinds of actors involved in TD sustainability research perceive the pathways to societal effects are rare. Likewise, empirical applications of how 'theories of change' can be utilised to render tangible the assumptions, perceptions and mental models of researchers and practitioners involved in TD sustainability research are few.

There is a need for systemic and empirical enquiries into the complex interlinkages between participation processes in and the societal effects of TD sustainability research.

2.4   Looking Beyond TDR: Participation Studies in Neighbouring Fields

Similar practices of involvement are not necessarily bound by the concept of TD and may use different terminologies. A thematic literature review might therefore be useful in terms of gaining important insight by looking beyond TD scholarship and including participation processes in the context of societal change and science-society interactions more generally. The following section will provide several examples of why looking at scholarship on participation in development research and STS seems promising for this thesis' enquiry into TD sustainability research. A more extensive review of the state of the art - on which this section is based - can be found in **Manuscripts I** and **II** (see Part II).

2.4.1   Development Research: Critical Voices on Participation and Power

As the introduction states, TD sustainability research is rooted in *lifeworld* problems, for which it strives to provide 'solutions'; what is considered a desirable solution is normatively guided by a certain conception of sustainability. There are similarities with development research, wherein participatory approaches strive to grasp *lifeworld* problems and offer solutions guided by what is considered desirable development. Not least in response to the sobering results of decades of development co-operation combined with the advent of post-colonial thought (e.g. Said, 1978), a tradition of participation and inclusion of 'local' and 'indigenous' knowledge in Participatory Rural Appraisal (PRA) and Participatory Action Research (PAR) has emerged over the past 50 years (Lacroix et al., 2011; Whyte, 1991).

However, the widespread adoption of participatory approaches in development research and practice has been accompanied by criticism of the concept and practice of participation (Christens and Speer, 2006; Cornwall and Coelho, 2007; Hickey and Mohan, 2004; Kothari and Cooke, 2001). This criticism falls into two categories whose

focus is on power: (i) a methodological critique with the goal of improving participation practices; (ii) a fundamental critique that points to the power effects of participatory discourses and the risk of a de-politicisation of development (Williams, 2004). In the methodological critiques of PRA processes, scholars – many of them working in a participatory manner themselves – call for reflexivity with regard to societal power relations and their manifestation in participatory practices. These power relations are found to have *"implications in [sic] the nature of involvement"* (Webber and Ison, 1995, p. 112). The second, more radical critique provocatively raises the question, has participation become *"the new tyranny"?* (Cooke and Kothari, 2001).

2.4.2   Science and Technology Studies: Expertise and Public Engagement

As also described in the introduction, TD sustainability research consists of knowledge production processes and aims at integrating different forms of expertise. STS can contribute decades of experience of studying the mechanisms of science and knowledge production practices. Furthermore, the participation of diverse actors in science and technology has become a major concern and issue of interest for STS scholars (Abels, 2006). This scholarly interest includes the involvement of so-called 'non-certified experts' (Collins and Evans, 2002) in technology and risk assessments, as well as public engagement in the governance of science and technology. These participation practices emerged in the 1970s in response to public controversies surrounding techno-scientific developments, such as nuclear power (Nowotny, 1976) and the Three-Mile Island and Chernobyl nuclear catastrophes, Genetically Modified Organism techniques (Hansen, 2010) and fracking (Goldstein et al., 2016). Participatory assessments of risks, for instance related to new technologies, involve "*assessors other than scientists […] as fully fledged social actors who bring not only their professional expertise (as farmers, campaigners, planners, business people, interest groups, etc.) to bear on the assessment but also their social expertise and experience*" (Joss, 2002).

Moreover, STS scholars are increasingly rethinking the public's involvement in science, technology and environmental issues as co-produced (Chilvers and Kearnes, 2015) and 'enacted' (Metzger et al., 2017). They also are starting to look at TD processes as 'adventures in relevance' (Klenk and Meehan, 2017). These scholars argue that participation should not be taken for granted, but rather should be understood as constructed and situated in an intellectual context (Jasanoff, 2003).

Critical reflection and research needs:

Research on participation in research practice and governance remains fragmented and piecemeal. Despite their specificities, participatory approaches across the three fields deliberatively blur the 'traditionally' clear-cut division of labour between research and practice. Their shared interest in participation notwithstanding, a look at publication

references from the respective fields suggests that the flow of knowledge across these fields is rather low. When moving beyond ideal-typical and theoretical reflections, boundaries blur; methods for addressing challenges in one field might be equally valuable for other fields. Combining experiences from these diverse fields holds potential for mutual learning with regard to factors that impinge on practices of participation.

There is a need for integrative analyses that look beyond the core of TD scholarship as a means for understanding participation. In particular, the critical perspectives on power in PAR in development research and STS perspectives on participation and expertise can provide valuable impulses for TD sustainability research.

3 Preparing the Grounds: Theoretical and Conceptual Starting Points

This section introduces the theoretical assumptions that frame the research goals and questions identified in this thesis, as well as the overall analytical and empirical approach chosen to address them. It expands the scope of our perspective, which focuses on participation studies in TD sustainability research and neighbouring fields, by considering related notions from social theory and (feminist) science studies[11]. This will prepare the grounds for the subsequent analyses and the discussion of results.

3.1 Science and Practice as Social Fields

The first notion that framed the way the issue of participation in TDR was approached in this thesis is the concept of 'social fields'. Following the terminology of Pierre Bourdieu (1998), in this thesis both science and practice[12] are considered as social fields. These fields are structured by specific rules, i.e. norms, quality standards, criteria of validation, reward mechanisms, as well as by the actions of the actors positioned within them[13] (Bourdieu, 1998). Thus, the science or research field refers to the academic system and how it functions in a certain research area (e.g. energy research). The

---

[11] Science studies are a heterogeneous scholarly field comprised of different schools of thought and traditions, such as STS, sociology of knowledge, sociology of scientific knowledge and science of team science (Roosth and Silbey, 2009). They generally share the understanding that knowledge and the social and material conditions that underpin it are intertwined and mutually constitutive. In an anti-positivist tradition, this implies that this intertwining is not a threat to scientific objectivity or integrity which needs be erased. On the contrary, it must be acknowledged that *"knowledge comes in socio-historical and situational packages that need to be analysed in full"* (Maasen and Winterhager, 2001, p. 16).

[12] We use the terms 'science' and 'research' synonymously to refer to both natural and social sciences and the practices of knowledge production of the researchers within them. We distinguish the 'research' field from the 'practice' field in the narrower sense in which TD scholarship speaks of 'practice' in order to refer to political, economic, cultural or any other 'non-scientific' activities in a given sector; this understanding is reflected also in labels such as "partners from practice" (Lang et al., 2012). The double connotation of the notion of 'practice' needs to be noted here. In our understanding, also research constitutes a practice, as defined in broader terms by scholars who have moved attention away from structures to the (collective) practices that produce them (Schatzki et al., 2001). The simplified partitioning in 'research' and 'practice', thus, does not mean to say that science is not a form of practice too – a kind of routinized behavior that comprises *"forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge"* (Reckwitz, 2002, p. 250).

[13] The positioning of actors, to whom Bourdieu often refers as 'agents', depends on their 'habitus' as well as their social, economic and cultural capital (Bourdieu, 1998).

practice field subsumes practical work and activities in a certain problem-related area or sector (e.g. energy policy) and includes heterogeneous actors - practitioners - who are positioned and act in this sector.

Understanding the scientific field as a social field like any other, renders the investigation of the scientific practices of academics - like those of any other social practice - indispensable. However, while social science has striven to reveal and highlight social practices and structures in other social fields, with regard to its own practices Bourdieu and Wacquant (1992) observed a "self-mystification" because, as they put it, *"Homo academicus relishes the finished"* (Bourdieu and Wacquant, 1992, p. 219). While 'homo academicus' has long been writing about and describing the knowledge it has produced and discoveries it has made, its own practices when it comes to producing this knowledge have remained invisible. In order to respond to and avoid the corresponding de-contextualising of research outcomes (Mountz et al., 2003), scrutinising '*homo academicus*' in his/her scientific field requires *"exoticiz[ing] the domestic, through a break with his initial relation of intimacy with modes of life and thought which remain opaque to him because they are too familiar"* (Bourdieu, 1988, p. 132). Doing so, allows us to see work in its "becoming" (Bourdieu and Wacquant 1992). We will come back to this aspect and science study's quest for shedding light on such processes in section 3.3.

Such a perspective on research as a social field implies that researchers and their knowledge production activities are entangled with and shaped by the social and institutional structures and processes in the field (Van Kerkhoff and Lebel, 2006). Let us consider a stylized example of what research and practice fields might look like in the area of sustainability. The production and consumption of energy are a key area of concern in sustainability research (energy research). Several (European) countries have set political targets for a transition towards renewable energy systems (energy policy) (see e.g. German Federal Government, 2019; Swiss Federal Department of the Environment, Transport, Energy and Communications, 2019). Research on energy-related topics is generally situated in the research field, which functions according to specific rule sets (Felt et al., 2016). Researchers working on questions relative to the energy transition, e.g. on new energy storage technologies, smart grids, consumption behaviour and energy market analyses, are involved in what is perceived to be 'good' scientific practice in their respective fields of research, follow specific rules when applying for research funding and adopt publication standards prevalent in their field. With regard to energy policy, the practice field is comprised of activities conducted by competent individuals or organisations with regard to a specific problem area (e.g. energy suppliers, political representatives, consumers, citizens or interest groups). Similar to researchers, practitioners exist within, abide by or contest, and change the rules of the field and organisational cultures of which they are part (e.g. Geels and Schot, 2007), be they economic rationales in the case of companies, political calculus in the case of political parties, or other.

The notion of social fields that are comprised of rules and the actors within them, provides a useful frame for thinking about the idiosyncrasies of research and practice fields and the actors within them. This constitutes the theoretical starting points for Module 1 and 2 (see section 6). It compels us to look for the different rule-sets that structure these fields as well as the positioning of actors, researchers and practitioners, within them. As will be clear in the next section, this is a helpful starting point for thinking what happens when researchers and practitioners step out of their fields and engage in a dialogue with the rules and actors in the respective other field.

3.2   Co-production and the Role of Power and Knowledge Hegemonies

The second theoretical reference point that frames how the issue of participation in TD sustainability research is approached in this thesis is the idea of overlapping and multidirectional links between different social fields. Despite the idiosyncrasies of the respective fields with regard to TD sustainability research, the fields of research and practice overlap and interact (Van Kerkhoff and Lebel, 2006). Such a perspective implies that the boundaries between research and practice are not static and pre-established, but rather are the result of 'boundary work' (Gieryn, 1983) and continuous social and political contestations. These boundaries are, thus, changeable and permeable (Van Kerkhoff and Lebel, 2006).

Figure 1. Research-practice interface (own illustration)
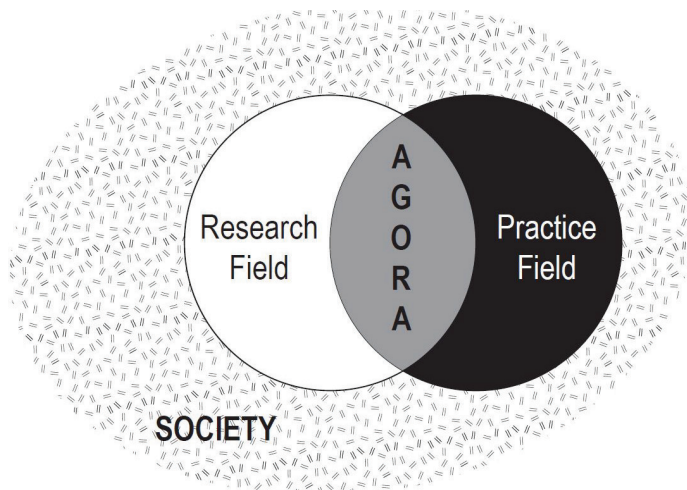
Considering an active interface between researchers and other societal actors breaks with the traditional 'knowledge deficit model' (Brooks and Johnson, 1991). In the deficit model, the producers (researchers) and users ('the public') of knowledge were considered as closed, autonomous groups that each fulfilled specific functions. In this conception, knowledge is produced and made available by researchers, then transferred to the public – i.e. the end-users who need this knowledge - via information channels. The relationships between researchers and the public at large are thus characterised by unidirectional flows of knowledge (Cvitanovic et al. 2015: 27).

Various attempts have been made to design alternatives to such models of unidirectional knowledge transfer. For instance, concepts of 'boundary organisations' (Guston, 1999) focus on the emergence of new organisations that mediate between the stable borders of science and practice in general, and policy in particular (Pohl et al. 2010). In contrast, the concept of 'mode 2' suggests that the epistemological boundaries between the two fields at least partially dissolve or blur (Nowotny, Scott and Gibbons 2001). At the intersection of the realms of science and other societal (practice) fields, a new common space emerges that Nowotny et al. (2001) call the 'agora' (see figure 1). In reference to the Greek *"political arena and the market place"* (Nowotny et al., 2003, p. 192), they conceive of this interface as *"a public space in which 'science meets the public', and in which 'the public speaks back to science'"* (Nowotny et al., 2001, p. 247). This concept has received considerable attention in both science studies and sustainability scholarship (e.g. Harding, 2008; Pohl et al., 2010). Conceptually, TD approaches and the participation of diverse actors within them can be situated within this 'agora'.

The third and related theoretical reference point guiding the work conducted in this thesis is the claim that such a public space is co-produced with the wider societal order, and hence tends to be pervaded by power dynamics and knowledge hegemonies. From a feminist science studies perspective, Sandra Harding (2008) criticises the fact that the conception of the 'agora' remains vague with regard to how such a democratic ideal can be achieved. In her view, the concept remains silent with respect to how marginalised or disempowered voices can receive equal attention and be equally heard in negotiations in this public space. Adapting from what was stated in the previous section regarding social fields (e.g. Bourdieu 1998), this raises the question of which rules structure this new space and which actors have the corresponding dispositions (e.g. habitus and capital) to navigate this new space. Calling for more sensitivity toward the working of power Harding concludes that in writings on the 'agora' "*[t]here is no discussion of how power relations of race, class, gender and imperialism have already shaped the sciences and technologies we have and the societies that have co-evolved with these sciences and technologies"* (Harding, 2008, p. 92).

This strongly resonates the notion of co-production of science and societal order, which was coined by STS scholar Sheila Jasanoff (2004, p. 2) and which refers to the observation *"that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it"*. Coming back to the stylized example from the field of energy, a look at the trajectories of nuclear energy in different states illustrates how national political cultures shape and are shaped by technological and scientific developments. National political cultures affect visions of the "good" and "bad" aspects of nuclear power, and translate them into regulatory frameworks that influence which kinds of technologies are developed and deployed, and which kinds of actors become powerful. The resulting developments and techno-scientific

projects are implicated in collective identity-building (Jasanoff and Kim, 2009)[14]. Through an historical-interpretative account of the development and regulation of nuclear energy in the US and South Korea, Jasanoff and Kim (2009, p. 122) demonstrate how the formulation and implementation of nuclear energy policies *"have simultaneously reinforced particular imaginations of risk and benefit, public good, and nationhood"*.

Taking up this notion of co-production and the above-mentioned criticisms from feminist STS requires having a view of participation in TDR that is sensitive to societal power relations and historically rooted knowledge hegemonies. Following a co-productionist idiom, for such an analysis a look at TD project design and implementation does not suffice. Such an analysis demands a broader perspective that takes into account deeper, historically grown knowledge hegemonies (Harding, 2008) and the situatedness of knowledge (Haraway, 1988). Perceptions of which knowledge is reliable and representing the 'truth' are tied to actors' standpoints (Harding, 1992) and status as 'certified experts' (Collins and Evans 2002). Such a perspective traces the ways in which generally acknowledged truths and knowledge about desirable developments give rise to or stabilise certain paths of action. Thus, within this perspective, knowledge production appears not merely as an epistemic enterprise, but also as an ontological one, an act *"of making, rather than merely depicting, what is at stake"* (Passoth and Rowland 2016, p. 38).

In the following sections, it will become clear that this idea of a space at the interface of research and practice entangled with wider societal power relations is important for the work developed in this thesis. Section 6 will come back to this interstice and the power relations and value negotiations that shape it in presenting the thesis results (notably Module 1, 2a, b, c).

3.3   Opening the Black Box: Participation in TDR 'in the Making' and the Role of 'Politics'

Acknowledging that TD encounters are situated at the interface of different social fields requires critical enquiries into the tacit ways in which such knowledge production practices are shaped by and shape the diverse actors, elements and dynamics in these fields. In order to render these tacit dynamics visible, this thesis, fourthly, is guided by notions of 'opening the black box' and studying science 'in the making'.

---

[14] In their comparative study of the US and the South Korean case, they use the notion of sociotechnical imaginaries, which they define as the *"collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects"* (Jasanoff and Kim, 2009, p. 120).

Similar to Maasen and Lieven's (2006, p. 402) proposal to enquire into "transdisciplinarity in the making", this thesis conceives of "participation in the making" and aims to unpack the complex processes involved in its constitution. In so doing, it takes up and is inspired by science studies scholars' quest to open the black box of knowledge production, which in our case is TD knowledge production processes involving researchers and practitioners. This reveals their internal complexity and the diversity of the interacting components involved in their making. Bruno Latour describes, the functioning of such a black box: *"scientific and technical work is made invisible by its own success. When a machine runs efficiently, when a matter of fact is settled, one need focus only on its inputs and outputs and not on its internal complexity. Thus, paradoxically, the more science and technology succeed[s], the more opaque and obscure they become"* (Latour, 1999, p. 304). In such a black box the *"many elements are made to act as one"* (Latour, 1987, p. 131); it thus conceals the complex machinery of interacting human and non-human components - or *actants* - behind scientific knowledge.

Only when this black box of scientific practice and technology development is opened can the complex processes that shape knowledge production be rendered visible (Knorr-Cetina, 1995). These insights are linked to a tradition of laboratory studies that emerged in the 1980s. With the help of methods known from anthropology and sociology – typically used to investigate the 'Others' – science study scholars started to look at the practical activities of scientists in their laboratory experiments, lecture halls and offices (Knorr-Cetina, 1995, 1981; Latour and Woolgar, 2013). Such an approach directs analytical attention away from the final product toward the processes involved in its production.

Doing so allows us to shed light on the 'politics' of participation and can potentially unveil the roots of the challenges that persist in TD practice. The notion of 'politics' has a profusion of meanings. In political science, in particular in its Anglo-Saxon traditions, 'politics' is frequently described as one element of the tripartite notion of the 'political', being 'polity', 'policy' and 'politics'. Here politics defines the procedural aspects of the political - the processes (for instance a parliamentary debate or elections in democratic systems) through which interests are bargained and decisions taken, including conflicts and negotiations occurring therein. These processes and above all their outcomes are constitutive of societal power gradients (Vowe, 2008). Despite it being more narrowly focused on institutionalised political processes and political systems, this interpretation of 'politics' and its focus on processes of interest negotiations and dispute can open up new perspectives on participation in TDR.

In STS work on different meanings of the 'political', inspired by pragmatist thought and John Dewey's conception of the public in particular, 'politics' is conceived more broadly (Latour, 2007). In this sense, 'politics' refers not only to a pre-made sphere (e.g.

parliament) or a profession (e.g. politicians), but to the diverse ways in which concerns and issues are being brought to the attention of a public, i.e. a collective of actors. These issues can encompass disputed controversies as well as seemingly apolitical and routinized practices (Latour, 2007; Marres, 2007). In STS-related scholarship on the 'politics of knowledge' (Rubio and Baert, 2012), the notion of 'politics', furthermore, refers to the deep entanglements of knowledge and values that are particularly salient and visible in participatory knowledge production processes, such as TD sustainability research. In this view, unlike in 'liberal views' of knowledge (e.g. Merton, 1973), in participatory knowledge production knowledge and societal order are not separate, but mutually constitute one another. Consequently, studying these relations and the ways in which they make some issues visible, while obscuring others, is paramount.

Yet another interpretation of the link between 'politics' (or rather 'post-politics') and participation is offered by scholars arguing that the prevalence of participation concepts and practices in public debate rather defines 'post-politics' and the 'post-political condition' (e.g. Mouffe, 2005; Swyngedouw, 2015, 2011). In this understanding, the 'politics' of participation might be seen as being one element of a wider de-politicisation process that in these scholars' reading characterises liberalism (Tsouvalis and Waterton, 2012). In this sense, participation is political because it forecloses politics by compartmentalising societal debate into individual and pre-defined consensus-seeking practices that disguise antagonisms, and give no place to dissent and contestation (e.g. Mouffe, 2005; Swyngedouw, 2015, 2011). This interpretation resonates and is reminiscent of the 'radical' critique of participation in development studies which voiced concerns over a fragmentation of the public sphere into discrete participation spaces at the expense of more radical democratic politics (White, 1996; Williams, 2004) (see section 2.4.1). Such an interpretation of 'politics' reminds us to consider how participation practices in TDR and the request for societal impact placed on them might be inscribed in broader societal developments and political discourses.

What runs across these different, partly contrasting, interpretations of 'politics' is - with different emphasis given to it - the idea that 'politics' are both constituted by and constitutive of societal power relations (Dikeç, 2005). The many different meanings given to notions of 'politics' and 'political', however, make clear that participation might be political not only because it is imbued with power relations, but also because of the ways in which it brings to light new issues, reassembles actors and their knowledge about them and (re-)configures possible actions related to them.

The theoretical assumptions from social theory and STS outlined in this section provide a broader frame for the research questions identified and the arguments developed in this thesis. The next section will turn to the research questions and goals.

4 Research Goals, Questions and Modules

The theoretical starting points outlined in section 3 combined with the research needs identified throughout section 2 guided the formulation of this thesis' objectives and compel us to ask several questions. This section introduces these objectives and the corresponding research questions.

OVERALL GOAL: The overall goal of this thesis is to enhance our understanding of the complex processes that constitute and shape participation practices and their effects in TD sustainability research. This thesis also seeks to provide analytical tools for critically studying researcher-practitioner interactions in knowledge production in the field of sustainability.

This overall goal is divided into three sub-goals, which were operationalised through several research questions (see table 2). The publications, which tackle the respective questions and contribute to the realisation of the sub-goals, have been divided into three main modules (1, 2a-c, 3).

SUBGOAL 1: *Models and discourses:* Deconstructing and reconstructing participation: developing a critical perspective on participation that allows for seeing participation in TD sustainability research as 'in the making' and embedded in diverse contexts

Research questions:

1a) How is participation constructed and problematised in different scholarly fields, and which understanding of and assumptions about participation underpin such forms of knowledge production?

1b) How can we conceive of and critically analyse participation as 'in the making' and embedded in diverse contexts?

Question 1a is addressed in Manuscripts I and II, and touched upon in Manuscript IV. By means of a literature review on participation in sustainability research, STS and development research, these publications reveal the assumptions that underpin the models of participation frequently used in TD scholarship. They shed light on normative ideals of consensus and interactions on equal footing, logics of 'the more participation the better', as well as

47

constructions of practitioners as passively awaiting involvement. *Question 1b* is addressed in Manuscript I, which develops a relational approach to participation and proposes seeing participation as a relational space. This relational space is produced in a dynamic interplay of structures and actions. Thus, unpacking participation requires an investigation of the structural and actor-related elements that shape it.

Research related to sub-goal 1 is grouped in **MODULE 1:** *Models and Discourses:* Deconstructing and reconstructing participation as a relational space.

SUBGOAL 2: *Unpacking processes*: identifying the structural and actor-related elements - including values, power relations, norms and expectations - involved in the making of participation in TD sustainability research

Research questions:

2a) Which structural and actor-related elements shape participation processes in TD sustainability research?

2b) In which ways do power relations shape participation processes in TD sustainability research? How and on what basis do different actors wield power over participation processes in TD sustainability research?

2c) In which ways do values and worldviews shape knowledge production processes and the participation of diverse actors in the field of sustainability?

Question 2a is addressed in Manuscript I and corroborated by empirical findings in Manuscripts III and IX (Module 2a). In applying the novel perspective of participation as a relational space, Manuscript I systematically analyses scholarship in sustainability research, STS and development research and identities a plethora of factors that shape participation. Manuscripts IV, V, VI, VII and VIII go further into two of these factors - power (Module 2b) and values (Module 2c) -, thereby broaching *questions 2b* and *2c* through empirical and theoretical explorations.

Research related to sub-goal 2 is grouped in **MODULE 2**, which consists of three parts (a, b, c): *Unpacking processes:* a) the role of structural and actor-related factors in the constitution of participation spaces, b) the role of power dynamics in the constitution of participation spaces and; c) the role of values and worldviews.

48

SUBGOAL 3: *Linking processes and effects:* grasping the complex interlinkages between participation processes and the societal effects of TD sustainability research

Research questions:

3a) How do researchers and practitioners in TD sustainability research projects perceive participation-effect pathways, and what role do participation dynamics play therein?

3b) How do researchers and practitioners assess the link between form, timing and intensity of participation and the practical relevance and usefulness of results?

Building on findings from the other modules, *question 3a* is addressed in Manuscript III, which empirically explores researchers' and practitioners' perceptions of pathways to societal effects and the role of participation dynamics therein. Manuscript IX addresses *question 3b* through a quantitative survey of researchers' and practitioners' perceptions of the link between process qualities and the practical relevance and usefulness of results.

Research related to sub-goal 3 is found in **MODULE 3:** *Linking processes and effects:* participation-effect pathways of TD sustainability research.

Table 2. Overview of overall goal, sub-goals and research questions

OVERALL GOAL	To enhance our understanding of the complex processes that constitute and shape participation practices and their effects in TD sustainability research; to provide analytical tools for critically studying researcher-practitioner interactions in knowledge production in the field of sustainability.		
SUBGOALS	1) Deconstructing and reconstructing participation: developing a critical perspective on participation that allows us to see participation in TD sustainability research as 'in the making' and embedded in diverse contexts	2) Identifying structural and actor-related elements - including values, power relations, norms and expectations - involved in the making of participation in TD sustainability research	3) Grasping the complex interlinkages between participation processes and the societal effects of TD sustainability research
RESEARCH QUEST- IONS	1a) How is participation constructed and problematised in different scholarly fields? Which understanding of and assumptions about participation underpin such forms of knowledge production?	2a) Which structural and actor-related elements shape participation processes in TD sustainability research?	3a) How do researchers and practitioners in TD sustainability research projects perceive participation-effect pathways and what role

			do participation dynamics play therein?
	1b) How can we conceive of and critically analyse participation as 'in the making' and embedded in diverse contexts?	2b) In which ways do power relations shape participation processes in TD sustainability research? How and on what basis do different actors wield power over participation processes in TD sustainability research?	3b) How do researchers and practitioners assess the link between form, timing and intensity of participation and the practical relevance and usefulness of results?
		2c) How do values and worldviews shape knowledge production processes and the participation of diverse actors in the field of sustainability?	
MODULES	1) Models and discourses: de- and reconstructing participation	2a, 2b, 2c) Unpacking processes	3) Linking processes and effects
MANU-SCRIPTS	I, II, IV	I, III, IV, V, VI, VII, VIII, IX	III, IX

4.1   Research Modules

The research goals and questions outlined in the previous section are addressed in three main modules. Figure 2 shows the three main research modules. Each module contributes to achieving one of the three sub-goals that operationalise the overall research goal. Several manuscripts contribute to each module's goal. The three modules, which work towards achieving the overall goal, are linked. Accordingly, several of the manuscripts contribute to more than one module. In order to work towards the respective goals, different methods and sensitising concepts are used. These will be explained in the next section.

Figure 2. Overview of research modules

MODULE 1: De-and Reconstructing Participation

Source: Manuscript I

GOAL: developing a critical perspective on participation that allows for conceiving of participation in TD sustainability research as 'in the making' and as embedded in diverse system contexts

Methods
- Literature review
- Comparative analysis

Sensitising concept
- Relational space

Manuscripts:
I IV
II

MODULE 2a-c: Unpacking Processes

Source: Manuscript IV

Power over
4th face   1st face
3rd face   2nd face

GOAL: identifying structural and actor-related elements - including values, power relations, norms and expectations - involved in the making of participation in TD sustainability research

Methods
- Literature review (synthetic approach)
- Structuring qualitative content analysis
- Document analysis
- Expert workshop

Sensitising concept
- Relational space
- Power over, to and with
- Ecologies of participation
- Fermeture des possibles
- Co-production

Manuscripts:
I VI III
IV VII IX
V VIII

MODULE 3: Linking Processes and Effects

Source: Manuscript III

GOAL: grasping the complex interlinkages between participation processes and societal effects of TD sustainability research

Methods
- Situational analysis
- Document analysis
- Statistical analysis

Sensitising concept
- Systems approach
- Theories of change
- Intensities of involvement

Manuscripts:
III
IX

51

5 Research Approach, Methods and Materials

This section sheds light on the research approach chosen for the study of the diverse elements that shape processes of participation in TD sustainability research. It renders transparent assumptions that underpin the research approach and provides an overview of the methods chosen and material collected. Moreover, it reflects on the embeddedness of this thesis in an accompanying research project and identifies the challenges encountered during the research process. More detailed descriptions of how the respective data were used to address the different research questions presented in section 4 can be found in the manuscripts in Part II of this thesis.

5.1 Research Approach: Epistemological Assumptions and Logic of Inquiry

In line with the theoretical assumptions described in section 3, this thesis is part of a qualitative research paradigm. Understanding the processes and elements that shape participation practices in TD sustainability research requires methods that allow for tracing the perceptions, experience, and narrations by researchers and practitioners, who enact and translate these concepts into practice. The main unit of interest is the interactions of researchers and practitioners, and the diverse elements that shape them at the micro-level. The latter are accessed through the narrations and perceptions of the actors involved. Qualitative research, which aims at understanding the sense-making practices of reflexive and knowledgeable actors (Denzin and Lincoln, 2011; Silverman, 2013), thus seems particularly apt for such a study.

Before presenting the methods applied in this thesis, this section lays out some of the premises that underpin the choice of methods, as well as the interpretation of the findings. Silverman (2013) states that the choice of a qualitative research approach and the methods applied must be made within the framework of the research questions to be investigated. He argues that, more fundamentally, such choices *"reflect a commitment (explicit or implicit) to a particular model of how the world works"* (Silverman, 2013, p. 11).

In order to reflect on my "commitment" and clarify the premises underlying the research approach I used in this thesis, this section elucidates the assumptions that guided the choices made during the collection and analysis of data on participation in TD sustainability research.

Epistemologically, I adopt a constructivist stance in which knowledge is seen as the result of interactions between the 'subjects' and 'objects' of knowledge (Crotty, 1998). In this interpretation, science is embedded in society and knowledge production is entangled with values (Knorr-Cetina, 1983). This position builds on the scholarship of science studies and the works of philosophers and historians of science. This work demonstrated that scientific findings and the 'reality' they encompass are not 'pure' facts, but rather reflect the cultures and value systems of their time and are shaped by dynamics within a given (thought) collective (Berger and Luckmann, 2005; Fleck, 1980; Kuhn, 1962). They state that, in practice, the separation between facts and values is difficult to achieve and that alleged facts often contain an abundance of normative decisions and weightings (Kaiser, 2015). This interpretation is linked to the ontological assumption that conducting research and producing knowledge is not merely about representing and describing an external, given world, but rather is an act of bringing about, performing and constituting certain realities (Law, 2004). Following this assumption that scientific knowledge production is consequential in the world, research and knowledge production no longer appear as a representation of the world at a distance, but rather as an intervention in and engagement with the world (Denzin and Lincoln, 2011).

These assumptions imply that instead of aiming at universal explanations, qualitative research as applied in this thesis aims at what Merton calls "middle range theories" (Merton, 1949) and what Glaser and Strauss (1967) allude to when they speak of a "grounded theory". Different elements of this thesis show different theoretical and methodological imprints. This is reflected in the use of several 'sensitising concepts' (Blumer, 1954) guiding theoretical and empirical explorations of different elements that shape and constitute participation practices in TD sustainability research. Grounded in frustration with regard to the relationship of social theory to empirical research, Blumer (1954, p. 4), who introduced the notion of sensitising concepts, calls on researchers to *"reduce drastically their preoccupation with the literature of social theory and instead get in touch with the empirical social world"*. Sensitising concepts can be understood as provisional frameworks that *"suggest directions along which to look"* (Blumer, 1954, p. 7), but that need to be continuously refined through empirical research so as to avoid becoming "vague stereotypes" (Blumer, 1954, p. 9).

The reciprocity of theory and empirical investigation that is inherent to the idea of sensitising concepts aligns well with the "iterative theory building" approach used in this thesis. The iterative, back-and-forth movement between theory and empirical analyses lies at the core of this thesis' logic of inquiry (Kerssens-van Drongelen, 2001). Unlike 'traditional' or purist versions of grounded theory (Glaser and Strauss, 1967), iterative theory building explicitly integrates pre-existing knowledge, theories and frameworks into the research process (Kerssens-van Drongelen, 2001), thus combining inductive and deductive steps in the logic of inquiry. The sensitising concepts used,

adapted and refined in different parts of this thesis include[15]: the concept of relational space (Löw, 2013), theories of power over, power to and power with (e.g. Allen, 1998; Fuchs and Glaab, 2011), ecologies of participation (Chilvers et al., 2018), co-production of knowledge and social order (Jasanoff, 2004), 'fermeture des possibles' ('closing down of possibilities') (Bourdieu, 2012), theories of change (Weiss, 1997), and systems thinking (Binder et al., 2020).

Following the assumptions outlined above, the iterative logic of theory building used in thesis is rooted in a constructivist version of grounded theory (Charmaz, 2006; Clarke, 2005). In Clarke's 'situational analysis', which is a methodological development of grounded theory, researchers appear knowledgeable about theory. Thorough consideration of the existing literature is an integral part of the analytical process (Clarke, 2005, p. 294). Her approach suggests to focus on the *"situation of inquiry broadly conceived, inducing the turn to discourse"* (Clarke, 2005, p. xxviii). Following Clarke, (2005, p. 63) material elements are essential in sense-making to the extent that *"non-human actants structurally condition interactions within a situation"*. When investigating knowledge production, turning to discourse urges us to take into account the situatedness of knowledge (including scientific knowledge) and the associated hegemonies of knowledge production (Haraway, 1988). These assumptions about the importance of materiality and situatedness inform the logic of inquiry chosen for studying "situations" of participation in TD sustainability research. The latter led me to trace the interactions between researchers and practitioners as well as their interactions with material and non-material elements in a given situation (for instance, values and norms). Furthermore, assumptions about the contextuality of such "situations" inspired me to look for the power relations and structures involved in the making of participation in TDR.

5.2   Research Strategy: Overview of Empirical Sites and Methodology

In connection with the iterative theory building approach outlined in the previous section, the research strategy used in this thesis consisted in a continuous exchange between social theories, existing scholarship and empirical investigations. Methodologically, the research approach I described implies that I gathered material that allows for grasping researchers' and practitioners' perceptions and narratives on participation practices and the way they made sense of and translated ideal-typical concepts into practice.

---

[15] Further details can be found in the Manuscripts in Part II of this thesis.

This section presents the methods applied and multiple empirical sites in which they were used. In order to avoid redundancy, this depiction aims at providing an overview of how the pieces of the puzzle fit in the overall frame of this thesis, rather than at a detailed description of each component. A detailed description of individual methods of data collection and analysis can be found in the respective "materials and methods" section in the manuscripts in Part II of this thesis, as well as in the appendices in Part III.

5.2.1 Empirical Sites: Participation in Different Funding Contexts

Collection of primary data took place at different empirical sites that allowed for the gathering of "rich data" (Charmaz, 2006). This "multi-sited research" (Clarke, 2005) approach was chosen in order to gain multifaceted insight into the different enactments of the participation practices that are focus of this thesis, as well as of the diverse institutional and structural contexts in which they are embedded.

Main empirical site. Due to the embeddedness of this thesis in an accompanying research project (see section 5.3.), the main empirical site was the research funding programme *"Science for sustainable development"* (WfNE, original German title "Wissenschaft für Nachhaltige Entwicklung") by the Volkswagen Foundation and the Ministry for Science and Culture of Lower Saxony (MWK), Germany[16].

The programme aims to foster societally relevant research that contributes to sustainable development. In order to be eligible for funding, research projects must be interdisciplinary, include societal actors in the research process, and demonstrate their intended contribution to sustainable development (MWK Niedersachsen and VolkswagenStiftung, 2015, 2014). Thus, the programme and the projects funded within it provide an empirical site for studying TD and participatory practices in the field of sustainability research.

Thematically, the funding call stresses the programme's openness to any topic relevant to sustainable development (MWK Niedersachsen and VolkswagenStiftung, 2015, 2014). Consequently, the selected projects cover diverse sectors pertaining to sustainability, including technology, agriculture and food, regional and urban development, education, energy, mobility, health, as well as discourses on and the history of sustainability (based on the research proposals of funded projects 2014, 2015, 2018) (see figure 3). One of the peculiarities of the funding programme, which is interesting in terms of participation, concerns the project selection process. Applying projects are reviewed by an

---

[16] The programme description as well as the call for projects can be found on the Ministry's webpage, http://www.mwk.niedersachsen.de/portal/live.php?navigation_id=33675&article_id=118898&_psmand=19

interdisciplinary panel, which makes a pre-selection. In the next phase, representatives of the pre-selected projects are asked to present and defend their project proposal in a public forum, in which fellow researchers and ordinary citizens are invited to partake and raise questions. However, the decision regarding the final project selection is made exclusively by the scientific reviewer panel.

Figure 3. Thematic cluster of funded projects (Source: research proposals of funded projects 2014, 2015, 2018)
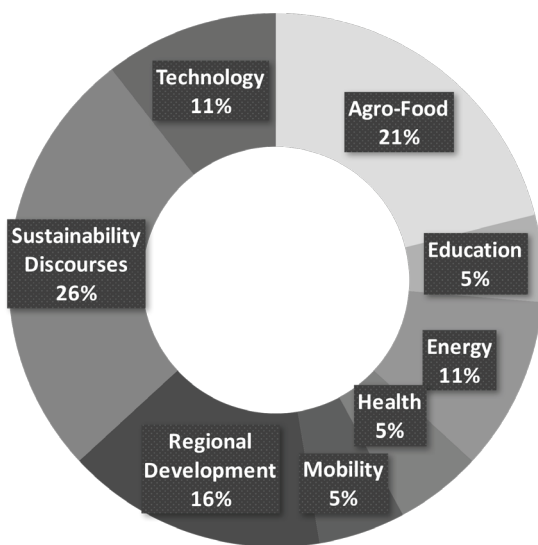
Since its inception in 2014, three funding calls have been launched and 19 projects funded[17], for a total funding volume of approximately 28.2 Million Euros (MWK Niedersachsen, 2019). Of these projects, a subset was selected for an in-depth analysis of participation processes and researchers' and practitioners' perceptions of the factors shaping them (see section 5.2.2.).

In an attempt to broaden perspectives and diversify the institutional settings in which participation processes play out, the empirical basis of this thesis was nourished with inputs from other funding contexts (see table 3).

Additional empirical sites. Findings from the main empirical site were complemented and contrasted with explorations in two additional funding programmes by the Swiss National Science Foundation (SNSF): National Research Programmes (NRP) 71 ("Managing Energy Consumption") and 68 ("Sustainable Use of Soil as a Resource"). According to the SNSF webpage, NRPs aim to produce knowledge in order to *"solv[e] Switzerland's most pressing problems"* (SNSF, 2019a). It is the Federal Council that defines what these pressing problems are that the NRPs should address. NRPs support in particular inter- and transdisciplinary research. Funded projects are expected to work towards a common overall programme goal. The programme description also stresses the importance of knowledge and technology transfer to society (SNSF, 2019a). With an overall funding volume of 8 Million CHF, NRP 71 supports a

---

[17] Three calls for funding have been launched, with eight projects funded in 2014, seven in 2015 and four in 2018.

total of 19 projects wherein researchers work together with partners from the private and public sectors (programme duration 2013-2020) (SNSF, 2019b).

In addition, an expert workshop with TD scholars experienced in TD projects in different funding contexts provided further empirical examples (see section 5.2.2.).

Table 3. Overview of empirical sites

	MAIN EMPIRICAL SITE	**ADDITIONAL EMPIRICAL SITES**		
Programme context	WfNE: "Science for Sustainable Development" (Ministry of Science and Culture, Lower Saxony; Volkswagen Foundation)	NRP 71: "Managing Energy Consumption" (Swiss National Science Foundation)	Diverse funding contexts	NRP 68: "Sustainable Use of Soil as a Resource" (Swiss National Science Foundation)
Participation in	TD projects	TD projects	TD projects	Programme-level synthesis
Data collection	35* semi-structured interviews with researchers and practitioners; research proposals; programme documents	Survey among researchers (72 responses) and practitioners (61 responses)	Expert workshop with TD 7 experts	Participatory observations during a 3-day workshop; paper-and-pen questionnaire among researchers and practitioners
Contribution	Module 2b, Module 3 (Manuscripts III, V)	Module 3 (Manuscript IX)	Module 2b (Manuscript VI)	Generation of hypothesis for Module 2b; report to the programme administrators

*12 of which were conducted by a project colleague

5.2.2 Qualitative and Quantitative Methods

This thesis combined both qualitative and quantitative data collection and analysis methods (Flick, 2018). These included desk research, semi-structured interviews and actor-influence mapping, an expert workshop, participatory observation, collection of text documents such as research proposals and funding programme documents, as well as a survey. These methods are briefly described in this section, based on the sequential logic illustrated in figure 4.

Figure 4. Overview of methods per module
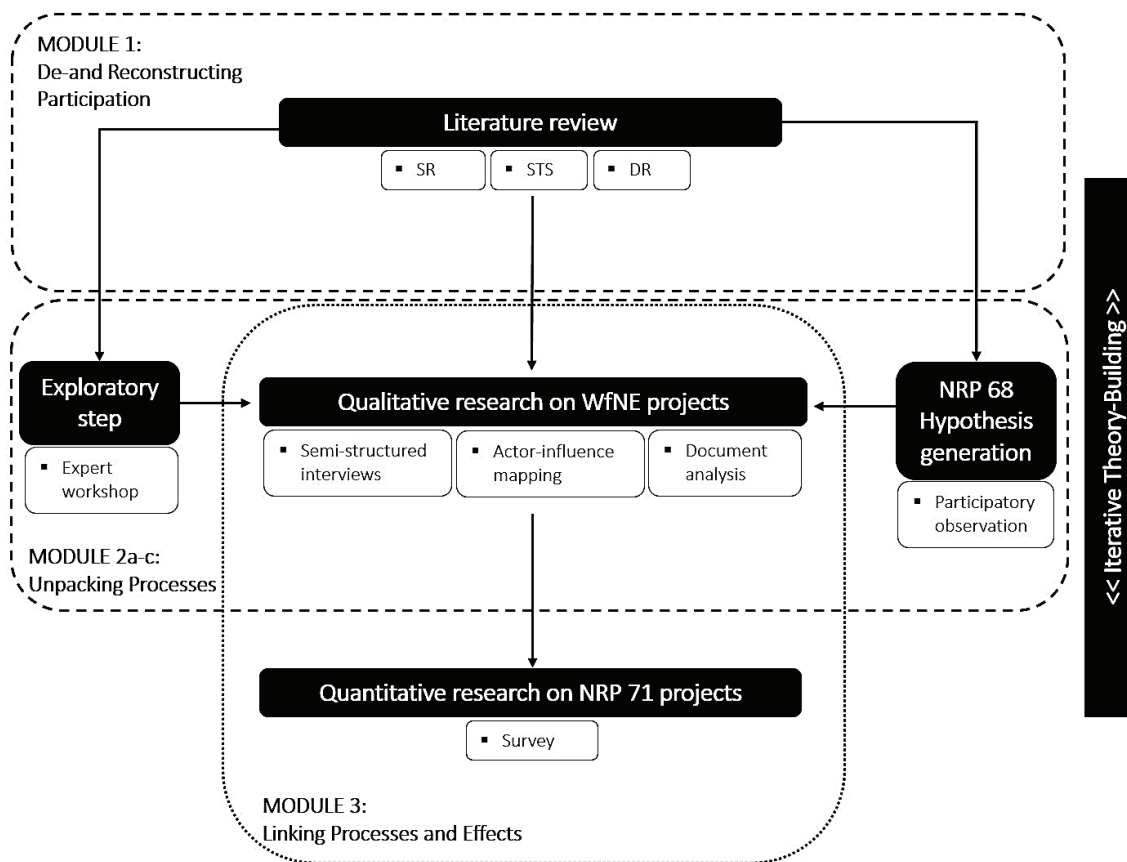
[Legend: SR=sustainability research, DR=development research, STS=science and technology studies]

Qualitative literature review: a synthetic approach

In a first phase, a qualitative literature review of participation in knowledge production in sustainability research, development studies and STS was conducted. The aim was to identify the factors that shape participation processes. Following the principle of saturation (Onwuegbuzie et al., 2012), 79 articles were selected and reviewed (see table 4). The material included monographs and edited volumes, journal publications, working papers and a project report. This variety made it possible to consider publishing traditions in the three fields (see Manuscript I and Appendix A for an overview as well as for the selection procedure). Depending on the self-declared scholarly field to which the authors contributed, publications were attributed to one of the three fields. The location of the case study (for development research), the author's institutional affiliation and journal were considered when this distinction was not clear. As the thesis focused on participation processes in practice (vs. theoretical ideal-types), empirical and case study-based literature was selected. Due to the differences between and within participatory approaches, similar reviews identify the empirical and case study level as the most meaningful unit of analysis (Brinkmann et al., 2015). Researchers' reflections

on their projects as well as empirical studies by third parties were included. The cases are located in various geographical regions and include thematic foci in the areas of development, environmental and technological issues. In addition, the few available meta-analyses and enquiries *not* based on specific (own or third-party) projects but rather address participation in empirical studies (e.g. interview and survey-based investigations) were considered (Manuscript I).

Table 4. Literature review: Types and number of articles (Fritz and Binder 2018)

FIELD/APPROACH+TYPE OF ARTICLES	SUSTAINABILITY RESEARCH	DEVELOPMENT RESEARCH	SCIENCE AND TECHNOLOGY STUDIES
Main approaches	Transdisciplinary research	Participatory rural appraisal (PRA), participatory action research (PAR); transdisciplinary research	Participatory risk assessment, participatory technology assessment; public engagement
Review articles	7	/	1
Case study-based articles	28	12	7
Other empirical articles	9	3	1
Additional	1	7	3

The analytical approach relied on a qualitative in-depth analysis of each publication and used a synthetic approach for qualitative studies (Noblit et al., 1988). To begin, the material was categorised by basic literary characteristics, i.e. publication category, main scholarly field, purpose, type of actors involved, notion of participation used, etc. Next, the parts that were relevant to understanding participatory knowledge production processes and the factors forging them were extracted. The perspective on participation as a relational space (see section 6.1.) provided the conceptual frame for analysing the material; the sub-categories for factors, however, were inductively developed. Hence, a statement was categorised as a potential factor if the authors explicitly described it as:

- a condition for success or failure of a participation process,
- a challenge to involvement,
- a (un)favourable precondition,
- having had an impact on the process,
- a guiding principle of a 'good' process
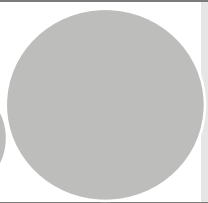
In an iterative process, the empirical findings were analysed, clustered and discussed relative to the conceptual perspective on participation as a relational space (see Module 1 and 2a, Manuscript I).

Qualitative Meta-Analysis of Projects in the WfNE context

While the systematic, qualitative literature review provided a broad overview of the amalgam of elements that shape participation processes, it was circumscribed by the quality of the process descriptions and interpretation in the publications it studied. Since the latter often lacked deeper insight into the making of participation and largely neglected practitioners' perceptions of these processes, the collection of primary data and an in-depth investigation of participation processes in TD practice were required.

For this, five (Manuscript V) respectively seven (Manuscript III) projects from the pool of projects described above were selected for a qualitative in-depth study. The rationale for the selection of projects was based on the criterion of maximum diversity in terms of (i) institutions and disciplines, (ii) topics, and (iii) types of practitioners involved. Consequently, the projects analysed encompassed a variety of sustainability issues and included researchers from diverse disciplines, as well as practitioners with multifaceted professional backgrounds (see table 5). The projects were part of two funding rounds and in different project phases at the time of data collection.

Table 5. Overview of projects from the WfNE funding context (Fritz et al., 2019)

CHARACTERISTIC/ PROJECT	A	B	C	D	E	F	G
Funding cohort	2015	2015	2015	2015	2014	2014	2014
Project duration	4 years	4 years	3 years	3 years	4 years	3 years	3 years and 3 months
Thematic cluster	health	regional development	food production	mobility	regional development	urban development	technology
Submitted budget (450 000 - 3 M EUR)							
N° academic institutes	4	8	6	8	7	3	7
Type of P involved	public service providers, associations	public sector actors	private sector actors, "consumers"	public and private sector actors, service providers	NGOs, associations	NGOs, associations, public sector actors, "citizens"	public and private sector actors, "consumers"

Letter of intent of P	yes	yes	yes	no	no	yes	no
Reference to TD	Strong, mostly in the interdisciplinary sense	strong	strong	strong	strong	strong	weak
Financing for P in budget plan	no	no	no	no	no	no	no

[Legend: P=practitioners; in grey, empirical data gathered by a project colleague]

This qualitative investigation into participation processes in ongoing TD sustainability research projects was based on different types of materials: documents, transcripts of interviews and notes from observations and workshops.

Documents. We started by collecting research proposals and programme documents, such as the funding call and informational material, from the funding bodies' websites. Such documents were treated as 'methodologically created communicative features' (Wolff, 2004, p. 288) whose purpose (e.g. attracting funding), and audiences (e.g. scientific reviewers, etc.) were to be considered. As such, these documents cannot be seen as mere 'information containers' that provide factual content on the (anticipated) research endeavour. Similarly to Felt et al. (2016) and inspired by Akrich's (1992) approach to studying technologies, we analysed the funding programme "script" which researchers and practitioners need to "de-script" (Akrich, 1992) and "translate" (Callon, 1984). As the latter provided a description of the immediate structures in which the actors engaged, it was assumed to shape participation practices (see Manuscript V, Part II). Programme documents were analysed with regard to how they prescribed the kind of participation performed in the projects. The qualitative analysis of project proposals aimed to capture conceptions of participation and considered the discursive formations that provide a framework for the narratives of the actors involved (Völker, 2014, p. 68). The analysis focused on the applicants' underlying view of TD, the actors involved, the participation procedures planned, and how they translate into project structures and budgets. This analysis also supported the selection of a sample of projects from the pool of funded projects for in-depth examination.

Interviews. Next, semi-structured and problem-centred interviews (Witzel and Reiter, 2012) were conducted with 21 researchers and 14 practitioners at different times throughout the project process[18]. Using a purposeful sampling approach (Lincoln and

---

[18] Most interviews were conducted in January 2016, June 2017, October 2017, December 2017, and Mai-June 2018 and were held in venues suggested by interviewees in 13 cities/towns in Germany.

Guba, 1985), principal investigators (PIs) were approached as gatekeepers. The latter were asked to establish contact with researchers who were closely involved in research-practice interactions, as well as with practitioners participating in the projects. As data collection proceeded, a snowball technique (Lincoln and Guba, 1985) was employed to enlist further interviewees. An interview guide was used and adapted on a case-by-case basis (Manuscripts III, VI). The interview guide consisted of narrative questions about the initiation of the collaboration, framing of the research problem, structures, decision-making procedures within the projects, forms and intensities of interactions between researchers and practitioners, and factors within the project and structural context that shaped the interactions (see Appendix B for interview guides and list of interviewees).

Actor influence mapping. Additionally, actor influence mapping supported the interview questions about actors and their relationships in the participation process (Schiffer and Hauck, 2010). Based on these actor "maps", interviewees were asked to weigh the respective actors' importance in achieving the overall project goal using a scale of 'very important', 'important' and 'less important'. They were then invited to label the forms of interaction as either 'information', 'consultation' or 'cooperation' - a scale commonly used to measure intensity of involvement (e.g. Schneider and Buser, 2018).

All interviews were recorded and transcribed verbatim. The transcripts were managed, coded and analysed using the 'MAXQDA' qualitative data analysis software. The analysis of these qualitative data combined inductive and deductive elements. The first round of analysis followed Clarke's (2005) situational analysis combined with a systems approach (see Manuscript III). The second round of analysis took a more deductive approach and applied a structuring qualitative content analysis (Mayring, 1991), guided by 'sensitising concepts' from theories of power (see Manuscript IV). Method triangulation and data source triangulation were applied by combing different data collection methods and examining different data sources using similar methods (Patton, 1999). In the first round of analysis, the data was collectively analysed with a second ZiFoNE project researcher. Thereby, investigator triangulation relied on a 'negotiated agreement' approach to establish inter-coder agreement (Campbell et al., 2013). In the second round following the initial development of a theory-based coding system and definition of each code, I pre-tested its practicability with a sub-set of the material and discussed it with my co-author. I then made the necessary refinements before proceeding with the coding and analysis of the material (Mayring, 1991).

Based on **participatory observations** in the NRP 68 context, furthermore, we developed hypotheses that informed the choice of analytical foci in the qualitative

---

They lasted between 45 and 85 minutes. 12 interviews were conducted by a ZiFoNE project colleague, but were included in the analyses conducted for Manuscript III.

analysis. This notably concerned the role of power dynamics and hierarchies in researcher-practitioner interactions. In a team of two observers and two assistants, we observed the three-day knowledge integration workshop, in which researchers and broad range of practitioners took part. The observation guidelines focused on three main topics: (i) group dynamics, (ii) understanding of science and policy, (iii) dealing with different forms of knowledge and values. The guideline was flexibly used and refined throughout the observation. We inductively added further perspectives, for instance on the role of the moderator in the integration process (see Appendix C for guidelines used for participatory observation).

Expert workshop. To explore the question of power, one of the focal points of this thesis, I organised an expert workshop (Manuscript VI, Module 2b). Seven TD experts from across Switzerland took part in the workshop, which was held in Lausanne in November 2018. The following criteria guided the choice of participants: experience practicing and researching TD, specialisation in sustainability-related topics and affiliation with various Swiss institutions. The goal was to test and refine a framework for analysing different forms of power across a TDR process based on the experience and expertise of the workshop participants. Participants were asked to select one TD project they had been involved in and that had been completed at the time of the workshop. Recalling this experience, with the help of guiding questions on power, participants mapped their experiences with power on a matrix that crossed forms of power and process phases (see Appendix D for the mapping grid used). The workshop lasted three hours and was documented by two note-takers.

Quantitative Online Survey in the SNSF context

In a final step, observations made in the qualitative study of projects in the WfNE funding context and other literature fields were tested through a quantitative online survey in another funding context: The SNSF's NRP 71 "Managing Energy Consumption" (see section 5.2.1.). This enabled us to validate some of the in-depth, contextually rich knowledge gained in the qualitative studies and to complement it with more generalisable knowledge gained in a larger sample of projects.

This step consisted in a collaboration with the President of the SNSF NRP 71 Steering Group. The opportunity arose thanks to one of my supervisor's role as an acting member in the Swiss Research Council's Presiding Board. Based on my previous observations and findings, I provided content input, hypotheses and survey questions while the

president of the steering committee[19] and his team compiled and distributed the survey and were the officially responsible actors.

The investigation aimed to analyse how researchers and practitioners collaborated in the 19 projects and perceived the benefits/costs of their collaboration, as well as to elicit the factors underlying their collaboration. For this, an online survey was conducted among the researchers and practitioners involved. To ensure that all of the actors involved in NRP 71 projects were invited to participate, the survey was distributed in consultation with the respective project leaders. 72 of the 99 researchers contacted (72%) and 61 of the 120 practitioners contacted (51%) participated in the online survey. Among the researchers, employees of universities and universities of applied science accounted for the largest group. Most of the practitioners were employees of private companies, the federal administration, various interest groups or municipalities (Balthasar and Roose, 2018).

The survey centred on three main aspects (see Appendix E for the survey):
- Collaboration design: forms of practitioner involvement, timing and intensity of involvement;
- Results of the collaboration: assessment of the relevance, usefulness and practicability of the results of the collaboration; degree of expectations met, benefits and added-value of the collaboration;
- Success factors for the collaboration: factors researchers and practitioners perceived as important for ensuring a fruitful collaboration;

The data set produced though this survey (Balthasar et al., 2018) was the basis of Manuscript IX.

5.3 Research Context: Thesis' Embeddedness in an Accompanying Meta-Research Project

The majority of the empirical research conducted for this thesis was embedded in the third-party project "Civil society and research for sustainable development: challenging and promoting transdisciplinarity" (ZiFoNE)[20], funded by the Ministry for Science and Culture of Lower Saxony (MWK), Germany. The project was led by Prof. Dr. Claudia Binder (EPFL), Rico Defila (University of Basel) and Dr. Antonietta Di Giulio (University of Basel), and included a second PhD project on the societal effects of

---

[19] For their final report based on the survey please see Balthasar and Roose (2018).
[20] Original German title "Zivilgesellschaft und Forschung für Nachhaltige Entwicklung: Transdisziplinarität fordern und fördern"; project duration 10/2014 – 09/2019.

research (conducted by Thorsten Schilling, co-author of Manuscript III) in addition to this PhD project.

The ZiFoNE project scientifically accompanied the research funding programme "Science for sustainable development" (WfNE) mentioned above. The research activities conducted within the project framework can be broadly split into two categories i) research at WfNE funding programme level and ii) research at the level of the research projects funded by the WfNE programme.

Regarding the programme-level, the accompanying research was conducted in a TD collaboration with the funding body and the interdisciplinary panel of reviewers. In this collaboration process, project selection criteria were refined, the first funding call was revised and the public project selection events were analysed based on interviews with applicants, the funding body and scientific reviewers, online surveys of applicants and paper-and-pen surveys. While activities relative to the funding programme were led by our project partners at the University of Basel (results of which are not included in this thesis), mentioning them is nonetheless important for understanding the positioning of this thesis and how I was perceived in the field (see section 5.3.1.). Regarding the project-level, research activities consisted mainly of studying how researchers and practitioners in the funded projects made sense of and translated the funding criteria regarding "involvement of societal actors" (participation) and "contributing to sustainable development" (societal effects) into practice.

In the typology of accompanying research to research programmes suggested by Defila and Di Giulio (2018), the approach used in the ZiFoNE project falls within the "meta-type" of accompanying research. This type mainly strives to produce knowledge about the processes that take place within the research programme, considers projects as the research 'object', and assumes certain additional process-related tasks, such as supporting the dissemination of results.

5.3.1   Reflections on Own Positioning

Being part of the official research project that accompanied the funding programme had implications for the data collection process and my own positioning in the field. It gave rise to *"fluid, every-changing positionalities"* (Kohl and McCutcheon, 2015, p. 747) in my relationship to the research projects and the researchers within them, as well as to the research programme and funding body.

My project affiliation certainly facilitated access to the project leaders due to prior contact with them during programme-level activities. It also facilitated access to the submitted project proposals and budget plans. My 'official' role gave 'legitimacy' to the PhD project and was an entry point for gaining insight into ongoing research

processes. It presumably enhanced the researchers' motivation or even perceived obligation to participate in the study. However, being perceived in a role that was close to the funding body also posed a number of challenges.

Being perceived as an evaluator: reflections on the interview process

A key issue when conducting interviews is the question of how to introduce oneself and how interlocutors perceive the interviewer (Gunasekara, 2007; Silverman, 2013). This was particularly challenging in the setting in which this thesis was embedded. Interviewees were often not sure what to make of a study into the processes of participatory knowledge production. Consequently, some were reluctant to grant access to their project partners from practice for interviews. It thus took some effort to explain the interest of the study (to better understand TD and participation processes), and to establish a trust relationship. The reluctance to share experiences with ongoing knowledge production processes I observed might reflect the uneasiness of granting an inside view on the messy processes involved in doing (TD) research in a research culture that focuses on communicating the finished product rather than its making (Bourdieu and Wacquant, 1992, see section 3). Employing actor-influence mapping during the interviews proved useful in breaking the ice and guiding interviewees' attention to something concrete and tangible: the people with whom they interact. This facilitated interaction with the interviewees and allowed us to come back to these visual elements throughout the interview, for instance when addressing questions of the intensity of exchanges, of the different expertise present in the projects or of decision-making and the division of roles and responsibilities.

Some interviewees used the opportunity to voice suggestions and complaints during the interviews (e.g. regarding budget cuts), and asked me to transmit them to the funding body. This indicates that I was at least partly perceived as being close to the funding body. My reflections on interview situations, which I documented in 'memos' (Clarke, 2005), suggest that despite repeated affirmation that we were not evaluating projects and by no means reporting back to the funding bodies, I was at times perceived as an evaluator. My role during official events at the programme-level, being introduced by the funding body, and conducting interviews and surveys at project selection events ("Auswahlkolloquien") might have contributed to this perception.

Furthermore, the fact that the researchers interviewed asked me to report back to the funding body could have influenced their responses, as they might have feared a negative report regarding their project (i.e. lagging behind time schedules, difficulty regarding inter -and transdisciplinary collaboration). The analysis of the interviews showed that several interviewees nonetheless critically reflected on their own projects and the struggles they had encountered. However, some project leaders were hesitant to provide me with the contact details of the practitioners involved in their projects because they

perceived the latter's time constraints or considered their relations with them to be fragile. In one case notably, the PI and some of the researchers interviewed feared that my presence in the field could negatively affect their upcoming empirical research due to practitioners being overloaded with research requests. This required persistence and patience on my part to schedule times that did not interfere with their own activities in the field.

Relations with the different interviewees varied according to their status and entailed different power relations in interview situations (England, 1994). Addressing (predominantly male) professors - who are used to articulating their expert knowledge - not in their role as experts in a given field, but rather with regard to their practical, experience-based knowledge about research-practice collaboration was challenging. On several occasions, interviewees tried to direct the interview towards the content of their projects and their preliminary findings, and away from reflections on the processes involved. While I was regarded as junior in most interviews with project leaders and professors, relations with other early stage researchers were different. In these situations, I was instead perceived as a peer. Thus, establishing trust was easier and at times, interviewees rhetorically addressed 'shared' experiences. In the interviews with practitioners, I was positioned and regarded as a member of the "scientific community" at large. In some instances, interviewees initially associated me with the project that they were involved in. This was reflected in comments such as, "like *you* do in this project". These experiences show that interviews are interactional research settings and can be seen as a collaborative production of meaning. Considered this way, interviewees are the "editors" (Gubrium and Holstein, 1998) of the stories they share with us; they decide what is worth mentioning and what gets left out. At the same time, the interviewees draw on specific culturally embedded patterns of narration and collective resources (Völker, 2014). The peculiar situation of a research interview in the framework of a research funding programme on sustainability presumably influences what can be said and how. For example, I had the impression that, PIs tended to stay in their official roles, and were inclined to tell the success stories of their projects, whereas employees tended to address tensions and (personal) struggles within the projects in a more outspoken way. At times, the latter seemed almost 'relieved' to finally be able to share their experience of the challenges and burden of conducting TDR. Including the perspective of different project actors proved useful for gaining multifaceted insight beyond success stories. Furthermore, the fact that the first round of interviews was conducted in collaboration with a project colleague allowed to minimise some of the biases of my own interview skills.

Being adaptable and flexible: dealing with developments at the funding programme and project levels

In addition to effects on the roles ascribed to me and fear of being evaluated, conducting research in and on an ongoing programme and research projects introduced several uncontrollable elements in my research. The latter influenced the research process and time schedule in several ways.

Firstly, the data collection process had to adapt to the ongoing, dynamic nature of the projects. When projects were delayed in their processes, e.g. in the conducting of participatory activities, I had to flexibly adjust my data collection process. Some projects did not want to participate in the study due to a lack of practitioner involvement. After all, I could not study something that had not taken place (yet). Consequently, the progress of my empirical research was co-dependant on the progress of the projects under investigation.

Secondly, in 2016, the funding body decided to suspend one of the four funding rounds it had planned. While one can only speculate as to whether this decision was a political reaction to the unfolding "Volkswagen emissions scandal"[21], it required flexibility on the part of the ZiFoNE project. The cut in funding rounds and one-year postponement affected the pool of possible projects that could be included in my study. The opening up of this thesis to other funding programmes was partly in reaction to these circumstances.

---

[21] The scandal related to the alleged use of manipulated software for emissions control in Diesel cars. For news coverage, see for instance https://www.bbc.com/news/business-34324772.

6 Synthesis and Discussion of Results

This section provides an overview of the key findings for each of the modules and synthesises them with regard to this thesis' overall goals: (i) deconstructing and reconstructing participation, (ii) unpacking processes (including two focal points on the role of power and values respectively), (iii) linking processes and effects. Each subsection integrates the findings of several manuscripts that contributed to answering the respective modules' research questions (see table 2). This section also discusses the contribution of the findings to TD sustainability scholarship and highlights their practical relevance. A more detailed description of the research results can be found in the manuscripts enclosed in Part II of this thesis.

6.1 Module 1: Models and Discourses: Deconstructing and Reconstructing Participation as a Relational Space

HIGHLIGHTS

- Participation discourses in TD sustainability research, development research and STS differ regarding (i) the main issue to be addressed through participation (complexity of problems, lack of ownership, lack of trust), (ii) the actors to involve (practitioners, individuals and communities, the public) and (iii) their emphasis and potential contribution to other discourses (process design and guidance, analysis of power relations, analysis of the construction of expertise).
- The comparative analysis found that the assumptions that underlie models of participation across participation discourses in the three fields show similarities. These include the idea i) that participation is intrinsically 'good' and should be maximised, ii) that the key dimension describing participation is the participants' degree of involvement and iii) that 'ideal speech situations' and consensus are possible. The models reviewed favour descriptive accounts of forms of participation while overlooking the question of why different forms emerge and change throughout the course of a TDR project.
- In response, this module reconstructed participation as a relational space. This novel analytical perspective conceives of participation as dynamically constituted through the interplay of actors and structures.

Practical relevance:

> ■ This research put forward an analytical perspective and guiding questions that aid researchers and practitioners to reflect on the role of structures and actors in the constitution of participation spaces.
> ■ The research results provide orientation with regard to what other scholarly fields can contribute to understanding participation in TD sustainability research.

With the aim of de-and reconstructing participation[22], this module set out to explore, systematise and develop models and conceptions of participation. The findings in this literature- and theory-based module can be divided into two groups: (i) work centred on the deconstruction of models and discourses on participation that reveals the assumptions and values behind them; and (ii) theoretical explorations resulting in the reconstruction of a perspective on participation that is designed for exploring its making.

Deconstruction. The comparative analysis of selected literature from sustainability research, STS and development research uncovered a myriad of discourses on participation in research and governance processes. Their differences were mapped along the axes: (i) main problem to be addressed through participation, (ii) actors involved; and (iii) substantive focus and potential contribution to other discourses (**see Manuscript II, table 1 for an overview**).

Firstly, the comparative analysis showed that participation has been put forward in reaction to different kinds of 'problems'. Put simply, TD sustainability research observes mismatches between what we know about (un)sustainability and how we act, as well as the complexity and normativity of sustainability issues. Development research identifies a lack of ownership and marginalisation of certain communities and societal groups in development policy and practice. With regard to science and technology, decreasing public trust in new technologies and scientific developments is problematised. The participation of heterogeneous actors in the respective knowledge production and development processes has been proposed as the answer to these problems across the three fields (**Manuscript II**).

Secondly, the various problems that should be addressed through participation in the respective field were accompanied by different conceptions of the actors invited to participate in the respective processes: TD sustainability research mostly speaks of 'practitioners', often alluding to institutionalised actors such as municipalities,

---

[22] We use the notion of deconstruction to refer to a discursive activity with regard to a focal body of practice and the associated meanings of this practice as represented in written accounts, here participation (see e.g. Baert et al., 2011; McGee and Warms, 2013). By using the term reconstruction, we describe a further discursive move of reassembling an alternative view on participation, a reimagination of participation. No claims are made that our research endeavour constitutes a participatory exercise itself, in which participatory practices are reconfigured and enacted in the light of the critical deconstruction of the very practices and understandings. Such a complementary move back from discourse to participatory practice would, however, constitute a much-desired next step.

companies or NGOs; in development research, participants are mainly conceived as individuals and communities concerned (e.g. by an intervention); and in participatory technology assessment and other science and technology-related participation processes frequent reference to citizens and the 'public' at large are found (**Manuscript II**). Hence, while the same kinds of actors might be involved in sustainability research, development research and STS, scholarship across the fields frames these very actors in different ways and illuminates different facets or segments of their identities[23].

Thirdly, the various scholarly fields highlighted and reflected on different challenges related to participation processes and offer different strategies of tackling them. This made it possible to pinpoint the learning potential and opportunities for cross-fertilisation: i) TD sustainability scholarship offers guidance in process design and choice of methods for involving practitioners; ii) development research presents critical analyses of power in and through participation processes and; iii) STS provides inputs on reflexivity and the construction of expertise (**Manuscript II**).

Despite this plurality, there were common points with regard to understandings of participation. Models of participation based on the degree of involvement, motivation[24] and nature of involvement were found to be popular across the fields. A closer look at conceptualisations and models used to describe participation across the fields revealed several assumptions inherent to them. These included the finding that (i) normative conceptualisations of participation are dominant, (ii) these draw analytical attention to single dimensions of participation (e.g. intensity) and (iii) these are frequently underpinned by a search for consensus (**Manuscripts II, IV**). These three premises are summarised below.

Across the scholarly fields analysed, numerous scholars (see e.g. Burgess and Chilvers, 2006; Mobjörk, 2010; Stauffacher et al., 2008) express a vision of participation that echoes the "Ladder of Participation", wherein each rung corresponds to the degree of power redistributed to citizens (Arnstein, 1969). Arnstein's model has marked a vision of participatory progress and reflects a linear logic of 'the more participation, the better'. Firstly, conceptualisations inspired by Arnstein's model are, thus, normatively underpinned by the idea that participation is intrinsically valuable and desirable, and the more of it, the better (**Manuscript II**).

Secondly, ladder-inspired models are one-dimensional in their conceptualisation of participation as a function of the degree of power given to the to-be-empowered citizens

---

[23] For example, a practitioner can be a citizen, a citizen can be part of a specific community, and so forth.
[24] For an overview of different motivations or 'rationales' underpinning participation see Manuscript IV.

by the power-holding actors (Chilvers and Kearnes, 2015). Linked to the powerful/powerless dichotomy, ladder-inspired models have been criticised for failing to capture the agency of those involved (Collins and Ison, 2006; Tritter and McCallum, 2006), as they assume a 'correspondence theory' of a public that is imagined to be waiting for mobilisation by participatory methods (Chilvers and Kearnes, 2015) (**Manuscripts, I and II**).

Thirdly, ladder-inspired accounts of participation echo ideals of deliberative democracy (Cornwall and Coelho, 2007, p. 79) and are normatively guided by Habermasian (1981) principles of ideal speech as set out in his "Theory of Communicative Action". Such ideal deliberative procedures assume interactions that are *"competent and free from delusion, deception, power and strategy"* (Holmes and Scoones, 2000, p. 9). Analyses that are normatively driven by this communicative rationality emphasise consensus and typically are silent regarding the constant negotiation among participants and their ensuing conflicts (Shdaimah and Stahl, 2012; van den Hove, 2006). TD design principles of 'shared control', 'co-leadership' and interactions between researchers and practitioners on 'equal footing' (Lang et al., 2012; Luthe, 2017; Scholz and Steiner, 2015b) reflect such communicative ideals. Their practical implementation in TD projects will be revisited in **Module 2b** (see **Manuscripts I, II, IV**).

Taken together, the findings from **Module 1** conclude that models and conceptualisations are available to distinguish different types of participation and categorise them, mainly according to the intensity of involvement. Their strengths unequivocally lie in the description and comparison of forms of participation and the normative compass they provide ('the more, the better'). However, they are not suited for analytical enquiries into why participation takes varied, mutable forms, leading to different - and not always the desired - outcomes (**Manuscript I**). In order to address the overall goal of studying the complex processes that constitute participation, a new perspective must be built.

Reconstruction. In the framework of this attempt at reconstruction, this thesis developed a novel approach to participation that will be briefly outlined here. It took up the idea introduced in section 3.2. of a space at the interface of research and practice fields (Nowotny, et al. (2011) label it the 'agora'). To operationalise the metaphor of space as an analytical approach, this thesis relied on the "sociology of space", developed by the sociologist Martina Löw (2013). The proposed reconstruction of participation in particular draws from Löw's theory of relational space and deducts a relational approach to studying participation (see **Manuscript I** for the theoretical deduction). At its core lies the duality of structures *(order)* and actions *(ordering)* as the foundation of space-making. Accordingly, the researchers and practitioners involved in a participation process actively create a space for their interaction. This space is co-constituted by the societal structures prevalent in the surrounding context (**Manuscript I**).
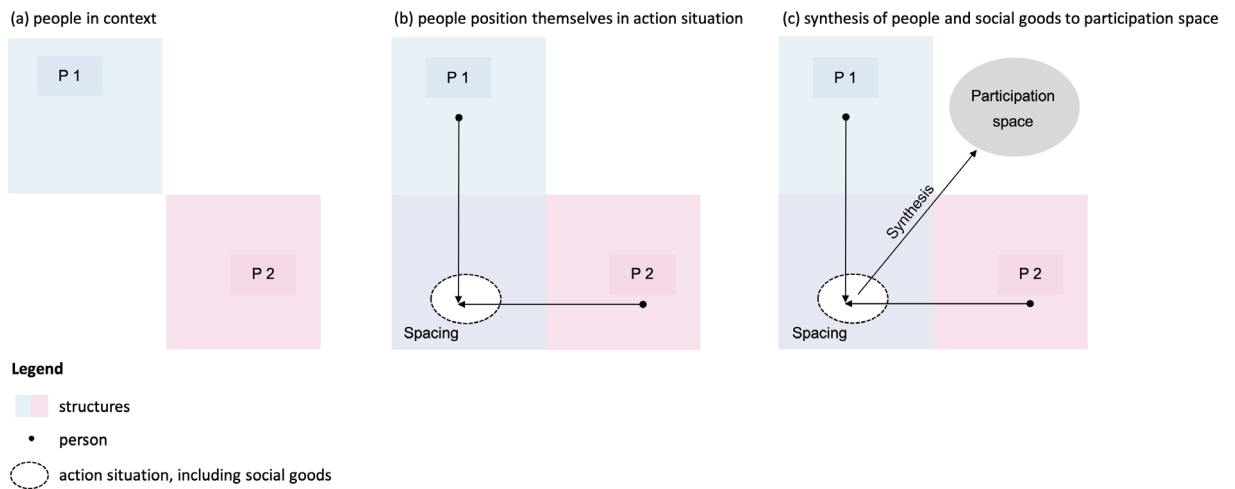
Figure 5. Conceptualising the constitution of a relational participation space, Manuscript I (Fritz and Binder 2018)

Figure 5 schematically depicts a process of space-making involving two people, for instance a researcher and a practitioner[25]. The actors (P1 and P2) enter into an action situation, a TDR project, and position themselves therein (*spacing*). The process of entering into the action situation hinges on the characteristics of the actors, the rules and norms of the context and the available resources ("structures" in figure 5). In this process of *spacing,* material and symbolic objects - so-called social goods - are also positioned. Once the actors are in the action situation, processes of *synthesis* begin. Through processes of perception, actors link symbolic and material goods and other people to yield a space. During these processes of *synthesis*, they create a space within which participation can take place - the participation space. Which kinds of spaces of participation emerge from *spacing* and *synthesis* hinges on the constellation of actors and structures. Moreover, the two main processes of *spacing* and *synthesis (ordering)* are shaped by and actively shape the surrounding structures (*orders*) (**Manuscript I**). Analogous to Löw's relational spaces, participation spaces are therefore not pre-given; rather, they are actively created and continuously formed through interaction.

The following analytical categories were developed to orient the study of participation as relational space:

- *Rules and norms* are key elements in the constitution of participation spaces. For example, norms and quality standards of how to do research influence the making of

---

[25] While providing a useful representation of the three main steps involved in space-making (a-b-c), we acknowledge that the visual simplification in figure 5 can hardly do justice to the assemblage of fluid actor characteristics and identities and the multifaceted structures shaping the making of participation spaces. The portrayal of structures using a symmetrical, rectilinear shape and monochromic shading insufficiently conveys the power gradients and their associated patterns of formativity on actors and practices involved in making participation spaces.

participation spaces. An analysis of participation must therefore consider its embeddedness in the respective societal structures (*orders*).

- *Resources* are intertwined with structures (*orders)* and are recursively embedded in the institutions which are established in a field. An analysis of participation spaces requires an examination of the types of resources that are available.
- *Actor characteristics and social goods* shape arrangements and the configuration of spaces. Accordingly, an analysis of participation spaces must understand which types of actors, material and symbolic goods are involved.
- *Spacing and synthesis* are the processes by which relational participation spaces are fabricated and become functional (*ordering*). Thus, conceiving of participation as space requires studying how actors and social goods position themselves or are passively placed (*spacing*) in an action situation. Likewise, processes of sense-making and perception through which actors and social goods are assembled to yield spaces of participation (*synthesis)* must be analysed.

Mechanisms of inclusion and exclusion operate across these four categories. Analysing the constitution of participation spaces requires being attentive to *access possibilities*, which are determined, for instance, by the distribution of resources amongst actors[26]. Due to their rooting in wider societal structures, actor possibilities are often unequally distributed, thus implying power gradients in the constitution of participation spaces. Taken together, the analytical categories draw attention to the relations between structures, actors and processes in the making of participation (see **Manuscript I**, table 2 for analytical guiding questions).

Summary and practical relevance. By deconstructing widely used models of participation, this module highlighted the dominant imagination of participation as a ladder and its analytical focus on intensity of involvement. This deconstruction of ladder-based models of participation demonstrated that the very conception of participation draws attention to selected aspects (e.g. the degree of power distribution), comes with specific actor understanding (e.g. powerless citizens) and is implicitly tied to specific procedural goals (e.g. the quest for consensus). Due to their limited usefulness for studying the making of participation in TDR, this module reconstructed participation as a relational space. This novel perspective makes it possible to analyse how participation is dynamically shaped and reshaped in an interplay of structures and processes. It contributes a relational approach designed specifically for studying participation in micro-practices of knowledge production to an emerging scholarship that conceives of participation as co-produced, enacted and in the making (Chilvers and Kearnes, 2015; Klenk and Meehan, 2017; Metzger et al., 2017). In drawing attention to

---

[26] Actors' possibilities to constitute space are restricted/enhanced due to (i) limited/increased possibilities of utilising social goods; (ii) limited/broader knowledge or credentials; (iii) limited/increased possibilities of utilising social status; and (iv) (non)-membership (Manuscript I).

the making of participation, this multidimensional perspective creates the opportunity to explore different structural and actor-related elements involved in the making of these spaces. The subsequent modules take up this relational understanding of participation and connect to different dimensions of 'space-making' - i.e. identifying the amalgam of actor-related and structural elements in **Module 2a**, assessing the access possibilities and the transversal nature of power in **Module 2b**, exploring the role of norms and values in **Module 2c**, and mapping the ways in which these spaces feed back into the respective structural and actor context in **Module 3**.

6.2 Module 2a: Unpacking Processes: The Role of Structural and Actor-related Factors in the Constitution of Participation Spaces

> **HIGHLIGHTS**
>
> ■ The key elements that constitute participation spaces can be divided into dimensions of "structures" and "actors". These were found to include structural elements such as: (in)coherences with structures in the science and practice fields, financial and time resources and the timing of involvement. The actor-related elements include: expectations, mutual trust, worldviews and values. Power relations pervaded all dimensions of participation in the making.
>
> ■ Empirical findings from quantitative and qualitative studies in two funding programmes confirmed the relevance of these elements as perceived by researchers and practitioners, and complemented them. Researchers and practitioners widely perceived similar factors as success factors for their collaboration: a shared perception of the problem to be solved, a trust relationship, clearly defined roles, time resources, financial resources, geographical proximity.
>
> **Practical relevance**:
>
> ■ This module unpacked participation processes and offers rich empirical insights into the factors that drive and impede participation in practice in three scholarly fields.
>
> ■ This view of participation as a relational space helps researchers and practitioners to differentiate between dynamic elements that can be actively addressed in planning and designing processes and more stable elements that require a primarily critical reflection.

The perspective on participation as a relational space developed in **Module 1** was applied and further refined in this module with the aim of unpacking processes. This module presents the combined findings of a systematic literature review in three scholarly fields (**Manuscript I**) and of qualitative and quantitative empirical research (**Manuscript III, IX**).

The application of the proposed perspective in a systematic analysis of literature from TD sustainability research, development research and STS revealed several **structural elements** that constitute participation spaces (see figure 6). These are briefly synthesised below. However, an extensive review including further references can be

Figure 6. Participation elements identified in literature review (own elaboration)

found in **Manuscript I** on which the below section is based. (i) **(In)Coherences with norms and structures in the practice and research field (the reference field)**: Numerous scholars refer to the influence of the institutional setting and established structures within which TD practices take place (Felt et al., 2013; Kläy et al., 2014; Wiek et al., 2012). Established rules, norms and resources in the academic field are described as constraining participatory activities in terms of knowledge production. Reported tensions with the dominant structures include: participatory and integrative research approaches vs. disciplinary career paths in academia; the necessity for delivering research findings to practitioners in a comprehensible form vs. the academic requirement of publishing in highly specialised scientific journals; time-consuming participatory processes vs. pressure and time constraints, particularly in externally financed projects (Cvitanovic et al., 2015; Robinson and Tansey, 2006; Schmidt and Pröpper, 2017; Siew et al., 2016; Talwar et al., 2011; Wuelser and Pohl, 2016).

(ii) **Financial and time resources**: Given the aforementioned structures in the academic field, researchers report a lack of time for defining participatory activities, including time consuming knowledge integration tasks and rigid timelines as elements constraining participation (Bister et al., 2008; McKee et al., 2015; Stauffacher et al., 2008; Thompson et al., 2017; Vilsmaier et al., 2015). Likewise, the opportunity costs for practitioners can be high and are often underestimated by researchers (McKee et al., 2015; Michener, 1998; Neef and Neubert, 2011). This lack of time resources was discussed in relation to the availability of financial resources. Financial restrictions during the development of research proposals shape the way the problem is defined and who is involved in this step of the process (Schmidt and Pröpper, 2017). The extent to which financial incentives are offered to participants shapes their capacity to get involved and influence the process (McKee et al., 2015; Siew et al., 2016). In the majority of cases included in the literature review, practitioners were not allocated financial resources.

(iii) **Timing of involvement**: The timing of practitioners' initial involvement was found to shape the evolution and outcomes of participation. The relevance of this timing lies in the question of who takes part in the initial definition of participation spaces. TD literature suggests that often project ideas originate in an academic context. Researchers

then approach whom they consider to be relevant practitioners. The latter are typically taken on board after the funding proposals have been submitted and accepted (e.g. Felt et al., 2013, 2012; Wuelser and Pohl, 2016). Scholars explain this phenomenon as being due to an incompatibility of co-design of project ideas and proposal-based research funding mechanisms (Schmidt and Pröpper, 2017; Talwar et al., 2011; Whitman et al., 2015).

These structural elements were found to interrelate with a set of **actor-related elements** that likewise affect processes of space-making:

(iv) **Expectations and motivation:** Participants' expectations, the compatibility of different expectations and the degree to which they are met by the research process shape the interactions of heterogeneous actors. Challenges regarding the ways in which expectations shape participation spaces include: incompatible expectations of different practitioners, disappointment of expectations during the process and difficulty of reconciling open-ended research processes with clear expectations on process outcomes on the part of practitioners (e.g. Di Giulio et al., 2016; Robinson and Tansey, 2006; Stokols, 2006; Talwar et al., 2011).

(v) **Mutual trust**: Trust between actors was highlighted as a precondition and success factor for participation. The absence of mutual trust among practitioners and researchers was reported to lead to interrupted or declining participation (e.g. Elzinga, 2008; Renner et al., 2013; Shdaimah and Stahl, 2012).

(vi) **Worldviews and values**: When it comes to framing and solving sustainability problems, different societal actors express diverse and sometimes incommensurable values (Pohl et al., 2010; Polk and Knutsson, 2008; Popa et al., 2015). This plurality of values feeds into the constitution of participation (Robinson and Tansey, 2006; Schneider, 2015; Schneider and Rist, 2014). Some stated that TDR must deal with reconciling rival worldviews (Thompson et al., 2017). Others argue that denying incommensurability in order to fulfil the principle of equal stance entails the translation of discordant knowledge into dominant knowledge (Pellizzoni, 2003).

Power relations both between researchers and practitioners as well as within the respective groups were found to intersect with multiple elements in the structural and the actor-related dimension. This transversal nature of power means that the above-mentioned elements related to the norms and structures in the practice and research field, financial and time resource, timing of involvement, expectations and motivation, mutual trust, worldviews and values are all constituted by and constitutive of power relations in the making of participation spaces. Notably, the literature reviewed discusses power relations with regard to their manifestation in the distribution of financial resources and in group dynamics, which reflect macro-societal relations of power (**Manuscript I**).

The empirical results of the quantitative survey (see **Manuscript IX**) and the qualitative interviews (see **Manuscripts III, V, VI**) in two funding programmes corroborated these findings on structural and actor-related elements and complemented them with additional elements. Notably, the analysis of selected participation factors in a survey among researchers and practitioners in the Swiss NRP 71 revealed that researchers and practitioners had a similar perception of the relevance of these factors. A ranking of the importance of selected factors revealed that a shared understanding of the problem, i.e. negotiated and aligned worldviews, was perceived as the most important success[27] factor by both researchers and practitioners in the collaborative projects studied (see table 6). Other mentioned factors included the need to develop a common language, and prior experience with TD collaborations. The analysis of the variables influencing practitioners' perceived contribution to the success of the project moreover confirmed the importance of mutual trust and of clearly defined roles (**Manuscript IX**). The qualitative findings from the WfNE funding context highlighted the dynamic nature of certain elements. They showed that trust can grow as the collaboration evolves, that expectations can be disappointed, that mutual understanding can develop and that researchers and practitioners learn to collaborate by collaborating (**Manuscript III**).

Table 6. Ranking of the importance of factors for successful research-practice cooperation, researchers' and practitioners' perceptions, Manuscript IX (Binder et al., submitted)

	PERCEPTION OF RESEARCHERS		**PERCEPTION OF PRACTITIONERS**
Rank	Factors	Rank	Factors
1.	Shared perception of the problem to be solved	1.	Shared perception of the problem to be solved
2.	Practitioners have sufficient time	2.	Researchers have sufficient time
3.	Researchers have sufficient time	3.	Practitioners have sufficient time
4.	Practitioners have sufficient financial resources	4.	Practitioners have sufficient financial resources
5.	Geographical proximity to practitioners	5.	Geographical proximity to researchers

Legend: Ranking based on the total number of points = sum of the awarded points over all researchers or practitioners participating in survey; scoring: most important reason = 5 points; second most important reason = 4 points; third most important reason = 3 points; fourth most important reason = 2 points; fifth most important reason = 1 point

---

[27] We do not mean to convey the idea of 'success' being an ostensibly independent analytical category, but rather are interested in the factors which in the experiences of survey participants had an influence on their cooperation. On the contrary, the very definition of what constitutes a successful collaboration varies and different actors make use of different collaboration features to qualify it as (un)successful. We concur with Zscheischler et al. (2018) that the ways in which actors think about success and 'failure', respectively, merits greater attention. Furthermore, this category's relation to neighbouring categories such as 'practical relevance' and 'societal impact' require closer examination (Schikowitz, 2019).

These empirical findings from both primary and secondary data substantiated the approach to participation as a relational space whose contours were outlined in **Module 1** (see figure 5). They show that several *structural elements* shape the positioning of researchers and practitioners in an action situation (*spacing*) (see table 7). In the case of researchers, norms with regard to 'sound' and 'state of the art' research practices, routinized ways of generating knowledge and academic reward systems pre-arrange which social goods and which people are perceived to be part of the action situation. Actors tend to position themselves in a way that makes it possible for them to uphold the norms and fulfil the requirements of their reference fields. The perceived incompatibilities with structures in the wider academic field, which were identified in the literature review, can lead to greater distances and weaker ties between participants due to time constraints or the prioritisation of other tasks. With regard to the institutional context, in most of the cases reviewed in the literature as well as in the projects empirically studied, the distribution of financial and time resources needed for engaging in participation spaces was unequal; practitioners generally received no financial allocation for participating. A participation space's rooting in a research setting or in a specific practice field makes an important difference in this regard (**Manuscript I**). This aspect will be revisited in **Module 2b**, wherein the role of power relations is discussed.

With regard to how researchers and practitioners interpret rules and norms in their respective fields of reference, several *actor-related elements* shape processes of *spacing and synthesis* (see table 7). Expectations concerning the process and its outcomes, worldviews, and actors' values, as well as prior experience collaborating were found to be critical in this regard. As suggested by empirical evidence from the NRP study (**Manuscript IX**), two actors who share the same perception of a problem, have a similar vision of change and/or value the knowledge of the respective other position themselves closer to each other. This proximity also depends on the level of mutual trust. While conceptually separate, the processes of *spacing* and *synthesis* occur simultaneously in the creation of participation spaces. Which worldviews, values and knowledge are synthesised in a participation space affects the kind of societal development and discourses to which participation outcomes will contribute. In this negotiation process, unequal possibilities of creating a participation space (*access possibilities*), e.g. due to limited access to resources, play a decisive role. In case of incommensurable values, researchers and practitioners might not find common ground in negotiating their positions (**Manuscript I**). The role of worldviews and values will be revisited in **Module 2b**.

In **Module 1**, we have made it clear that, in their theoretical conception, relational spaces are created in action and are inherently dynamic. When studying participation as a relational space, we found that some participation elements are dynamic, while others tend to be more stable; actors' priorities may change over time, and expectations unmet at some stage of the process tend to lessen actors' commitment to and motivation with regard to the process and its outcomes. Moreover, trust among actors may grow and enhance their commitment to take follow-up decisions based on process results. In contrast, rules and norms in the reference field tend to be stable over the course of a project. With changes in the constellation of these elements, the shape of a participation space changes too (**Manuscript I**).

Summary and practical relevance. Unpacking processes, this module shed light on the structural and actor-related elements involved in the making of participation spaces. It offered critical insights into the role of structures, actors and processes in the making of participation spaces and opened up new ways of studying them. The role of structures pointed to the embeddedness of participation spaces in wider institutional landscapes. In highlighting mechanisms of inclusion/exclusion and the role of power relations, this module contributed conceptual and empirical insight to studies on the politics of participation (e.g. Chilvers and Longhurst, 2016; Cornwall and Coelho, 2007; Tsouvalis and Waterton, 2012). Applying the proposed perspective enables researchers and practitioners to critically scrutinise the very norms, rules and resources that shape participation spaces. Regarding actors, the relational approach allowed us to consider that participation spaces are experienced, perceived and delimited differently depending on how and from whose standpoint synthesis takes place. A relational approach means seeing practitioners as agents in the making of participation. It enables TD scholars to study not only the perspectives and motivations of the 'architects of participation' (Felt et al., 2012), but also practitioners' active positioning and ways of synthesising, their strategies for appropriating and shaping participation spaces in order to influence the desired outcomes. This perspective therefore provides an alternative for those who have found missing the explicit consideration of participants' agency in ladder-inspired models of participation (Collins and Ison, 2006; Cornwall, 2004, 2002; Tritter and McCallum, 2006). Regarding processes, this module contributed insights into the dynamic nature of participation, which - so far - has hardly been captured in conceptual approaches (Collins and Ison, 2006). The findings of this module suggest that, depending on the constellation of elements, the participation spaces that emerge from spacing and synthesis take different forms. These shapes can change throughout the course of a TD project when mutual trust is built or undermined, expectations are fulfilled or disappointed, and worldviews aligned or conflicting (**Manuscript I**). This dynamic nature of participation elements was confirmed by empirical findings and will be further explored in the form of feedback effects in **Module 3**.

Dimension	Element found in literature review	Role for (re-)figuration of participation space via of spacing and synthesis (III)	Related empirical observations (reference to Manuscripts I-IX)
I. STRUCTURES	(In)Coherence with reference system	Affects via rules and norms which participation spaces are conceivable and which elements synthesise; the norms to which actors adhere affect how they position themselves; incompatibilities of rule-sets lead to a clear delimitation of participation spaces;	Part of the analysis of the structural power exercised by funding bodies that shape the behavioural options of researchers and practitioners in participation spaces (V);
	Financial, time and social resources	Affects actors' possibilities and capacities to actively shape participation spaces; affects the degree of actors' involvement and results in varying degrees of (a)symmetry of space; affects whether actors position themselves/are positioned at the core or on the periphery of participation spaces;	Sufficient time and financial resources perceived as success factors by researchers and practitioners participating in survey (IX); conceived of as a source of power in the qualitative analysis of 5 projects (V);
	Timing of participation	Affects who is entitled to set the cornerstones of participation spaces; affects in which context participation spaces are inscribed through synthesis; by ascribing roles to different actors, those not involved in initial steps are passively positioned; might affect the extent to which actors identify with aim and formats of participation;	Intensity of involvement perceived by survey participants to be lowest during the project development phase (IX); confirms qualitative findings that the instrumental power to set cornerstone of projects lies with researchers (V);
II. ACTORS	Expectations and motivations	Affects synthesis via perceptions of the dimensions of the participation space necessary to reach a specific aim; incongruence of expectations can lead to controversies and ruptures in the participation space; affects actors' commitment to engage in participation spaces and potentially ownership for follow-up steps;	Motivations and goals of researchers and practitioners shown to differ in survey, with researchers e.g. aiming at enhanced practical relevance and practitioners e.g. at establishing contacts and staying in touch with research (IX); fulfilment of expectations and positive experiences during the process found to increase commitment (III);
	Mutual trust	Affects distance between actors and whether the knowledge of others is synthesised; affects via the nature of ties between actors, participation' capacity to reconfigure in case of changing contexts; affects the likelihood of institutionalisation of participation spaces;	Previous collaboration experiences, learning and trust building identified as feedback effects in participation-effect pathways (III); also found to relate to the practical usefulness of results as perceived by practitioners (IX); developing a common language and learning how to collaborate found to be important in both qualitative and quantitative studies (III; IX);
	Worldviews and values	Affects potential conflicts of appropriation of participation spaces; which worldviews are effectively synthesised, relates to actors' ability to articulate them; depending on the implicit norms regarding to participation, controversy might be embraced or deemed problematic; affects which discourses outcomes feed into;	Shared problem understanding perceived as crucial success factor by researchers and practitioners identified as feedback effect in participation-effect pathway (III);
TRANS-VERSAL	Power relations	Affects the constant negotiation processes inherent to the making of participation spaces; affects the degree to which the latter reproduce or disrupt societal structures and/or dominant discourses; affects via the distribution of resources and the validation of knowledge, the equality of actors and their capacity to shape participation spaces;	Different forms of power – 'power over', 'power to' and 'power with' – were found to simultaneously shape different elements of participation throughout TD processes (V, VI);

Table 7. Role of participation elements in the constitution of relational participation spaces, adapted from Manuscript I (Fritz and Binder 2018)

82

6.3 Module 2b: Unpacking Processes, Focal Point I: The Role of Power Dynamics in the Constitution of Participation Spaces

HIGHLIGHTS

- The funding body, researchers, and practitioners were shown to exercise instrumental, structural, and discursive 'power over' three crucial elements of participation: actor selection and (re-)positioning, agenda setting, and rule setting. This exercise of power led - often in subtle ways - to the exclusion of some forms of knowledge, values and paths of action. In the projects analysed, researchers primarily exerted instrumental power over these three elements of participation, whereas practitioners as well as the funding body primarily wielded structural and discursive power.
- An intersecting of 'power over' forms with 'power with' (such as collective learning) and 'power to' forms (such as empowerment) was found throughout TD projects. Complementary findings for participation in sustainability assessments point to possible trade-offs between epistemic and societal goals, which are pursued through participation.
- Understanding power in TD projects means acknowledging that (i) depending on the scale and standpoint considered, interpretations of the same situation diverge, (ii) TD processes are situated and interact with context, and (iii) both dynamics and path-dependencies can exist throughout TD projects.

Practical relevance:
- This module developed a series of guiding questions that support those involved in TD practices in reflecting on the power dynamics that shape them. They support the identification of sources of power, thus making it possible to specifically target the creation and/or distribution of such sources.
- For funding bodies, these guiding questions facilitate reflection on their discursive and structural power, allowing them to consider the internal coherence of their funding regulations.
- By revealing the tacit and hidden power dynamics that shape participation in TDR, the findings in this module provide a basis for improving the design and implementation of participation process, as well as for developing targeted funding instruments.

This module aimed to further unpack processes of participation in TD sustainability research. Guided by the *access possibilities* of participation spaces (**Module 1**) and based on the aggregate view of the elements shaping participation (**Module 2a**), this module investigated the role of one of these elements in particular: power relations.

The findings are composed of two parts: theoretical developments and investigations into the interplay of 'power over', 'power to' and 'power with' throughout the different phases of TD projects (**Manuscript IV, VI**), and an in-depth empirical enquiry into the exercise of different forms of 'power over', namely instrumental, structural and discursive power (**Manuscript V**). While the first part was exploratory and aimed to map the variety of possible manifestations of power, the latter followed a more deductive approach. This module starts with a synthesis of the results of the latter.

'Power over'. In a theory-guided empirical analysis of the funding programme's 'script' (Akrich, 1992, see section 5.2.2) and the interviews with researchers and practitioners in five TD sustainability research projects, **Manuscript V** unveiled how the funding body, researchers, and practitioners exercised instrumental, structural, and discursive 'power over' the subjects (actor selection and (re-)positioning), objects (agenda setting) and procedures (rule-setting) of participation[28].

Firstly, looking at formal decision-making and power in its instrumental usage, researchers appeared as powerful actors across all three constitutive elements of participation. This observation aligns with previous findings on researchers' decisive role in initiating and controlling TD processes and ensuing power imbalances in researcher-practitioner relationships (Raymond et al., 2010; Rosendahl et al., 2015; Schmidt and Pröpper, 2017).

Secondly, the multidimensional analysis of 'power over' revealed that the examination of instrumental power, as manifest in the foregoing discussion of power imbalances, gives only a partial picture. The different actors' exercises of power demonstrated a relational interplay of power between the funding body, the researchers and the practitioners, thus showing a more nuanced picture. In particular, consideration of structural and discursive power shed light on the funding body's and practitioners' influence on actor selection, agenda setting, and rule setting. Supporting findings from earlier research (Benner and Sandström, 2000; Felt et al., 2016; Schmidt and Pröpper, 2017), the study exposed the powerful role of funding bodies in shaping researchers' and practitioners' behavioural options. By prescribing the kinds of project leadership, the rules of resource allocation and the topical foci (e.g. requiring topics to be relevant for sustainability), the funding body wielded structural and discursive power over participation practices in the projects. In coherence with the structural conditions set by the funding body and by way of the authority thus assigned to them as project leaders, researchers exerted instrumental power over the selection and initial positioning of actors, the agenda setting, and the definition of rules of interaction concurrently (**Manuscript V**).

---

[28] These three elements were derived from the 'sensitising concept' followed in this Manuscript: the 'ecologies of participation' approach (Chilvers et al., 2018).

Thirdly, the empirical analysis exposed situations of shifting power relations between researchers and practitioners. Across the three elements of participation analysed, the decisions of practitioners were influential and, in some cases, heavily affected the process. In several projects, the practitioners' influence became particularly tangible in their threats to withdraw or their actual withdrawal from the process, as well as in the contestation of rules, most notably regarding researchers' access and positioning in the respective practice field. Situations of withdrawal also revealed powerful actors' role in the network of practitioners who distantly influenced practitioners' participation and, in extreme cases, prompted their withdrawal by revoking their authorisation. These empirical insights substantiate previous assertions that participants do not act as isolated individuals, but rather are entangled in socio-material collectives (Chilvers and Kearnes, 2015). Practitioners' exercise of instrumental and structural power was intertwined with the structural conditions prescribed by the funding body. The exclusive possibility of scientific project leadership and the non-provision of financial resources to practitioners gave rise to predominantly non-formalised collaborations and rather low levels of accountability of practitioners (**Manuscript V**).

Lastly, researchers' and practitioners' simultaneous exercise of discursive power shaped the roles that they saw for themselves and the respective others. In so doing, interviewees from both actor groups largely maintained a 'traditional' division of labour between those producing and those using knowledge. Regarding the framing of which issues and solutions were considered germane and a contribution to the desired sustainable development in the field, practitioners wielded significant discursive power. They were seen and saw themselves as legitimate actors for judging the relevance of problems and results, as well as their potential to be taken up in practice, thus leading to greater sustainability. Taken together, the empirical findings of this module provide a nuanced view on power relations that extends beyond dichotomies and binary conceptions of 'the powerful' and 'the powerless' in participation practices, and their representation in ladder-inspired models of participation (**Manuscript V**).

Interpreted in the context of **Module 1**, these findings on 'power over' dynamics contrast some of the principles that were found to underlie models and ideals of participation in TD sustainability scholarship and beyond (**Manuscript II**). This contrast specifically concerns ideals of co-leadership and the assumption that practitioners want to actively participate and to assume responsibility throughout TD processes. Our findings suggest that for some practitioners, a 'traditional' division of labour and their punctual involvement as pre-structured by researchers is preferable. The fact that practitioners did not problematise the described dominance of researchers illustrates the need for a more nuanced understanding of the actors involved. Unlike implicit in TD ideals of shared control (Lang et al., 2012; Luthe, 2017), several practitioners in the projects analysed did neither expect to play any decision-making role nor want to assume responsibility for the process. Similar observations were made

in a previous interview study (Di Giulio et al., 2016). The analysis of the reasoning behind this showed that this reluctance was due to not only a lack of financial and time resources, but also because the observed division of labour aligned with some practitioners' epistemological values regarding appropriate science-society relations. Since previous studies have established direct links between inequalities in funding structures and the lack of ownership for the process and conclude that a redistribution of resources will contain this deficit (Zingerli, 2010), it remains to be investigated to what extent our findings are specific to the type of practitioners as well as the peculiarities of the funding context. Despite these ambiguities, interviewees' narratives on appropriate science-society relations further strengthen the recommendation outlined in **Module 2c**, that illuminating the ethical as well as the epistemological values of those involved in sustainability research is pivotal to ensure a fruitful process (see **Manuscript VII**).

Power over-to-with. The second, more explorative part of this module expanded the view on the role of 'power over' to also include facets of 'power to' and 'power with' in analysing participation in sustainability research. We started from the observation that, in TDR, we find implicit allusions to desired and productive facets of power. Firstly, in its goals: TD is often associated with the empowerment of certain ideas or actors, or with developing collective strength through mutual learning, for instance. Secondly, in ideals of how TD processes should be designed and conducted: we find reference to ideals of balanced power relations, co-leadership and egalitarian interactions (see **Module 1**). In order to provide the tools for simultaneous consideration of these desired aspects of power as well as the potentially undesired ones described in this module so far, a multidimensional power lens for TD sustainability research was developed. Relying on social theories of 'power over', 'power to' and 'power with', **Manuscript VI** designed a set of empirical questions which makes it possible to scrutinise the productive aspects of power throughout all project phases without neglecting the unproductive ones (**Manuscript VI**, **table 1** for empirical questions according to the process phase). The proposed power lens was applied and refined in an expert workshop. Based on the real-world experiences of TD experts, **Manuscript VI** uncovered how different forms of power occur according to the constellation and characteristics of the actors, the layout of the process and the configuration of the wider context.

The situations of power gathered in this workshop illustrated three salient points: firstly, the empirical examples discussed showed that 'power over', 'to' and 'with' intersect. Determining which form is at work depends on the scale considered in the analysis and the standpoint taken. What the actors directly involved perceive as 'power with' in the context of the project (mutual learning, for instance) can be seen and experienced as 'power over' in the wider societal context or as 'power to' from an individual actor's perspective (empowerment, for example). Secondly, the empirical examples suggested that power constellations within TD processes vary depending on the hierarchies and

structures engrained in the practice context as well as the funding and academic context. Likewise, power constellations within TD processes can affect their capacity to shape the wider context. Thus, analysing power requires sensitivity to the situatedness of participation spaces. Thirdly, both dynamics and path-dependencies were found across process phases. The TD experts shared the experience that those projects that were dominated by a few actors in the early project phases were less likely to unfold 'power with' dynamics at later stages. At the same time, the oscillation of different forms of power was described: while researchers might unilaterally shape the overall project design, responsibilities for designing and conducting workshops might be shared between researchers and practitioners and yet other steps may be dominated by practitioners' preferences. Thus, an analysis of power must ponder how power relations can change throughout TD processes and must be attentive to possible path-dependencies (**Manuscript VI**).

The schematic application of the power lens illustrated that, in TD projects, power works in multiple ways and can be both desirable and undesirable. The decision of whether a form of power is desirable or not implies a normative judgment, which is tied to the goals set for the process and the underpinning rationale of participation. Where multiple goals are pursued simultaneously, power dynamics can cause or reinforce trade-offs between the different goals attached to participation (**Manuscript VI**). For instance, in order to achieve knowledge production goals, dynamics of 'power over' in some steps of the process might be considered productive, yet might compromise procedural goals inspired by deliberative, democratic ideals. This aspect was explored in a literature-based study of participation in sustainability assessment processes (**Manuscript IV**). The study revealed potential trade-offs between the various goals often simultaneously pursued in participation processes. For instance, it showed that in contexts of rigid knowledge hierarchies, new knowledge or civic learning might only occur if marginalised ways of knowing are purposely empowered or if the process is managed in a top-down fashion (i.e. in an initial dynamic of 'power over'). In this way, it may be possible to counterbalance the prevailing power relations. Such a process, however, compromises the deliberative ideals that underlie the normative position that participation is an end in itself and should be maximised. Consequently, depending on the context, trade-offs between different motivations and goals of participation inexorably have to be made (**Manuscript IV**). Studies on the 'ideal' timing of practitioners' involvement in TDR have identified similar trade-offs between scientific productivity and societal effects (Newig et al., 2019). The analysis provided in **Manuscript IV** furthermore highlighted the fact that power dynamics between researchers and practitioners differ depending on whether a participation process is embedded in a primarily research-orientated or a primarily policy-orientated process. In the literature on sustainability assessments, these orientations were found to be often blurred and not made explicit. Greater differentiation of the main orientation and clear prioritisation of goals can help navigate some of the potential trade-offs (**Manuscript**

IV). In a similar vein, in the debate on the role of science in societal change, some TD scholars have observed a lack of differentiation between generating scientific knowledge and generating societal change (Defila and Di Giulio, 2018). In their understanding, since a TD project is primarily a research project, the activities that form it follow the functional mode and logics of the scientific field. This, by definition, implies a hierarchy, both regarding the goals and requirements to be fulfilled and the actors who can and must fulfil them. Accordingly, they claim that the primary goal of participation in TDR is and should be to generate knowledge. This means that other goals of participation can only be secondary (Defila and Di Giulio, 2018). While not all TD scholars might concur with this clear-cut separation of goals, the potential trade-offs between the goals that we have identified call for a nuanced view of frictions and tensions to which they may give rise in TD processes.

Summary and practical relevance. By unpacking participation processes, this module revealed the deep-rooted and often invisible power dynamics that shape the interactions between researchers and practitioners. Set in the context of the relational approach to participation developed in this thesis (**Module 1, 2a**), power dynamics affect the continuous negotiation processes inherent to the making of participation spaces; affect actors' capacity to shape participation spaces through the distribution of resources, the validation of knowledge and the mobilisation of further sources of power; and finally affect the potential of these spaces to disrupt societal structures and/or dominant discourses (**Module 2c**). Acknowledging power dynamics provides a first step towards tackling them. The empirical questions proposed support researchers and practitioners in rendering tacit power dynamics visible. This serves as a basis for stimulating forms of power, which are productive with regard to the goals of participation and the minimisation of unproductive ones. For researchers, the empirical questions provide not only the opportunity for reflexivity about their own powerful roles in TD processes, but can also support in uncovering the possible impact of weakly formalised collaborations with practitioners on the evolution and 'successful' completion of the process. In these asymmetrical constellations, instrumental power rests primarily with one actor group. However, such constellations are also likely to come with an unequal distribution of responsibilities and accountabilities among different actor groups. Accounting for power dynamics is useful for identifying and highlighting researchers' dependencies on practitioners as well as for communicating and planning accordingly, thus enabling them to reduce their vulnerability to practitioners' withdrawal from the process. For both researchers and practitioners, knowledge of the sources of power which they tap in order to shape the TD process helps to steer power dynamics, i.e., by deliberately creating these sources. Moreover, reflexivity regarding practitioners' exercise of discursive power gives an indication of the kinds of societal discourses and structures that the TD process and its outcomes (de-)stabilise (**Manuscript V**).

6.4 Module 2c: Unpacking Processes, Focal Point II: The Role of Values and Worldviews

HIGHLIGHTS

- In this module, we showed that different notions of sustainability are rooted in different understandings of ethics (consequentialist vs. deontological) and society-nature relations (e.g. technocentric or technosceptic anthropocentrism, essentialist ecocentrism, political ecology). These result in diverging perceptions of the research problem, the knowledge needed to tackle it and the possible solutions. Not only do trade-offs between different goals within one worldview emerge when involving diverse actors in researching sustainability, but value positions might also be incommensurable and mutually exclusive. In such a situation, developing a participation space is a major challenge for TDR.
- In addition to the normativity of the reference concept (sustainability), epistemological values shape sustainability research. These underlie positions about the desirable relationship between science and values, including the idea of a fact-value split, the idea of fact-value entanglements and a middle ground that conceives "epistemic-moral hybrids".
- The analysis showed that the value-laden nature of sustainability poses three main challenges for researching and assessing it: given their plurality and possible incommensurability, it is difficult to consider all values; given the intertwining of values and societal order, some values are more likely to be included than others; this also implies that participatory knowledge production processes risk reproducing dominant values and contributing to a 'closing down of possibilities' - i.e. of radically different ways of seeing and tackling unsustainable socio-ecological developments.

Practical relevance:
- This module identified ideal-typical positions that can stimulate researchers' and practitioners' reflection on their own worldviews and values as a basis for negotiating them.
- It proposes three axes for reflection that allow researchers and practitioners to question how their projects might contribute to a discursive closing down of possibilities: rendering explicit values and worldviews implicit in knowledge production processes and pinpointing hegemonic values; revealing power dynamics that affect the negotiation of values; and monitoring societal impacts of knowledge production and (technology) futures.

Linked to the question of whose values count (**Module 2b**) and the participation-related factors found in the literature review (**Module 2a**), this module unpacked the role of worldviews and values in sustainability-oriented knowledge production. It addressed the question of how values underpin notions of sustainability and play into research on and assessments of sustainability. This module synthesises research on the

implications of values for knowledge production in the context of sustainability assessment (**Manuscript VII**) and research on sustainability-oriented technology assessment (**Manuscript VIII**).

The findings of these theoretical and literature-based analyses revolve around three interrelated ways in which worldviews and values play into sustainability research, and the collaboration of diverse actors within it. Worldviews and values were found to (i) shape what is perceived to be a germane sustainability research problem and solution and whose perspectives are considered legitimate and included in the process, (ii) influence how researchers and practitioners deal with values in knowledge production and distribute roles amongst themselves and (iii) affect the societal implications of sustainability research. These three aspects are synthesised below.

To begin, we distilled the different ethical positions and worldviews that underpin notions of sustainability and shape the perceived solution spaces for sustainability problems. We illustrated that interpretations of sustainability are rooted in different understandings of ethics and the relationship of society with its environment, i.e. in different conceptions of nature-society relations (see table 8, for examples on anthropocentrism, ecocentrism, political ecology). These result in different beliefs on how problems should be approached and actions evaluated (see table 8, task of sustainability research). An example illustrates this point and allows us to see the various disagreements and conflicts that may arise from tacit ethical values and positions on nature-society relations (**Manuscript VII)**.

Analysing the example of human-induced CO_2 emissions, we illustrated how reflections on human needs and nature-society relations tie the concept of sustainability to values. If we approach the question of how to deal with CO_2 emissions from a consequentialist and utilitarian point of view as regards ethics, emissions are judged by the ends they allow for, e.g. economic growth (see O'Neill, 2008). In such an interpretation, whether any amount of CO_2 emissions is considered acceptable depends on what it allows societies to achieve in terms of socioeconomic development. Accordingly, the optimal and preferred course of action is the one that maximises 'pleasure' and minimises 'suffering' for all entities concerned (see O'Neill, 2008). If we change perspectives and look at the same example through the lens of deontological ethics, both the problem and the solution look different. Based on the principle of refraining from "*doing violence to the natural systems of life on earth*" (Kemp and Martens, 2007, p. 5), in such a worldview no amount of human-induced CO_2 emissions is deemed justified, irrespective of the ends. The idea that the ends justify the means - the basic premise underlying consequentialism - opposes the premise that the means must be judged irrespective of the ends they allow for. This is the basic premise of a deontological stance. Agreement between proponents of either one of these perspectives in a participatory knowledge production process might thus be difficult to reach. An actor who fundamentally

disagrees with the premise that CO_2 emissions can be justified in some cases might well refuse to negotiate on how to balance their positive and negative impacts and consider research targeting such questions obsolete. This very contrast between consequentialist and deontological ethics points to incommensurable values, which result in diverging perceptions of the problem and the possible solutions to it. They affect which research questions become the focus and which actors and expertise must be mobilised to tackle them. Thus, not only do trade-offs between different goals and priorities within one worldview emerge when involving diverse actors in researching and assessing sustainability, but value positions might also be incommensurable and mutually exclusive (**Manuscript VII**).

Table 8. Selected ideal-typical positions on nature-society relations and ethical values; adapted from Manuscript VII (Meinherz et al., 2020)

Position*	Implied worldview	Implied understanding of sustainability	Task of sustainability research
Technocentric Anthropo-centrism	'Engineering nature to fit humankind's needs'	Substitutability of ecosystem services; substitutability of technology and ecosystem services; environmental protection/destruction as a means to an end (consequentialist)	Assess to which degree a given technology is suitable for ensuring that societal resource needs can be met in the long term
Technosceptic Anthropo-centrism	'In the face of uncertainty, precaution is better and society should not gamble on future technological progress'	Maximally partial substitutability of ecosystem services; maximally partial substitutability of technology and ecosystem services; environmental protection/destruction as a means to an end (consequentialist)	Assess the degree to which any given course of action allows us to ensure the resource needs of humankind in the long term
Essentialist ecocentrism	'Respecting the integrity of Mother Nature'	All human interference in earth system processes is oppressive and to be condemned (deontological)	Identify all instances in which humankind interferes with natural processes
Political ecology	'Equilibrating the planetary Metabolism'	Embedding society in the flows of the planetary metabolism and freeing the planetary metabolism of forms of exploitation (deontological)	Assess to what degree the planetary metabolism is balanced and free of oppressive and exploitative power relations

*The different conceptions of nature-society relations as outlined here correspond to ideal types; positions on sustainability can incorporate elements of different perspectives

Interpreted in the context of the relational approach introduced in **Module 1**, in such a situation, the development of a participation space is a major challenge for TD sustainability research and achieving consensus might not be the most pertinent goal

(**Manuscript I**). This observation resonates an argument put forward in pragmatist approaches to TDR, which stress that the diversity of values and visions should not be subsumed to consensus (Lamine, 2018; Popa et al., 2015). However, as **Module 2a** has shown, a shared understanding of the problem was ranked as the most critical success factor of collaboration by researchers and practitioners in the NRP 71 context (**Manuscript IX**). This further substantiates the need for researchers and practitioners to clarify their ethical values and worldviews in order to trace covert disagreement and develop a shared problem understanding. The ideal-typical positions identified in table 8 can stimulate such a reflection on one's own worldviews and values as a basis for negotiating them. Doing so helps clarify the plurality of perspectives and interests beforehand, which has been identified as a crucial step in joint problem framing in TD projects (Pearce and Ejderyan, 2019).

Secondly, we showed that in addition to ethical values, another type of values shapes sustainability research and the collaboration of heterogeneous actors within it: epistemological positions on how research should engage with the ethical values and normative issues that have been outlined so far in this module. We identified three ideal-typical positions on how scientific knowledge production should address ethical values. These positions themselves are rooted in values of what 'good' science is, including the idea of a fact-value split, the idea of fact-value entanglements and a middle ground that conceives "epistemic-moral hybrids" (see table 9). The decision on how to deal with ethical values in sustainability research and assessments hinged on these epistemological values - i.e. values that define what is meant by 'good' science - which are held by an individual researcher and/or which are prevalent in a given discipline (**Manuscript VII**). It becomes clear that, depending on how relations between science and values are conceived, practitioners' involvement can appear respectively as a desirable approach to knowledge production on value-laden issues or, conversely, as a threat to scientific objectivity.

Although, on a theoretical level, researchers widely acknowledge the importance of epistemological values in the field of sustainability, they are often overlooked in scientific practice. **Manuscript VII** posits that irrespective of the position, these epistemological values should be reflected and made transparent. Notably, widely acknowledged or taken for granted positions also mirror values and worldviews. The fact that the latter go unquestioned may point to their hegemonic status and render explicit reflection all the more vital. This is especially relevant in the inter-and transdisciplinary processes in which different epistemological positions are likely to meet (see e.g. MacMynowski, 2007; Raymond et al., 2010). As will be discussed in **Module 3**, the epistemological values of both researchers and practitioners shape which kinds of roles and responsibilities they assume and conceive for the respective others in TDR. Concomitantly, they also affect how they conceive of the pathways from the research process to societal impact. Moreover, in **Module 3** it will also be shown that clarifying epistemological values is

an important step towards the appreciation of the other actors' expertise and knowledge. For practitioners, for example, the perception that researchers appreciated their knowledge and expertise was a key variable driving the (perceived) practical usefulness of the research project (**Manuscript IX**).

Table 9. Selected ideal-typical epistemological positions and values; based on Manuscript VII (Meinherz et al. 2020)

Position	Implied epistemological 'values'	Conceived task of (sustainability) research
Fact-value split	Facts and values as ontologically separate; 'good' science keeps values out of knowledge production	Provide objective assessments and produce neutral facts as an evidence-base for decision making; study 'what is'; science does not take part in value negotiations
Fact-value entanglement	Facts and values are intertwined, e.g. selection of research 'problem' relates to values; 'good' science acknowledges and is reflexive with regard to the value dimensions inherent to knowledge production	Engage with the normativity of sustainability; collaborate with societal actors and potentially intervene actively in the practice field; study 'what ought to be'
Hybrid	Facts and values are ontologically different, but in reality often entangled; 'good' science acknowledges moral issues within facts retrospectively and opens them up for deliberation	Acknowledge that sustainability issues are "epistemic-moral hybrids" (Potthast, 2015) that involve both substantive and normative elements; research on such issues must make both elements transparent and communicable

Thirdly, we showed that while many worldviews and values relate to notions of sustainability, they are not equally reflected in sustainability governance and research[29]. We argued that this has to do with the fact that values are historically constructed; they are shaped by and shape the socioeconomic, sociotechnological and socioecological order. We found that this 'co-production' process (Jasanoff, 2004) risks creating a prevalence of notions of sustainability that reproduce the very dynamics at the origin of the sustainability problem at hand. This mutual reproduction of values and the socioeconomic, sociotechnological, and socioecological order implies that the knowledge production processes and policy interventions that are aligned with the prevailing order are more likely to be heard. In so doing, they stabilise the extant order and narrow conceptions of sustainability in science, policy and civil society (see Díaz et al., 2018; Healy et al., 2015; Shove, 2010). This poses a challenge for sustainability research and

---

[29] Scholars from political ecology and ecological economics have noted an increasing emphasis on ecological modernization in sustainability discourses, a concept that is rooted in anthropocentric and technocentric values (Blythe et al., 2018; Healy et al., 2015; Salleh, 2015; van der Hel, 2018).

assessments – both participatory and not – whose goal is to shift to a different, more sustainable order (**Manuscripts VII, VIII**).

Guided by Bourdieu's (2012) work on discursive practices, **Manuscript VIII** further explores this risk of a perpetuation of dominant discourses on society-nature relations and societal development. Regarding sustainability policies since the 1970s, we demonstrated that despite the plethora of understandings and approaches to sustainability, the concrete policies that should respond to sustainability challenges show striking similarities; they are inscribed in a process of institutionalisation that, in Bourdieu's terminology, corresponds to a 'closing down of possibilities'. We illustrated how the national and international policies that followed the publication of the Brundtland report tend to subscribe to a worldview described as technocentric anthropocentrism in the previous section, and often follow a market-based logic. The development and assessment of technological innovations are put at the core of such sustainability policies, while the questioning of the societal and ethical premises that are at the root of many sustainability problems are neglected. This normative preselection also shapes what kinds of solutions and innovations are considered in participatory technology and sustainability assessments. By predefining which options are up for debate, those in charge exert the power to keep other options off the table and restrict the space of what is negotiable within an assessment. Incumbent actors and interests tend to instrumentally frame assessments so as to limit the range of commitments the latter might entail (Stirling, 2008). In such cases, technology assessments risk being part of the aforementioned 'closing down of possibilities'. Flipping the coin, this implies that they can also contribute to the opening of more sustainable alternative pathways[30] (**Manuscript VIII**).

Summary and practical relevance. Unpacking processes of sustainability research and assessment, this module demonstrated how values underlie notions of sustainability and concomitantly shape knowledge production about sustainability. Such an investigation proved valuable for critically approaching the ways in which the system and the issue contexts of researchers and practitioners shape knowledge production processes in general and the creation of participatory and TD spaces in particular.

---

[30] In Manuscript VII we discuss on the example of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) how the redefinition of sustainability assessment schemes can be part of an 'opening up' of alternatives. The argumentation that led the IPBES to complement the notion of ecosystem services with that of nature's contribution to people recognises the power of the mechanisms by which hegemony is generated and can be seen as an attempt to break with them. The IPBES states that thinking of the world in terms of ecosystem services and market relations has obscured the consideration of crucial aspects of the ecosystem which could not easily be expressed in these terms. Thinking the world in terms of ecosystem services thus came with the exclusion of experiences of the world not reflected in the values underpinning this concept. These people's growing opposition to conceptions such as ecosystem services has incited the IPBES to promote a more inclusive conception – the one of nature's contribution to people (Díaz et al., 2018) (Manuscript VII).

Considered through the lens of a relational space (**Module 1**), the role of the worldviews and values elucidated in this module is multifold. For one, they frame how researchers and practitioners make sense of their environment. They guide their decisions on which elements of a problem and which kind of knowledge are germane, and which changes in their environment are expedient and desirable. These decisions are critical for how actors create a participation space. Worldviews and values also shape the ways in which researchers and practitioners position themselves, e.g., if they share the same problem understanding, they might move closer to one another (**Module 2a, Manuscript I**). The findings in this module allow us to formulate **recommendations** for researchers and practitioners on how to deal with the many values and worldviews linked to sustainability. These include: (i) clarifying the ethical and epistemological values that guide sustainability-oriented knowledge production; the ideal-typical ethical and epistemological positions traced in this module provide support in doing so; (ii) acknowledging that some values are more easily and more commonly recognised than others and (iii) monitoring the effects and implications of knowledge production and of technology developments on societal order.

6.5   Module 3: Linking Processes and Effects: Participation-effect Pathways of TD Sustainability Research

<div class="highlights">

HIGHLIGHTS

- In this module, we found that the effects of participation processes in TD sustainability research are interwoven in complex pathways and span over three system contexts: the arena of actor collaboration, the arena of the practitioners involved and the arena of the wider practice context.
- Feedback effects on the ongoing participation process in TD projects were identified (e.g. increased trust between research and practice), thus calling into question linear conceptions of impact.
- The analysis uncovered differences in researchers' and practitioners' perceptions of participation-effect pathways, roles and responsibilities. For instance, some practitioners saw themselves as intermediaries between research and practice, while researchers saw them as the implementers of results.
- Similarities in researchers' and practitioners' narrations of types of effects were found, but different weightings were attached to these effects. For instance, practitioners placed network effects at the core, while practitioners perceived them as a side-effect.
- A complementary quantitative analysis revealed several process features that relate to greater practical 'usefulness' and 'relevance' of the results as perceived by researchers and practitioners respectively: frequency of contact (both actor groups), trustful relationship and perceived appreciation of practitioners' knowledge (practitioners), clearly defined role of practitioners (researchers), the extent to which practitioners' contributions were incorporated into the projects (practitioners).

Practical relevance:
- This research developed a systems approach that supports researchers and practitioners in making their theories of change and the participation-effect pathways they assume transparent and negotiable.
- The reduced effect terminology (asking for effects in three actor and system contexts) is helpful when mapping pathways and theories of change with diverse actors.
- The process features found to relate to increased relevance and usefulness of results allow for an improved project design and management.

</div>

The work carried out in this module inquired into the links between process dynamics and perceived (societal) effects of participation in TD sustainability research. It built on the theoretical and empirical insights gained in the previous modules, including the conceptual perspective on participation as relational and in the making (**Module 1**), the participation factors (e.g. trust, motivation, expectations) found to be dynamic (**Module 2a**), and the role of ethical and epistemological values in shaping what is

considered to be a desirable pathway and course of action towards sustainability (**Module 2b, 2c**). In order to grasp the links between processes and effects, a qualitative enquiry in the WfNE context and a quantitative study in the SNSF context were conducted. The main findings, presented in **Manuscript III** and **IX**, are summarised below.

Applying a systems approach, the qualitative analysis of researchers' and practitioners' perceptions in seven TD sustainability research projects uncovered *direct, indirect* and *interlinked* participation-effect pathways. These stretched across three system contexts, here labelled as arenas: the actor collaboration arena, the involved practitioners arena and the wider practice context arena (see figure 7).

Firstly, the *direct pathways* observed mostly related to the practitioners involved in the project, i.e. they unfolded in "the involved practitioners arena". For example, the empowerment of practitioners through collaboration or the building of networks were described as a direct participation-effect pathway (**Manuscript III**).

Secondly, the *indirect pathways* narrated by interviewees included effects on the research process as a first step that then contributes to a societal effect. In these pathways, participation was assumed to improve the practical relevance of the research and its outputs in order to maximise the chances of subsequent societal effects, such as the implementation or transfer of research outputs (**see Manuscript III, figure 1**).

Thirdly, beyond direct and indirect pathways connecting participation and societal effects, the analysis revealed interdependencies and sequential links between societal effects in the "involved practitioners" and "the wider practice context" arenas. These *interlinked pathways* start off with a first societal effect, which is directly linked to the participation process and which is then succeeded by one or several further societal effects (see figure 7). The composition of such interlinked pathways and the order of societal effects within them differed across interviews. Hence, researchers and practitioners identified divergent strategies and approaches for achieving the same societal effect. These different participation-effect pathways contribute empirical insight to scholarship on researchers' and practitioners' theories of change in TD sustainability research (Belcher et al., 2019; Oberlack et al., 2019) and participatory research more generally (Douthwaite et al., 2003). They partly confirm existing conceptions of a direct link between participation and the emergence of societal effects (Shirk et al., 2012; Walter et al., 2007; Wiek et al., 2014). However, we found that the same type of effect can occur at different places in pathways of interlinked societal effects (e.g. raising the involved practitioners' awareness of a sustainability problem vs. practitioners as intermediaries to raise awareness in the wider context). This indicates that categorising societal effects as either impacts or outcomes might be deficient in depicting the

complexity of effect pathways in TDR. In highlighting multidirectional interlinkages between individual effects, our findings reinforce previous calls for considering complex and non-linear relations when studying impacts and setting up theories of change (Oberlack et al., 2019; Van Kerkhoff, 2014; van Tulder and Keen, 2018) (**Manuscript III**).
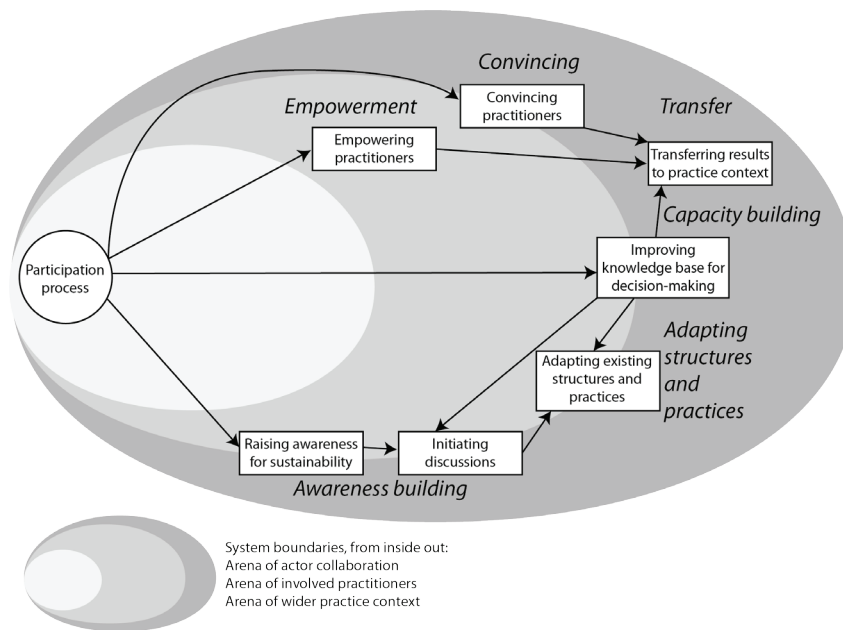
Figure 7. Interlinked participation-effect pathways: researchers' and practitioners' perceptions, Manuscript III (Fritz et al., 2019)

The actor-specific analysis showed that while researchers and practitioners mentioned similar types of effects[31] (though with different accentuation), the pathways in which these effects are embedded differ. For instance, researchers tended to see participation as input into the research process. Participation in this pathway appears as a way of learning from practitioners in order to get more relevant project outputs implemented. For practitioners, providing inputs for the research process was less important. Their narrations focused on direct and interlinked pathways, such as empowerment, building networks or influencing other practitioners (see **Manuscript III,** figures A.1., B.1.).

---

[31] The following types of effects were inductively developed and linked to existing scholarship: capacity building, implementation, adapting structures and practices, transfer, convincing, empowerment, network effects, awareness building, self-conception, input for research process, feedback effects on participation process (see Manuscript III, table 3). We introduced simplified terminology that builds on the understanding of change being *"any event or variation in the state of affairs"* (Belcher and Palenberg, 2018, p. 480). We use the notion of 'societal effects' to refer to changes affecting the involved practitioners and structural/processual shifts a project's wider societal context. In addition, 'effects' of participation in TDR designate process-related changes in researcher-practitioner interactions and the research process that may or may not lead to societal effects (Manuscript III).

This tendency was mirrored in the main motivations to collaborate in research projects revealed in the NRP survey. Researchers who participated in the survey typically involved practitioners to improve the project's practical relevance and to ensure the applicability of the results. Practitioners' motivations included developing solutions to concrete problems, building capacities through the generation of new knowledge and expanding their networks (**Manuscript IX**).

Researchers' and practitioners' diverging perceptions of participation-effect pathways were accompanied by often contrasting roles and responsibilities ascribed to themselves and to others. While in some cases, for instance, practitioners saw themselves as intermediaries between research and practice, researchers saw them as the implementers of project results (**Manuscript III**). These findings corroborate Schneider et al.'s (2019b) and Mitchell et al.'s (2015) suggestion that researchers and practitioners should ponder their epistemological values and assumptions regarding the appropriate division of roles between research and practice in general and reflect what they mean for research-practice interactions in their own projects. Furthermore, as also reported by similar studies (de Jong et al., 2016), the practitioners participating in the projects analysed comprised actors with multifaceted professional backgrounds, who were positioned in and navigating various reference systems and held diverse convictions. Our empirical insights demonstrate how practitioners' perceptions of societal effects are interwoven with the overall goals or mandate of their home organisation, their role in that organisation, and/or their own political or societal commitments. Hence, the intended societal effects and the pathways through which they should be reached must be negotiated in the context of existing norm and belief systems (**Manuscript III**).

Interpreting these findings through the analytical lens on values and worldviews developed in **Module 2c**, the expected and perceived effect pathways are likely to reflect actors' worldviews about what should be changed and/or preserved, as well as who should be in charge of and accountable for this stabilisation and/or transformation (e.g. science and/or practice, the appropriate division of labour). Together, these findings point to the politics involved when talking about societal effects of TDR. Far from being uncontested "linear input-output" relations (Healy, 2019), the relationship between producing and implementing research findings is, as Aniekwe et al. (2012) suggest, a "deeply political affair". It requires that those involved make their assumptions about change and targeted societal effects transparent and negotiable.
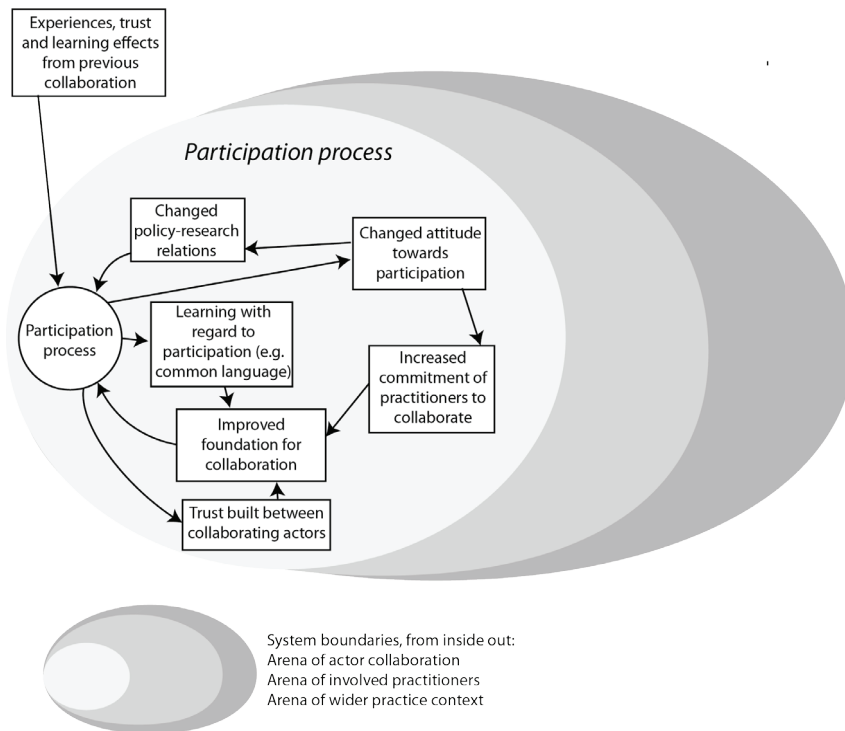
Figure 8. Feedback effects influencing the participation process: researchers' and practitioners' perceptions, Manuscript III (Fritz et al., 2019)

Fourthly, in addition to the various interlinkages between effects, the examination of participation dynamics revealed another type of effect, so-called *feedback effects* (figure 8). Feedback effects emerge from and affect researchers' and practitioners' interactions. They unfold within the inner system boundary that defines the "arena of actor collaboration". Researchers and practitioners shared similar aspects with regard to such effects as developing trust, a common language and aligning expectations (see also **Module 2a**). Several interviewees recalled previous collaborations as salient success factors for a fruitful participation process. This finding confirms the importance of personal and collective participation histories (Klenk and Meehan, 2017), and indicates that when limiting impact studies to the present project entity noteworthy participation-related effects might be overlooked. These findings regarding feedbacks on the collaboration process fleshed out effect categories for impact studies that have a primary interest in participation in TDR and add to process-oriented perspectives on the effects of participation (Currie et al., 2005; Darby, 2017; Hellström, 2015). They corroborate findings from PAR, which has shown that effects of participatory practices are often closely tied to the interactions and relationships of the actors involved (Darby, 2017; Evans, 2016). This implies that impact studies in TD contexts should be grounded in a dynamic understanding of participation (**Manuscript III**).

These qualitative findings were complemented with insights from a quantitative assessment of the link between participation processes and the practical usefulness and

relevance of project results in the Swiss funding context[32]. In a survey within the NRP 71, we found that several process features relate to greater practical usefulness and relevance of results as perceived by researchers and practitioners (**Manuscript IX**). These findings substantiate the indirect pathways via inputs into the research project identified in **Manuscript III**. The analysis of practitioners' perceptions revealed the influence of the frequency of contact, a trust relationship and their perceived appreciation of their knowledge on the project's practical usefulness. In the case of researchers, frequency of contact also showed as a determinant of the project's practical usefulness. The analysis of their perceptions, moreover, revealed the positive influence of practitioners' clearly defined roles and of the extent to which their contributions were integrated into the project (figure 9). The intensity of the collaboration, which in this study was measured as frequency of contact, was central in both researchers' and practitioners' assessments and has already been cited as a useful indicator of a successful participation process in different types of TDR (Stauffacher et al., 2008; Schneider and Buser, 2018). The findings of **Manuscript IX** validate the pertinence of intensities of collaboration as an indicator of a fruitful collaboration, but add a word of caution with regard to interpreting them. The researchers' and practitioners' perceptions of the intensities of their interaction were found to diverge throughout all process phases, with researchers consistently evaluating intensities higher than practitioners. Relying on intensities as an indicator for fruitful collaboration thus presupposes that both researchers' and practitioners' perceptions are duly considered.

Figure 9. Significant determinants of the perceived usefulness of the research project for the practitioners, Manuscript IX (Binder et al., submitted)
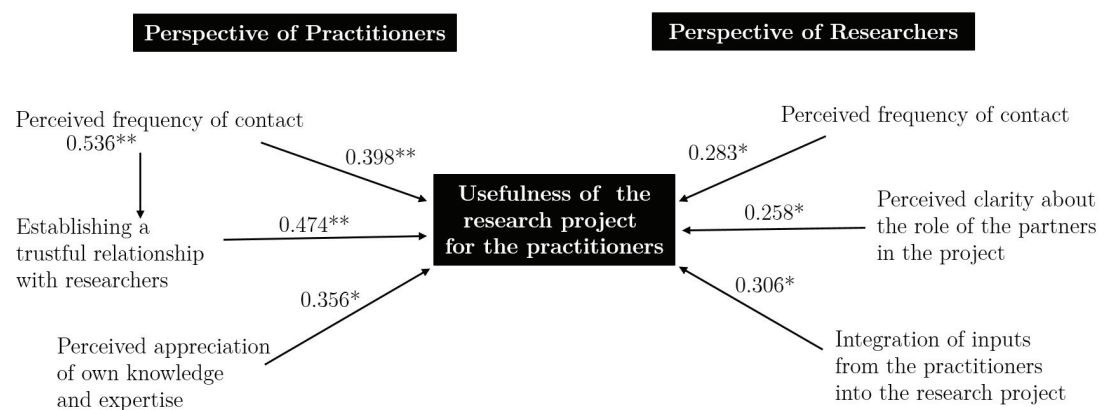
Legend: based on the analysis of the responses by both researchers and practitioners *p<.05, **p<.01 significant correlation coefficients (see Manuscript IX and Appendix E for corresponding survey items)

---

[32] We acknowledge that the category of 'usefulness', placed at the centre of figure 9, but also the category of 'practical relevance' are subject to fundamentally ambiguous interpretations and mean different things to different people. An assessment of the diverse and equally-valid ways in which they are conceived, however, was not at the core of this study.

Summary and practical relevance. Assessing the links between participation processes in TDR and their potential effects, researchers' and practitioners' narrations revealed diverse and complex participation-effect pathways. Depending on which types of participation-effect pathways researchers and practitioners seek to pursue, different processes and strategies are meaningful and likely to be efficacious. Building pathway models supports researchers and practitioners in shedding light on their perceptions of the links between participation processes and societal effects and making their implicit theories of change communicable and negotiable. Since differentiating outputs-outcomes-impacts can be overwhelming (Binder et al., 2015), the reduced 'effect' terminology suggested can be an easy-to-use alternative, particularly when working with diverse actors; it makes it possible to simply ask for changes that are supposed to emerge in different actor and system contexts. The tripartite categorisation by system contexts is a way of disentangling the effects that primarily affect the practitioners who are involved in the project from those that constitute changes in the wider context, as well as of capturing smaller-scale effects on the collaboration process. Mapping effects within different system boundaries can ultimately inform researchers and practitioners about their capacity to contribute to the attainment of an effect. It is thus a first step towards assessing their (and their projects') influence over it, as suggested in theory of change scholarship (Belcher et al., 2019; Earl et al., 2001; Vogel, 2012). While effects closer to the participation process are likely to be susceptible to the influence of the implicated actors in a TD project, those in the wider practice context can hardly be steered (**Manuscript III**). Pathway models can be fed with additional elements, such as the factors both inside the project (e.g. the features of the participation process identified in **Manuscript IX**, such as intensity of interaction or level of trust) and outside the project (e.g. socio-political factors, resistances against change) that support or impede the unfolding of societal effects.

7 Conclusions: New Perspectives for Participation in TD Sustainability Research

In presenting the overall conclusions, this section summarises the key dimensions that characterise the politics of participation. It likewise recaps how the conceptually and theoretically grounded analytical tools developed in this thesis render visible and address structural incoherencies, power dynamics, value negotiations, and impact narratives that shape participation in sustainability-oriented knowledge production. The conclusions are then set within the context of recent developments in science policy and research funding. Finally, it acknowledges the methodological limitations and blind spots of this thesis, and opens up promising avenues for future research.

This thesis started from the observation that in the face of complex, value-heavy sustainability problems, scholars and policy-makers alike have increasingly called into question the ability of traditional disciplinary research alone to provide the kind of knowledge needed to govern transformation processes towards sustainability. In response, they have urged for collaborative and integrative approaches. With the UN's 2030 Agenda for Sustainable Development and growing recognition of the climate crisis, the call for knowledge co-production and collaboration between scientists, policy-makers, businesses and civil society actors has become a priority on the international policy agenda. International policy documents refer to the need for intensifying cooperation at the research-practice interface. International initiatives have been launched to support such cooperation, and specific funding instruments that make researcher-practitioner collaboration an integral funding criterion have been put in place. Much research has been carried out on the different ways in which researchers and practitioners (should) collaborate and coproduce knowledge.

In view of this burgeoning interest in collaborative - often TD - approaches in science policy and practice, greater knowledge of the dynamics and processes shaping TD sustainability research is indispensable for supporting researchers, practitioners, funding bodies and (science) policy-makers in leveraging the potential of such approaches, and in reaching their epistemic and transformational goals. Against this background, there was a need for critical analyses of the actors, structures and processes that shape how practitioners' participation in TD sustainability research unfolds and which societal effects it ultimately produces.

Thus, this thesis aimed to **enhance understanding of the complex processes** that constitute and shape participation practices and their effects in TD sustainability

research, and to **develop analytical tools** for studying researcher-practitioner interactions in knowledge production in the field of sustainability.

In order to open the black box of participation in knowledge production practices at the science-society interface, this thesis linked diverse sensitising concepts and social theories to qualitative and quantitative empirical investigations. Drawing upon real-world examples of TD sustainability research in different German and Swiss funding contexts, structural and actor-related elements involved in configuring participation spaces were explored. It also enquired into participation-effect pathways, and how participation spaces and the resulting knowledge constructions shape governance by rendering some claims and issues visible and valuable while obscuring others. In order to approach participation from different angles and draw an empirically rich picture, due consideration was given to including the perspectives of both researchers and practitioners.

7.1   Main Conclusions of Modules 1-3

This thesis offered empirical and theoretical insights into participation in TD knowledge production **along three main axes of analysis**: (i) de-and reconstructing models and discourses of participation, (ii) unpacking participation processes, and (iii) linking participation processes and effects. This section revisits the conclusions for each of the modules and ties them together with regard to the politics of participation that manifest through them. A short summary of the main findings is given for each of the three main modules. The analytical tools developed are then recapped and the main conclusions drawn.

In the **first module**, we deconstructed models and discourses of participation, and explored how a shift in conceptual perspectives can address missing dimensions in the current understanding of participation in TD knowledge production. In so doing, this module elucidated implicit assumptions that underlie the models of participation frequently used in TD scholarship, including normative ideals of consensus and interactions on equal footing, logics of 'the more participation, the better' as well as conceptions of practitioners as passively waiting to be invited to participate. While the strengths and appeal of the reviewed models lie in their description and comparison of forms of participation as well in the normative compass they can provide, they were found to be inapt for analytical enquiries into why participation takes diverse and mutable shapes, leading to different outcomes, sometimes intended and desired, sometimes not. In response, this thesis put forward a novel perspective on participation 'in the making', suggesting to see participation as a relational space that is dynamically forged through an interplay of structures and processes. In developing this perspective on participation as a relational space, this thesis undertook a stronger methodological

and theoretical linking of sustainability research, STS and development studies. The articles included herein showed the added value of moving beyond the boundaries of TD scholarship and bridging with development research, STS and social theories amongst others. Integrative approaches and openness to experiences and expertise in neighbouring fields have proven valuable and are necessary for forging and further strengthening the comparatively young field of TD sustainability research.

Building on the concept of relational space, this module developed **analytical tools** for critically studying the constitution of participation spaces in sustainability research. These consist of guiding questions that support researchers and practitioners in grasping the role of structures (norms, rules and resources), actors and processes in the participation spaces they create in the framework of their projects. The guiding questions stimulate and strengthen reflexivity at different stages of the process: prospectively when planning participation and retrospectively when analysing participation. This perspective helps to distinguish between dynamic elements (e.g. mutual trust), which can be actively steered in planning and designing processes and more stable elements (e.g. norms, worldviews), which primarily require critical reflection on the preconditions that frame researchers' and practitioners' positioning.

Thus, the **first main conclusion** of this thesis is that conceptual perspectives on participation in TD sustainability research are not neutral and apolitical, but rather allow us to see some aspects of participation while masking others. How participation is conceived has repercussions on the practical implementation of participation and the empirical perspectives applied in its analysis. They shape how we think of the respective others who participate, affect the normative ideals we attach to the notion, the procedural aspects (e.g. consensus) we focus on when adopting such conceptualisations and the aspects we lose sight of (e.g. conflict). The shift in conceptual perspectives away from the imaginaries of ladders towards the making of participation spaces refocuses attention on the role of structures in the practice and research fields, on processes of positioning and perception and on researchers' and practitioners' characteristics, goals and aspirations. This shift in perspective enables a look beyond the intentions of those setting up the process and facilitates a critical assessment of why participation plays out one way or another in TD practice in sustainability research.

While **module 1** approached participation based on discourses and conceptions and the assumptions inherent to them, **module 2** looked at the complex processes that constitute participation spaces in TD practice.

In the **second module (2a, b, c)**, the perspective on participation as a relational space was applied in order to study participation 'in the making'. The literature-based and empirical analyses unpacked participation in TD sustainability research and revealed diverse structural and actor-related elements involved in its making, including:

(in)coherencies with structures in the science and practice fields in which researchers and practitioners are embedded, the availability of financial and time resources, the timing of involvement, motivations and expectations, mutual trust, worldviews and values and power relations. Two of these elements - power relations and worldviews and values - which often tacitly accompanied the process, were scrutinised in greater detail. An analysis of five TD projects showed how funding bodies, researchers and practitioners exercised instrumental, structural, and discursive 'power over' the selecting and positioning of actors, the setting of the agenda and the setting of rules and procedures. This ensued - often in subtle ways - the exclusion of certain knowledges, values and paths of action. In bringing certain issues to the surface and obscuring others, participation spaces in TDR – just as other knowledge-configuring practices (Cashmore et al., 2019) - foreground selected characteristics of a problem and possible solution and in consequence render some actors and actions more relevant than others. Unpacking these processes and their situatedness furthermore demonstrated how partly incommensurable values and normative claims regarding sustainability shape knowledge production, and how the latter can provoke a 'closing down of possibilities' by perpetuating dominant discourses on society-nature relations and societal development. The power-sensitive perspective on participation and TDR that this thesis put forward helped de-mystifying assumptions about researchers' and practitioners' shared control and equal footing, as well as about societal relevance and the contribution to societal transformation inherent to TD conceptions. The observations made in this thesis suggest that when sustainability researchers neglect the rich lessons to be learned from (for example) several decades of participatory action research, they may find themselves poorly equipped to anticipate and address power asymmetries, dissent and disruptions in their projects.

Moreover, the analyses of power dynamics throughout different project phases demonstrated how 'power over' intersected with desired forms of 'power with' and 'power to'. These findings pointed to possible trade-offs between the epistemic and transformational goals of participation. It became clear that participation in sustainability-oriented knowledge production has a myriad of meanings and goals, and can be grounded in diverse values on how societal change should take place and the role science should play therein. Hence, the epistemic goals of participation in knowledge production processes frequently mingle and blend with democratic aspirations and transformational goals. In TD scholarship, these goal-sets are largely presented as congruent, naturally symbiotic and achievable using a single instrument (a TDR project). Whether this ambitious approach leads to losses in achieving both goals remains largely unquestioned. The diverse elements we identified as shaping participation showed the need for greater differentiation and clarification of whether we speak of participation primarily with regard to generating societal change or to achieving epistemic ends.

In this module, we proposed a multidimensional power lens as an **analytical tool**, including guiding questions on forms of 'power over', 'power to' and 'power with' in different phases of the TD process. The empirical questions developed here help rendering power dynamics visible and provide a first step towards stimulating forms of power - which are productive regarding the goals of participation - while minimising unproductive ones. Regarding worldviews and values, this thesis contends that the possibility of goal conflicts, dissent and incommensurable values in TDR must be acknowledged. In order to support such an acknowledgement, this thesis identified ideal-typical value positions on nature-society relations (e.g. anthropocentrism, essentialist ecocentrism, political ecology) and science-society relations (e.g. fact-value split, fact-value entanglement and a hybrid middle ground). These can guide researchers' and practitioners' reflection on their own and others' epistemological and ethical values and their implications for joint knowledge production on sustainability issues.

Therefore, the **second main conclusion** to be drawn from this thesis is that researcher-practitioner interactions in TD sustainability research are complex processes that are shaped by structures and actors with diverse epistemological and ethical values, and are situated in a context and might be perceived differently by different actors. In the constitution of these participation spaces, power dynamics and negotiations inevitably take place and often in hidden ways. It is thus critical to ensure that these are made explicit and room for dissent and debate is provided. If researchers and practitioners pursue transformational goals, reflexivity is vital in avoiding the reinforcement of existing power relations, knowledge hegemonies or dominant discourses. Consequently, within-project power dynamics and power gradients in the wider societal context which imbue participation spaces need to be put forward concomitantly. In short, participation processes in knowledge production contexts are inherently political.

While **module 2** emphasised how the structural and actor-related factors forge participation spaces, **module 3** looked at the relationship between context and participation spaces from the other side. It asked how participation spaces might affect and transform the wider context in which they are embedded.

In the **third module**, we linked participation processes in TD sustainability research and their potential societal effects. The qualitative analysis of seven projects in the WfNE context identified direct, indirect and interlinked participation-effect pathways and showed how feedback effects shape participation processes. Researchers' and practitioners' diverging perceptions of participation-effect pathways came with contrasting roles and responsibilities they ascribed to themselves and others. Researchers tended to conceive participation as input into the research process. In this pathway, participation appeared as a way of learning from practitioners in order to get more relevant project outputs implemented. For practitioners providing inputs for the research process was less important. Their narrations focused on direct and interlinked

pathways, such as empowerment or network building. This tendency was reflected in the quantitative findings in the SNSF context on the main incentives for collaborating. Researchers most frequently involved practitioners in order to improve the practical relevance of the project and to ensure the applicability of results. Practitioners' motivations included the desire to develop solutions to concrete problems, build capacities by generating new knowledge and expand their networks. Researchers' and practitioners' diverging reasons for participating, as well as the variety and interrelatedness of expected effect pathways have important implications for the design of impact-oriented TDR. Notably, which collaboration processes and strategies are likely to be effective hinges on the types of participation-effect pathways actors choose to pursue. Hence, a common understanding of targeted pathways and intended effects is critical for bundling efforts towards achieving them.

The systems approach for studying the (potential) impact of TD sustainability research applied in this thesis can serve as an **analytical tool** for researchers and practitioners. It can assist researchers and practitioners in making their own tacit assumptions and perceptions of participation-effect pathways transparent and negotiable, thus allowing for greater success in achieving them. Pathway models can be filled with factors from within the project (e.g. the features of the participation process identified, such as intensity of interaction or level of trust) and from outside (e.g. engrained structures, socio-political factors), which either impede or support the unfolding of societal effects.

Thus, the **third main conclusion** to be drawn from this thesis is that interlinkages between participation processes and societal effects of TD sustainability research are non-linear and complex. Expectations and perceptions of participation-effect pathways mirror researchers' and practitioners' theories of change and can relate to different segments of their identities. They are tied to the objectives and mission of their home organisation, their role in that organisation, or their political and societal commitments, and reflect both their epistemological and ethical values. Pathways to effects and the role of participation processes therein are thus irretrievably political; they imply negotiating what should be transformed and/or preserved, as well as who should be responsible and accountable for performing this stabilisation and/or transformation.

Overall, this thesis contributed to critical participation studies and emerging debates on the politics of participation by examining the intimate interlinkages between knowledge, power and values in TD sustainability research. The conclusions of the three modules stress the multidirectional interactions between participation processes in TD sustainability research and the respective social fields. It became clear that participation spaces are not formed in a societal vacuum, but rather are enmeshed with structures, dynamics and actor networks in diverse ways in both the practice and research fields.

In the following section, we will see what these insights mean for one specific set of structures and actors in the research field, namely funding structures and funding bodies, as well as science-policy makers.

7.2 Practical Implications for Science Policy

While the practical implications and relevance of this thesis' findings for researchers and practitioners were emphasised throughout the synthesis and discussion of the results, the broader implications for science policy and funding merit further attention. This section sheds light on how some of the general conclusions can inform science policy-makers and funding bodies. A number of observations addressed in this section warrant greater attention and additional research before full-fledged policy recommendations can be developed. This section therefore focuses on emerging tensions and questions to be raised with regard to (i) the coherence of programme goals and regulations, (ii) the implications of calling for impactful research and the inclusion/exclusion effects of project assessment criteria and (iii) finding a balance between quality standards, the plurality of approaches and the need for experimentation spaces.

Firstly, the power analysis conducted in this thesis showed how funding bodies exercise power over research agendas, actor positioning and the procedures of participation in TDR. Hence, the funding structure had an impact on the design and practical implementation of TDR projects. These findings suggest that, through their funding instruments, funding bodies can contribute to the creation of a larger environment in which favourable structures and norms for TDR can develop. A reflection on funders' structural and discursive power can be useful in assessing whether their programmes' goals are coherently reflected in the funding structures and whether these structures are conducive to the kinds of research processes the funding body intends to promote. The process factors highlighted in this thesis orientate such reflection. For instance, with regard to fruitful collaboration, the participation factor ranked highest by researchers and practitioners in the NRP survey was shared perception of the problem and agreement on the research question. This common understanding usually occurs early on in the research project when the problem is framed, the foundations of the project are laid and roles and responsibilities are distributed among participants. However, both researchers and practitioners stated that the intensity of their interaction was the lowest in this phase. It therefore remains to be further explored in which cases the involvement of practitioners in the design phase is necessary and, if so, how funding structures can incentivise such early involvement (for instance, through the provision of seed money). Furthermore, if the funding body aims to foster research guided by the ideals of TD, including shared ownership and responsibility, then the co-leadership of researchers and practitioners and the provision of financial means can partially countervail power asymmetries between researchers and practitioners in TD collaborations, depending on

the type of practitioners. For funding bodies that attempt to promote research with a high practical relevance then activities that stimulate frequent interactions between researchers and practitioners seem a promising option to explore. To increase the transformative potential of TDR, it seems it will be necessary to re-open discussions about highly normalised and standardised academic practices. Several of the participation factors identified in this thesis, such as the importance of developing trust and the time investment it demands, point to the need to reflect on the adequate temporalities for TD sustainability research expected to deliver societal impact. This might imply revisiting the usefulness of a 'projectification' (e.g. Felt, 2017) of such research and challenges the usual three to four-year project durations.

Funding bodies should ensure the internal coherence of their funding programmes and acknowledge the possibility of the incongruence of the epistemic goals of researchers, who are embedded in traditional scientific structures and career paths, and the transformational goals associated with an impact imperative. In setting up funding instruments, they should thus pay due diligence to the provision of support structures that allow for the containment of potential conflicts of goals (and interests), and counteract the observed 'responsibilisation' (Maasen and Lieven, 2006) of a few individuals (often project coordinators positioned at the research-practice interface in TD projects).

Secondly, this thesis' findings on the variety of participation-effect pathways make clear that demanding research projects to demonstrate impact is fundamentally political and involves value judgements on which developments, changes and hence impacts are desired. Funding bodies of impact-oriented programmes should be aware of the implications of these decisions. Looking at the broader political picture, it seems that funders who support sustainability-oriented research have to navigate a contested terrain, where mistrust of science and 'post-truth' claims meet calls for evidence-based policy-making. It is therefore seemingly all the more important to clearly specify what kinds of research problems require what kinds of research approaches and research-practice relations, in order to arrive at a meaningful combination of approaches (and knowledges) necessary for addressing sustainability issues.

In setting funding priorities and selecting projects, funding bodies assume a crucial role as 'value articulating institutions' (Vatn, 2005). Funding criteria and decisions regarding which yardstick to apply when assessing project proposals always convey messages of what is valued and rewarded in the research field. This necessitates a reflexive self-conception on the part of funders and consideration of how, for instance, the criteria they use to assess a project's potential to generate a sustainability-oriented impact has inclusion and exclusion effects itself. Depending on how the notion of impact is operationalised, there is a risk that applied and/or technology-oriented projects will be more eligible for (and worthy of) funding, while projects with less tangible outputs that,

for instance, provide critical reflections and the problematisation of societal developments, appear less effective. Such effects of marginalisation (of critical social science, for instance) are hotly debated in the United Kingdom with regard to the Research Excellence Framework (Chubb and Reed, 2018; Demeritt, 2010). Funders and scholars who call for impact and a transformative role of TDR in the field of sustainability should be aware of such facets of the wider impact debate in the scientific field so as to prevent a narrowing of the types of research that are considered 'relevant' and 'useful' in the sustainability context. Calling for 'societal relevance', furthermore, must imply pondering what different actors mean when they refer to different forms of relevance, including societal relevance, political relevance, practical relevance and even scientific relevance, and which tensions may arise when asking for multiple forms of relevance concurrently (Schikowitz, 2019).

Finally, the plethora of understandings, theoretical framings and real-world practices of TD and the many meanings attached to the notion of participation pose challenges for funding bodies. It positions them in a field of tensions, between embracing the plurality of approaches and the need to adapt to the specific context (beyond blueprints) on one hand, and the need to arrive at quality standards and the consolidation of such approaches on the other, to ensure that public money is spent in a meaningful way. Funding bodies and academic institutions more generally must therefore reflect on the 'right' degree of flexibility and adaptability of assessment and evaluation schemes. The findings on feedback effects presented in this thesis illustrated that effects of TD sustainability research can emerge in unintended and serendipitous ways, which means that funding structures must provide flexibility for experimentation spaces to develop.

7.3 Limitations of Completed Research and Avenues for Future Research

The combination of qualitative and quantitative methods with social theories proved effective for answering the overall research questions. The meta-level chosen notably was required in a field in which single case-study based self-reflections are the most common source of empirical knowledge about TD processes in practice. Yet, this approach also left some blind spots.

The three major limitations of the research conducted relate to (i) limited consideration of actor specificities and dynamics, (ii) limited consideration of the specific system contexts in which participation in the selected projects was embedded and (iii) the limited empirical validation of some of the aspects explored theoretically. This section addresses these limitations and opportunities for future research. The main conclusions of this thesis point to several dimensions that warrant greater attention in order to

further enhance our understanding of participation processes in TD sustainability research and their contribution to societal transformations.

The **first limitation** relates to the meta-level perspective applied in the research. While the meta-level perspective on researcher-practitioner interactions in TD sustainability research projects produced valuable insights into the variety of elements that shape them, its analytical scope remains partial. In both of the qualitative empirical articles based on the WfNE projects, the analysis and aggregation of findings were done in a way that made it possible to map the many perceptions in the five and seven projects respectively, while ensuring the anonymity not only of the interviewees, but also of the projects. This compromised the extent to which the specificities of actors and their institutions could be considered in the analysis of participation processes and their societal effects. Accordingly, in both the quantitative and qualitative analyses, actors were distinguished in two categories: researchers and practitioners. Hence, the heterogeneity within these two groups was considered only to a limited degree. More fundamentally, the limitations inherent to the very terminology used here and in numerous publications in the TD research community needs to be acknowledged. The terminology of researcher-practitioner and the associated categorisation of actors runs the risk of reproducing a seemingly clear-cut separation of values and expertise as well as of reinforcing a partitioning and dichotomisation of actors that does not do justice to the multiple segments of actors' identities, the various shades of their existences and their multifaceted societal roles which they bring into participation spaces. A more nuanced look at actors within and across the broad categories of researchers and practitioners is needed. Within the group of researchers, for instance, the role of intermediaries and coordinators who act as go-betweens for research and practice fields merits attention. Exploring their roles seems also promising with regard to participation-effect pathways and research's potential to generate the intended societal effects. The methodological repertoire used and my own positionality in an accompanying research project to the funding programme also circumscribed the extent to which actor dynamics in everyday research practices were considered. Although data collection took place at different times during the ongoing WfNE projects, only snapshots of continuously evolving projects could be taken. Hence, actor dynamics were primarily accessed based on interviewees' perceptions and narrations. The additional analyses - including completed projects in the expert workshop and nearly completed projects in the quantitative survey - partly accounted for this limitation. Some of the tacit dynamics related to power and the negotiation of values, however, will require further empirical research based on a diverse methodological repertoire, including extended participatory observations and an assessment of project outputs with regard to whose knowledge and values are captured in them.

The **second limitation** related to the meta-level perceptive described above, concerns the extent to which differences in both system and funding contexts, as well as in

democratic and participation cultures, could be considered in the analysis of participation processes and their effects. The meta-level perspective and level of aggregation chosen to display qualitative findings across projects limited the extent to which each project's system and organisational contexts were considered. This was not at last due to the funding programme's topical openness to any sustainability-related problem and the resulting variety of topics addressed by the projects included in this thesis. Another related limitation regarding the situatedness of TDR requires acknowledgement. As part of an accompanying research project, the main empirical site studied in this thesis focused on one specific funding programme and the projects supported through it. In order to account for the influence of institutional settings and the funding context, the analysis was expanded to projects from the Swiss funding contexts. Yet, the perspectives provided and captured in this thesis remain partial and Eurocentric. This limitation, which is representative of a general trend in TD literature, points to the importance of "decolonising TD" (Chilisa, 2017), and of including the perspectives and experiences of actors from the Global North and South. Comparative analyses into the ways in which different contexts affect participation spaces are needed to explore the influence of socio-political conditions and/or the democratic and participation culture on the evolution of participation in knowledge production processes. With regard to one of the central themes explored in this this thesis – power – such greater attention to contexts could allow to grasp how power gradients in the wider cultural, political and institutional environments of a TD project encompass the *lifeworld* of the particular implicated researchers and practitioners and of their participatory practices. This could provide vital indication of the unintentional ways in which participation spaces may reproduce macro-societal power structures and hegemonies, for instance when wider political-institutional pressures for justification are pushing all those within the TD research process to undertake a performance of producing integrated findings (Klenk and Meehan, 2015) and of manufacturing (artificial) consensus (Turnhout et al., 2020). Moreover, greater knowledge of contextual factors (e.g. socio-political factors, power relations) is essential for capturing the potential of participation spaces in shaping context, e.g. to contribute to desired developments in the respective practice field.

A **third constraint** has to do with the limited empirical application and validation of some of the aspects this thesis explored at a conceptual and theoretical level. With regard to the role of worldviews and values in TD sustainability research, theoretical readings were provided and supported with existing scholarship. However, they lack empirical application in the context of participation in TD sustainability research and require further validation. Further empirical insight is, moreover, needed to substantiate the categories of 'success', 'relevance' and 'usefulness' in TDR that were mobilised in the quantitative study conducted in this thesis and translated into survey items in a simplistic manner. The inexorable ambiguity of meanings associated with these categories merit greater attention, not least because of their importance in research

evaluation and funding policies. Also the analytical tools and guiding questions on power and the constitution of participation spaces are not definitive, but rather are meant to serve as living documents that can constantly be adapted and refined as their empirical basis evolves and participation dynamics are better understood. They are intended to provide a framework for analysis and reflection. While their theoretical scope can certainly include projects in various sectors and researchers and practitioners from different disciplines and backgrounds, not all questions (and the elements they refer to) are equally relevant in every project context.

To conclude, this thesis paved the way for three main avenues for future research:

Firstly, further empirical enquiries into processes constituting participation spaces and the role of power dynamics and negotiations of values within them are needed. This includes the question of how to deal with dissent and value incommensurability in participation spaces. In so doing, more attention should be paid to nuancing the view on the diversity of the actors within the heterogeneous groups of researchers and practitioners, as well as the role of context. In this regard, it would be interesting to look at how such dynamics differ when researcher-practitioner interactions are not situated in a genuinely scientific context (e.g. a research project, with scientific PIs, research funding), in which academic interests have priority and researchers 'naturally' take the lead.

Secondly, greater efforts need to be made in order to grasp the societal effects of TD sustainability research and to better understand how they link to the features of participation processes highlighted in this thesis. Building on the diverse perceptions of both processes and their pathways to effects revealed in this thesis, future research should inquire into how varying perceptions of participation-effect pathways relate to the epistemological and ethical values of the actors involved in TD sustainability research. Moreover, the co-production of knowledge and societal order explored here suggests that future work on impact should enquire into the unintended effects of TD sustainability research that might perpetuate unsustainable societal structures and practices. The results of this thesis on diverging perceptions of researchers and practitioners regarding both the processes and their links to effects reveal the necessity to more systematically include practitioners' standpoints in future analyses of TD sustainability research.

Thirdly, the science policy and funding programme levels warrant greater attention. The importance of structures in the making of participation spaces indicates the need for further investigation of how funding programmes and instruments should be designed to ensure effective, high-quality TD sustainability research. In this vein, the extent to which funding instruments are able to 'kill two birds with one stone' (e.g. scientific excellence and cutting edge research often defined in terms of disciplinary excellence

and problem-solving of concrete often local sustainability issues) should be systematically scrutinised. The design of coherent funding structures also requires a critical analysis of pertinent quality criteria for TDR that can guide the selection of projects for funding. Arriving at such quality criteria necessitates greater knowledge of how to strike a balance between acknowledging a plurality of participatory and TD approaches and (commonly agreed) quality standards. This should be accompanied by an assessment of the political dimension of research funding and priority-setting, a deliberation of which kinds of science-society relations are envisaged and a critical assessment of potentially undesirable side-effects of an impact imperative in academia.

In exploring these avenues, future research can build on the conceptual and empirical insights gained in this thesis. This work drew attention to how novel ways of conceptualising, knowing and observing participation in sustainability-oriented knowledge production can be harnessed productively to tackle some of the hidden dynamics and ongoing challenges of participation at the science-society interface. Through the combined findings on the making of participation spaces, the value negotiations and power relations that form them, the multiple purposes for which they are mobilised and their role in transformation processes, I hope to incite other researchers to further enquire into the complex entanglements of knowledge, power and values at the science-society interface. The theoretically and empirically-grounded analytical perspectives and guiding questions designed here can assist in doing so. They allow us to further unravel how structures, power relations, worldviews and values shape participation spaces and their pathways to societal effects. The need for further refinement notwithstanding, the perspective on participation as a relational space and the tools for analysing power, values and participation-effect pathways developed here provide a stepping stone for better understanding how spaces of participation in sustainability research can become much needed spaces of transformation and change.

***

8 References

Abels, G., 2006. Forms and functions of participatory technology assessment–Or: Why should we be more sceptical about public participation? Presented at the Participatory Approaches in Science & Technology Conference 4th–7th June, Edinburgh, Scotland.

Akrich, M., 1992. The description of technical objects. In Shaping technology/building society, studies in socio technical change, edited by W.E. Bijker and J. Law, 205-224. Cambridge, MA: MIT Press.

Allen, A., 1998. Rethinking power. Hypatia 13, 21–40. https://doi.org/10.1111/j.1527-2001.1998.tb01350.x

Aniekwe, C.C., Hayman, R., Toner, A., 2012. Academic-NGO collaboration in international development research: A reflection on the issues. Working Paper Development Studies Association. https://doi.org/dx.doi.org/10.2139/ssrn.2995689

Arnstein, S.R., 1969. A ladder of citizen participation. Journal of the American Institute of planners 35, 216–224.

Avelino, F., Grin, J., Pel, B., Jhagroe, S., 2016. The politics of sustainability transitions. Journal of Environmental Policy & Planning 18, 557–567. https://doi.org/10.1080/1523908X.2016.1216782

Bäckstrand, K., 2003. Civic science for sustainability: reframing the role of experts, policy-makers and citizens in environmental governance. Global Environmental Politics 3, 24–41. https://doi.org/10.1162/152638003322757916

Baert, P., Weinberg, D., Mottier, V., 2011. Social constructionism, postmodernism and deconstructionism. The SAGE Handbook of the Philosophy of Social Sciences, SAGE, Los Angeles, CA 475–486.

Balthasar, A., Roose, Z., 2018. Befragung der Forschenden und Praxispartner/-innen des Nationalen Forschungsprogramms 71 «Steuerung des Energieverbrauchs» zum Nutzen ihrer Zusammenarbeit.

Balthasar, A., Roose, Z., Binder, C.R., Fritz, L., 2018. Datensatz der Befragung der Forschenden und Praxispartner/-innen des Nationalen Forschungsprogramm 71 «Steuerung des Energieverbrauchs » zum Nutzen ihrer Zusammenarbeit. Luzern, Lausanne.

Belcher, B., Claus, R., Davel, R., 2019. Theory of change | Methods and tools for co-producing knowledge [WWW Document]. URL https://naturalsciences.ch/topics/co-producing_knowledge/methods/td-net_toolbox/theory_of_change (accessed 7.11.19).

Belcher, B., Palenberg, M., 2018. Outcomes and Impacts of Development Interventions: Toward Conceptual Clarity. American Journal of Evaluation 39, 478–495. https://doi.org/10.1177/1098214018765698

Bell, S., Morse, S., Shah, R.A., 2012. Understanding stakeholder participation in research as part of sustainable development. Journal of environmental management 101, 13–22. https://doi.org/10.1016/j.jenvman.2012.02.004

Benner, M., Sandström, U., 2000. Institutionalizing the triple helix: research funding and norms in the academic system. Research Policy 29, 291–301. https://doi.org/10.1016/S0048-7333(99)00067-0

Berger, P.L., Luckmann, T., 2005. Die gesellschaftliche Konstruktion der Wirklichkeit, Fischer. ed. Berlin.

Bergmann, M., Brohmann, B., Hoffmann, E., Loibl, M.C., Rehaag, R., Schramm, E., Voß, J.-P., 2005. Qualitätskriterien transdisziplinärer Forschung (No. 13), ISOE Studientexte.

Bergmann, M., Jahn, T., Knobloch, T., Krohn, W., Pohl, C., Schramm, E., Faust, R.C., 2012. Methoden transdisziplinärer Forschung. Campus Verlag.

Binder, C.R., Absenger-Helmli, I., Schilling, T., 2015. The reality of transdisciplinarity: a framework-based self-reflection from science and practice leaders. Sustainability Science 10, 545–562. https://doi.org/10.1007/s11625-015-0328-2

Binder, C.R., Fritz, L., Balthasar, A., Hansmann, R., Roose, Z., submitted. Increasing the relevance of science for practice and practice for science: quantitative empirical insights. Science and Public Policy.

Binder, C.R., Hutter, M., Pang, M., Webb, R., 2020. Systems Science and Sustainability Assessment, in: Sustainability Assessment of Urban Systems. Binder, C.R., Massaro, E., Wyss, R. Cambridge University Press, Cambridge, pp. 30–64.

Bister, M., Felt, U., Strassnig, M., Wagner, U., 2008. Zeit und Partizipation im transdisziplinären Forschungsprozes, in: Transdisziplinäre Praxis. Forschen Im Sozial-Und Gesundhetiswesen. Reitinger, Elisabeth, Heidelberg, pp. 35–45.

Blackstock, K.L., Kelly, G.J., Horsey, B.L., 2007. Developing and applying a framework to evaluate participatory research for sustainability. Ecological Economics 60, 726–742.

Blumer, H., 1954. What is wrong with social theory? American sociological review 19, 3–10.

Blythe, J., Silver, J., Evans, L., Armitage, D., Bennett, N.J., Moore, M.-L., Morrison, T.H., Brown, K., 2018. The dark side of transformation: Latent risks in contemporary sustainability discourse. Antipode 50, 1206–1223.

Boeckmann, T., Dorsch, P., Hoffmann, F., Ohlhorst, D., Schumacher, U., Wulff, J., 2005. Zwischen Theorie und Praxis. Anregungen zur Gestaltung von Wissenschafts-Praxis-Kooperationen in der Nachhaltigkeitsforschung. Discussion paper, Zentrum für Technik und Gesellschaft 17.

Bourdieu, P., 2012. Sur l'État. Cours au Collège de France (1989-1992), Editions raisons d'agir. ed. Seuil.

Bourdieu, P., 1998. Vom Gebrauch der Wissenschaft. Für eine klinische Soziologie des wissenschaftlichen Feldes., UVK Verlag. ed. Konstanz.

Bourdieu, P., 1988. Homo academicus. Stanford University Press.

Bourdieu, P., Wacquant, L.J., 1992. An invitation to reflexive sociology. University of Chicago Press.

Bracken, L.J., Bulkeley, H.A., Whitman, G., 2015. Transdisciplinary research: understanding the stakeholder perspective. Journal of Environmental Planning and Management 58, 1291–1308. https://doi.org/10.1080/09640568.2014.921596

Brand, U., 2016. "Transformation" as a New Critical Orthodoxy: The Strategic Use of the Term "Transformation" Does Not Prevent Multiple Crises. GAIA-Ecological Perspectives for Science and Society 25, 23–27.

Brandt, P., Ernst, A., Gralla, F., Luederitz, C., Lang, D.J., Newig, J., Reinert, F., Abson, D.J., von Wehrden, H., 2013. A review of transdisciplinary research in sustainability science. Ecological Economics 92, 1–15.

Bréthaut, C., Gallagher, L., Dalton, J., Allouche, J., 2019. Power dynamics and integration in the water-energy-food nexus: Learning lessons for transdisciplinary research in Cambodia. Environmental Science & Policy 94, 153–162. https://doi.org/10.1016/j.envsci.2019.01.010

Brinkmann, C., Bergmann, M., Rödder, S., Schuck-Zöller, S., 2015. Zur Integration von Wissenschaft und Praxis als Forschungsmodus– ein Literaturüberblick. Climate Service Center Germany, Hamburg Report 23.

Brooks, H., Johnson, R.B., 1991. Comments: Public policy issues., in: The Genetic Revolution: Scientific Prospects and Public Perceptions. B. Davies, Johns Hopkins University Press, Baltimore, MD.

Burgess, J., Chilvers, J., 2006. Upping the ante: a conceptual framework for designing and evaluating participatory technology assessments. Science and Public Policy 33, 713–728.

Buxton, M., 2011. The payback of 'Payback': challenges in assessing research impact. Research Evaluation 20, 259–260.

Callard, F., Fitzgerald, D., 2015. Rethinking interdisciplinarity across the social sciences and neurosciences. Springer.

Callon, M., 1984. Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay. The sociological review 32, 196–233.

Campbell, J.L., Quincy, C., Osserman, J., Pedersen, O.K., 2013. Coding in-depth semistructured interviews: Problems of unitization and intercoder reliability and agreement. Sociological Methods & Research 42, 294–320.

Carew, A.L., Wickson, F., 2010. The TD Wheel: A heuristic to shape, support and evaluate transdisciplinary research. Futures 42, 1146–1155. https://doi.org/10.1016/j.futures.2010.04.025

Cashmore, M.A., Iuel-Stissing, J., Sp, P., 2019. Introduction: the knowledge politics of urban sustainability transitions, in: Politics of Urban Sustainability Transitions. Routledge, Abingdon.

Charmaz, K., 2006. Gathering rich data, in: Constructing Grounded Theory: A Practical Guide through Qualitative Analysis. SAGE, London, pp. 13–41.

Chilisa, B., 2017. Decolonising transdisciplinary research approaches: an African perspective for enhancing knowledge integration in sustainability science. Sustain Sci 1–15. https://doi.org/10.1007/s11625-017-0461-1

Chilvers, J., Kearnes, M., 2015. Remaking Participation: Science, Environment and Emergent Publics. Routledge, London and New York.

Chilvers, J., Longhurst, N., 2016. Participation in transition(s): reconceiving public engagements in energy transitions as co-produced, emergent and diverse. Journal of Environmental Policy & Planning 1–23. https://doi.org/10.1080/1523908X.2015.1110483

Chilvers, J., Pallett, H., Hargreaves, T., 2018. Ecologies of participation in socio-technical change: The case of energy system transitions. Energy Research & Social Science 42, 199–210. https://doi.org/10.1016/j.erss.2018.03.020

Christens, B., Speer, P.W., 2006. Review essay: tyranny/transformation: power and paradox in participatory development. Forum: Qualitative Social Research 7.

Chubb, J., Reed, M.S., 2018. The politics of research impact: academic perceptions of the implications for research funding, motivation and quality. British Politics 1–17.

Churchman, C.W., 1979. The systems approach and its enemies, Basic Books. ed. New York.

Clarke, A., 2005. Situational analysis: Grounded theory after the postmodern turn. Sage, Thousand Oaks, a.o.

Collins, H.M., Evans, R., 2002. The third wave of science studies: Studies of expertise and experience. Social studies of science 32, 235–296. https://doi.org/10.1177/0306312702032002003

Collins, K., Ison, R., 2006. Dare we jump off Arnstein's ladder? Social learning as a new policy paradigm, in: Proceedings of PATH (Participatory Approach in Science and Technology). Edinburgh.

Cooke, B., Kothari, U., 2001. Participation: The new tyranny? Zed Books, London.

Cornell, S., Berkhout, F., Tuinstra, W., Tàbara, J.D., Jäger, J., Chabay, I., de Wit, B., Langlais, R., Mills, D., Moll, P., 2013. Opening up knowledge systems for better responses to global environmental change. Environmental Science & Policy 28, 60–70. https://doi.org//10.1016/j.envsci.2012.11.008

Cornwall, A., 2004. Spaces for transformation? Reflections on issues of power and difference in participation in development, in: Participation: From Tyranny to Transformation. Hickey, Samuel; Mohan, Giles, London and New York, pp. 75–91.

Cornwall, A., 2002. Making spaces, changing places: situating participation in development. IDS Working Papers 170.

Cornwall, A., Coelho, V.S., 2007. Spaces for change? The politics of citizen participation in new democratic arenas. Zed Books, London.

Crotty, M., 1998. The foundations of social research: Meaning and perspective in the research process. Sage, London a.o.

Currie, M., King, G., Rosenbaum, P., Law, M., Kertoy, M., Specht, J., 2005. A model of impacts of research partnerships in health and social services. Evaluation and Program Planning 28, 400–412.

Cvitanovic, C., Hobday, A., van Kerkhoff, L., Wilson, S., Dobbs, K., Marshall, N., 2015. Improving knowledge exchange among scientists and decision-makers to facilitate the adaptive governance of marine resources: A review of knowledge and research needs. Ocean & Coastal Management 112, 25–35. https://doi.org//10.1016/j.ocecoaman.2015.05.002

Darby, S., 2017. Making space for co-produced research 'impact': learning from a participatory action research case study. Area 49, 230–237.

Davydova, I., Sharrock, W., 2003. The rise and fall of the fact/value distinction. The Sociological Review 51, 357–375.

de Jong, S.P., Wardenaar, T., Horlings, E., 2016. Exploring the promises of transdisciplinary research: A quantitative study of two climate research programmes. Research Policy 45, 1397–1409. https://doi.org/10.1016/j.respol.2016.04.008

Defila, Di Giulio, A., 2018. Eine Reflexion über Legitimation, Partizipation und Intervention im Kontext transdisziplinärer Forschung, in: Interventionsforschung Als Vermittlung Zwischen Wissenschaft Und Praxis. Einblicke in Methodologische Fragen Transdisziplinärer Forschung, Interventionsforschung. Springer, Wiesbaden, pp. 85–108.

Defila, R., Di Giulio, A., 2018. What Is It Good For? Reflecting and Systematizing Accompanying Research to Research Programs. GAIA - Ecological Perspectives for Science and Society 27, 97–104. https://doi.org/10.14512/gaia.27.S1.17

Defila, R., Di Giulio, A., 2015. Integrating knowledge: Challenges raised by the "Inventory of Synthesis." Futures 65, 123–135.

Defila, R., Di Giulio, A., 1998. Interdisziplinarität und Disziplinarität, in: Zwischen Den Fächern—Über Den Dingen? Springer, pp. 111–137.

Defila, R., Di Giulio, A., Scheuermann, M., 2006. Forschungsverbundmanagement: Handbuch für die Gestaltung inter-und transdisziplinärer Projekte. vdf Hochschulverlag AG.

Demeritt, D., 2010. Harnessing science and securing societal impacts from publicly funded research: reflections on UK science policy. Environment and Planning A 42, 515–523.

Denzin, N.K., Lincoln, Y.S., 2011. The Sage handbook of qualitative research. Sage, Los Angeles a.o.

Di Giulio, A., Defila, R., Brückmann, T., 2016. "Das ist halt das eine ... Praxis, das andere ist Theorie"-Prinzipien transdisziplinärer Zusammenarbeit im Forschungsalltag, in: Defila, R., Di Giulio, A. (Eds.), Transdisziplinär Forschen-Zwischen Ideal Und Gelebter Praxis: Hotspots, Geschichten, Wirkungen. Campus Verlag.

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R.T., Molnár, Z., Hill, R., Chan, K.M., Baste, I.A., Brauman, K.A., 2018. Assessing nature's contributions to people. Science 359, 270–272. https://doi.org/10.1126/science.aap8826

Dikeç, M., 2005. Space, politics, and the political. Environment and Planning D: Society and Space 23, 171–188.

Douthwaite, B., Kuby, T., van de Fliert, E., Schulz, S., 2003. Impact pathway evaluation: an approach for achieving and attributing impact in complex systems. Agricultural systems 78, 243–265.

Dryzek, 2000. Deliberative democracy and beyond: Liberals, critics, contestations. Oxford University Press, Oxford.

Earl, S., Carden, F., Smutylo, T., 2001. Outcome mapping: Building learning and reflection into development programs. IDRC, Ottawa, ON, CA.

Elzinga, A., 2008. Participation, in: Handbook of Transdisciplinary Research. Springer, pp. 345–359.

Enengel, B., Muhar, A., Penker, M., Freyer, B., Drlik, S., Ritter, F., 2012. Co-production of knowledge in transdisciplinary doctoral theses on landscape development—an analysis of actor roles and knowledge types in different research phases. Landscape and Urban Planning 105, 106–117.

England, K.V., 1994. Getting personal: Reflexivity, positionality, and feminist research. The professional geographer 46, 80–89. https://doi.org/10.1111/j.0033-0124.1994.00080.x

European Commission, 2019. Horizon 2020 - Work Programme 2018-2020. Science with and for Society. Decision C(2019)1849 of 18 March 2019. http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-swfs_en.pdf

European Commission, 2015. Horizon 2020. Work Programme 2016-2017. 16. Science with and for Society. C(2017)2468 of 24 April 2017.

Evans, R., 2016. Achieving and evidencing research 'impact'? Tensions and dilemmas from an ethic of care perspective. Area 48, 213–221. https://doi.org/10.1111/area.12256

Fam, D., Palmer, J., Riedy, C., Mitchell, C., 2016. Transdisciplinary research and practice for sustainability outcomes. Routledge, New York.

Felt, U., 2017. Under the shadow of time: where indicators and academic values meet. Engaging Science, Technology, and Society 3, 53–63.

Felt, U., Igelsböck, J., Schikowitz, A., Völker, T., 2016. Transdisciplinary Sustainability Research in Practice: Between Imaginaries of Collective Experimentation and

Entrenched Academic Value Orders. Science, Technology, & Human Values 1, 732–761. https://doi.org/10.1177/0162243915626989

Felt, U., Igelsböck, J., Schikowitz, A., Völker, T., 2013. Growing into what? The (un-) disciplined socialisation of early stage researchers in transdisciplinary research. Higher education 65, 511–524. https://doi.org/10.1007/s10734-012-9560-1

Felt, U., Igelsböck, J., Schikowitz, A., Völker, T., 2012. Challenging participation in sustainability research. The Journal of Deliberative Mechanisms in Science 1, 4–34. https://doi.org/10.4471/demesci.2012.01

Fleck, L., 1980. Entstehung und Entwicklung einer wissenschaftlichen Tatsache. Einführung in die Lehre vom Denkstil und Denkkollektiv. Suhrkamp, Frankfurt a. M. Erstveröffentlichung 1935.

Flick, U., 2018. Doing triangulation and mixed methods. Sage.

Frame, B., Brown, J., 2008. Developing post-normal technologies for sustainability. Ecological Economics 65, 225–241.

Fritz, L., Binder, C.R., 2018. Participation as Relational Space: A Critical Approach to Analysing Participation in Sustainability Research. Sustainability 10, 2853. https://doi.org/10.3390/su10082853

Fritz, L., Schilling, T., Binder, C.R., 2019. Participation-effect pathways in transdisciplinary sustainability research: An empirical analysis of researchers' and practitioners' perceptions using a systems approach. Environmental Science & Policy 102, 65–77. https://doi.org/10.1016/j.envsci.2019.08.010

Fuchs, D., Glaab, K., 2011. Material power and normative conflict in global and local agrifood governance: The lessons of 'Golden Rice'in India. Food Policy 36, 729–735. https://doi.org/ttps://doi.org/10.1016/j.foodpol.2011.07.013

Funtowicz, S.O., Ravetz, J.R., 1993. The emergence of post-normal science, in: Science, Politics and Morality. Springer, pp. 85–123.

Future Earth, 2019. Initiatives [WWW Document]. FutureEarth. URL https://futureearth.org/initiatives/ (accessed 10.6.19).

Garmendia, E., Stagl, S., 2010. Public participation for sustainability and social learning: Concepts and lessons from three case studies in Europe. Ecological economics 69, 1712–1722. https://doi.org/10.1016/j.ecolecon.2010.03.027

Geels, F.W., Schot, J., 2007. Typology of sociotechnical transition pathways. Research policy 36, 399–417.

German Federal Government, 2019. Energiewende im Überblick [WWW Document]. URL https://www.bundesregierung.de/breg-de/themen/energiewende/energiewende-im-ueberblick-229564 (accessed 11.6.19).

Gieryn, T.F., 1983. Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists. American Sociological Review 48, 781–795. https://doi.org/10.2307/2095325

Glaser, B.G., Strauss, A.L., 1967. The discovery of grounded theory: Strategies for qualitative research. Chicago: Aldine.

Goldstein, B.D., Renn, O., Jovanovic, A.S., 2016. Public Health, Risk Perception, and Risk Communication: Unconventional Shale Gas in the United States and the European Union, in: Rose, T. (Ed.), Environmental and Health Issues in Unconventional Oil and Gas Development. Elsevier, pp. 107–127.

Gross, M., Hoffmann-Riem, H., 2005. Ecological restoration as a real-world experiment: designing robust implementation strategies in an urban environment. Public Understanding of Science 14, 269–284. https://doi.org/10.1177/0963662505050791

Grunwald, A., 2015. Transformative Wissenschaft-eine neue Ordnung im Wissenschaftsbetrieb? GAIA-Ecological Perspectives for Science and Society 24, 17–20.

Grunwald, A., 2004. Strategic knowledge for sustainable development: the need for reflexivity and learning at the interface between science and society. International Journal of Foresight and Innovation Policy 1, 150. https://doi.org/10.1504/IJFIP.2004.004619

Gubrium, J.F., Holstein, J.A., 1998. Narrative practice and the coherence of personal stories. The sociological quarterly 39, 163–187. https://doi.org/10.1111/j.1533-8525.1998.tb02354.x

Gunasekara, C., 2007. Pivoting the centre: reflections on undertaking qualitative interviewing in academia. Qualitative Research 7, 461–475. https://doi.org/10.1177/1468794107082302

Guston, D.H., 1999. Stabilizing the boundary between US politics and science: The role of the Office of Technology Transfer as a boundary organization. Social studies of science 29, 87–111.

Habermas, Jürgen, H., 1981. Theorie des kommunikativen Handelns. Frankfurt, Suhrkamp.

Hansen, J., 2010. Biotechnology and public engagement in Europe. Palgrave Macmillan, Houndmills, Basingstoke.

Hansson, S., Polk, M., 2018. Assessing the impact of transdisciplinary research: The usefulness of relevance, credibility, and legitimacy for understanding the link between process and impact. Research Evaluation 27, 132–144. https://doi.org/10.1093/reseval/rvy004

Haraway, D., 1988. Situated knowledges: The science question in feminism and the privilege of partial perspective. Feminist studies 14, 575–599. https://doi.org/10.2307/3178066

Harding, S., 2008. Sciences from below: Feminisms, postcolonialities, and modernities. Duke University Press.

Healy, H., 2019. A political ecology of transdisciplinary research. Journal of Political Ecology 26, 500–528.

Healy, H., Martinez-Alier, J., Kallis, G., 2015. From ecological modernization to socially sustainable economic degrowth: lessons from ecological economics, in: The International Handbook of Political Ecology. Edward Elgar Publishing.

Hegger, D., Lamers, M., Van Zeijl-Rozema, A., Dieperink, C., 2012. Conceptualising joint knowledge production in regional climate change adaptation projects: success conditions and levers for action. Environmental science & policy 18, 52–65. https://doi.org/10.1016/j.envsci.2012.01.002

Hegger, D., Van Zeijl-Rozema, A., Dieperink, C., 2014. Toward design principles for joint knowledge production projects: lessons from the deepest polder of The Netherlands. Regional environmental change 14, 1049–1062. https://doi.org/10.1007/s10113-012-0382-6

Hellström, T., 2015. Formative evaluation at a transdisciplinary research center, in: Co-Producing Knowledge for Sustainable Cities. Routledge, London and New York, pp. 162–181.

Hickey, S., Mohan, G., 2004. Towards participation as transformation: critical themes and challenges, in: Participation: From Tyranny to Transformation. Hickey, Samuel; Mohan, Giles, London and New York, pp. 3–24.

Hirsch Hadorn, G., Hoffmann-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., Wiesmann, U., Zemp, E., 2008. Handbook of transdisciplinary research. Springer, Dordrecht.

Hoffmann, S., Pohl, C., Hering, J., 2017a. Methods and procedures of transdisciplinary knowledge integration: empirical insights from four thematic synthesis processes. Ecology and Society 22. https://doi.org/doi.org/10.5751/ES-08955-220127

Hoffmann, S., Pohl, C., Hering, J.G., 2017b. Exploring transdisciplinary integration within a large research program: Empirical lessons from four thematic synthesis processes. Research Policy 46, 678–692. https://doi.org/10.1016/j.respol.2017.01.004

Holmes, T., Scoones, I., 2000. Participatory environmental policy processes: experiences from North and South. Institute of Development Studies, IDS Working Papers.

Hoppe, R., 1999. Policy analysis, science and politics: from 'speaking truth to power'to 'making sense together.' Science and public policy 26, 201–210.

International Council for Science, 2017. A guide to SDG interactions: from science to implementation. International Council for Science (ICSU). https://doi.org/10.24948/2017.01

International Science Council, 2019. Science as a global public good: ISC Action Plan, 2019-2021. International Science Council. https://doi.org/10.24948/2019.09

Irwin, A., 2006. The politics of talk: coming to terms with the 'new' scientific governance. Social studies of science 36, 299–320. https://doi.org/10.1177/0306312706053350

Jacob, M., 2009. On commodification and the governance of academic research. Minerva 47, 391–405.

Jahn, T., 2008. Transdisciplinarity in the practice of research. Transdisziplinäre Forschung: Integrative Forschungsprozesse verstehen und bewerten. Campus Verlag, Frankfurt/Main, Germany 21–37.

Jahn, T., Bergmann, M., Keil, F., 2012. Transdisciplinarity: Between mainstreaming and marginalization. Ecological Economics 79, 1–10. https://doi.org/10.1016/j.ecolecon.2012.04.017

Jasanoff, S., 2004. States of knowledge: the co-production of science and the social order. Routledge, London and New York.

Jasanoff, S., 2003. Technologies of humility: citizen participation in governing science. Minerva 41, 223–244. https://doi.org/10.1023/A:1025557512320

Jasanoff, S., Kim, S.-H., 2009. Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea. Minerva 47, 119–146.

Jonassen, D.H., Hung, W., 2008. All problems are not equal: Implications for pbl (problem-based learning). Interdisciplinary Journal of Problem-Based Learning 2, 6–28. http://dx.doi.org/10.7771/1541-5015.1080

Joss, S., 2002. Toward the public sphere—Reflections on the development of participatory technology assessment. Bulletin of Science, Technology & Society 22, 220–231.

Kaiser, M., 2015. Ethics of science and a new social contract for knowledge, in: Ethics of Science in the Research for Sustainable Development. Nomos Verlagsgesellschaft mbH & Co. KG, Baden-Baden, pp. 153–178.

Kates, R.W., 2011. What kind of a science is sustainability science? Proceedings of the National Academy of Sciences 108, 19449–19450. https://doi.org/10.1073/pnas.1116097108

Kates, R.W., Parris, T.M., Leiserowitz, A.A., 2005. What is sustainable development? Goals, indicators, values, and practice. Environment: science and policy for sustainable development 47, 8–21. https://doi.org/10.1080/00139157.2005.10524444

Kemp, R., Martens, P., 2007. Sustainable development: how to manage something that is subjective and never can be achieved? Sustainability: science, practice and policy 3, 5–14. https://doi.org/10.1080/15487733.2007.11907997

Kerssens-van Drongelen, I., 2001. The iterative theory-building process: rationale, principles and evaluation. Management Decision 39, 503–512.

Kläy, A., Zimmermann, A.B., Schneider, F., 2014. Rethinking science for sustainable development: Reflexive interaction for a paradigm transformation. Futures 65, 72–85. https://doi.org/10.1016/j.futures.2014.10.012

Klein, J.T., Grossenbacher-Mansuy, W., Häberli, R., Bill, A., Scholz, R.W., Welti, M., 2012. Transdisciplinarity: joint problem solving among science, technology, and society: an effective way for managing complexity. Birkhäuser.

Klenk, N., Meehan, K., 2015. Climate change and transdisciplinary science: Problematizing the integration imperative. Environmental Science & Policy 54, 160–167. https://doi.org/10.1016/j.envsci.2015.05.017

Klenk, N.L., Meehan, K., 2017. Transdisciplinary sustainability research beyond engagement models: Toward adventures in relevance. Environmental Science & Policy 78, 27–35. https://doi.org/10.1016/j.envsci.2017.09.006

Knorr-Cetina, K., 1995. Laboratory studies: The cultural approach to the study of science, in: Handbook of Science and Technology Studies. SAGE, Thousand Oaks, a.o., pp. 140–167.

Knorr-Cetina, K., 1981. The manufacture of knowledge Oxford: Pergamon.

Knorr-Cetina, K.D., 1983. The ethnographic study of scientific work: Towards a constructivist interpretation of science, in: Science Observed: Perspectives on the Social Study of Science. SAGE, London, pp. 115–140.

Kohl, E., McCutcheon, P., 2015. Kitchen table reflexivity: negotiating positionality through everyday talk. Gender, Place & Culture 22, 747–763. https://doi.org/10.1080/0966369X.2014.958063

Kothari, U., Cooke, B., 2001. Power, knowledge and social control in participatory development. Participation: the new tyranny? 139–152.

Kuhn, T.S., 1962. The Structure of Scientific Revolutions. Chicago (University of Chicago Press) 1962.

Lacroix, L., Rist, S., Gerritsen, P.R., Péclard, D., 2011. Social and political participation in sustainable development with a focus on governance, in: NCCR North-South. Research for Sustainable Development: Foundations, Experiences, and Perspectives. pp. 147–164.

Lamine, C., 2018. Transdisciplinarity in research about agrifood systems transitions: A pragmatist approach to processes of attachment. Sustainability 10, 1241. https://doi.org/doi:10.3390/su10041241

Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., Thomas, C.J., 2012. Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustainability science 7, 25–43. https://doi.org/10.1007/s11625-011-0149-x

Latour, B., 2007. Turning Around Politics: A Note on Gerard de Vries' Paper. Soc Stud Sci 37, 811–820. https://doi.org/10.1177/0306312707081222

Latour, B., 1999. Pandora's hope: essays on the reality of science studies. Harvard University Press.

Latour, B., 1987. Science in action: How to follow scientists and engineers through society. Harvard University Press.

Latour, B., Woolgar, S., 2013. Laboratory life: The construction of scientific facts. Princeton University Press.

Law, J., 2004. After method: Mess in social science research. Routledge, London and New York.

Lincoln, Y.S., Guba, E.G., 1985. Naturalistic Inquiry. SAGE.

Löw, M., 2013. Raumsoziologie. Suhrkamp Verlag, Frankfurt am Main.

Luthe, T., 2017. Success in Transdisciplinary Sustainability Research. Sustainability 9, 71. https://doi.org/10.3390/su9010071

Lux, A., Schäfer, M., Bergmann, M., Jahn, T., Marg, O., Nagy, E., Ransiek, A.-C., Theiler, L., 2019. Societal effects of transdisciplinary sustainability research—

How can they be strengthened during the research process? Environmental Science & Policy 101, 183–191. https://doi.org/10.1016/j.envsci.2019.08.012

Maasen, S., Lieven, O., 2006. Transdisciplinarity: a new mode of governing science? Science and Public Policy 33, 399–410. https://doi.org/10.3152/147154306781778803

Maasen, S., Winterhager, M., 2001. Science Studies: Probing the Dynamics of Scientific Knowledge. transcript.

MacMynowski, D.P., 2007. Pausing at the Brink of Interdisciplinarity: Power and Knowledge at the Meeting of Social and Biophysical Science. Ecology and Society 12. https://doi.org/10.5751/ES-02009-120120

Marres, N., 2007. The issues deserve more credit: Pragmatist contributions to the study of public involvement in controversy. Social Studies of Science 37, 759–780.

Marshall, F., Dolley, J., Priya, R., 2018. Transdisciplinary research as transformative space making for sustainability: enhancing propoor transformative agency in periurban contexts. Ecology and Society 23. https://doi.org/10.5751/ES-10249-230308

Martens, P., 2006. Sustainability: science or fiction? Sustainability: Science, Practice and Policy 2, 36–41. https://doi.org/doi.org/10.1080/15487733.2006.11907976

Mauser, W., Klepper, G., Rice, M., Schmalzbauer, B.S., Hackmann, H., Leemans, R., Moore, H., 2013. Transdisciplinary global change research: the co-creation of knowledge for sustainability. Current Opinion in Environmental Sustainability 5, 420–431. https://doi.org/10.1016/j.cosust.2013.07.001

Mayring, P., 1991. Qualitative Inhaltsanalyse, in: Handbuch Qualitative Sozialforschung. Grundlagen, Konzepte, Methoden Und Anwendungen. Psychologie Verlags Union, München.

McCool, S.F., Stankey, G.H., 2004. Indicators of sustainability: challenges and opportunities at the interface of science and policy. Environmental Management 33, 294–305. https://doi.org/doi.org/10.1007/s00267-003-0084-4

McGee, R.J., Warms, R.L., 2013. Theory in social and cultural anthropology: An encyclopedia. Sage Publications.

McKee, A., Guimaraes, M.H., Pinto-Correia, T., 2015. Social capital accumulation and the role of the researcher: An example of a transdisciplinary visioning process for the future of agriculture in Europe. Environmental Science & Policy 88–99. https://doi.org/10.1016/j.envsci.2015.02.006

Meinherz, F., Fritz, L., Schneider, F., 2020. How values play into sustainability assessments: challenges and a way forward, in: Sustainability Assessment of Urban Systems. Binder, C.R., Massaro, E., Wyss, R. Cambridge University Press, Cambridge, pp. 65–86.

Merton, R.K., 1973. The sociology of science: Theoretical and empirical investigations. University of Chicago press.

Merton, R.K., 1949. On sociological theories of the middle range [1949], in: Social Theroy and Social Structure: Theory. Simon and Schuster, The Free Press, New York, pp. 39–53.

Metzger, J., Soneryd, L., Linke, S., 2017. The legitimization of concern: A flexible framework for investigating the enactment of stakeholders in environmental planning and governance processes. Environ Plan A 49, 2517–2535. https://doi.org/10.1177/0308518X17727284

Michener, V.J., 1998. The participatory approach: Contradiction and co-option in Burkina Faso. World Development 26, 2105–2118. https://doi.org/10.1016/S0305-750X(98)00112-0

Miller, T.R., Wiek, A., Sarewitz, D., Robinson, J., Olsson, L., Kriebel, D., Loorbach, D., 2014. The future of sustainability science: a solutions-oriented research agenda. Sustainability science 9, 239–246. https://doi.org/10.1007/s11625-013-0224-6

Mitchell, C., Cordell, D., Fam, D., 2015. Beginning at the end: The outcome spaces framework to guide purposive transdisciplinary research. Futures 65, 86–96.

Mittelstraß, J., 1989. Wohin geht die Wissenschaft? Über Disziplinarität, Transdisziplinarität und das Wissen in einer Leibniz-Welt. Konstanzer Blätter für Hochschulfragen 26, 97–115.

Mobjörk, M., 2010. Consulting versus participatory transdisciplinarity: A refined classification of transdisciplinary research. Futures 42, 866–873. https://doi.org/10.1016/j.futures.2010.03.003

Morton, S., 2015. Progressing research impact assessment: A 'contributions' approach. Research Evaluation 24, 405–419.

Mouffe, C., 2005. On the political. Routledge, Abingdon.

Mountz, A., Miyares, I.M., Wright, R., Bailey, A.J., 2003. Methodologically becoming: power, knowledge and team research. Gender, Place and Culture: A Journal of Feminist Geography 10, 29–46.

MWK Niedersachsen, 2019. Pressemitteilung vom 28.06.2018. 3,9 Mio. Euro an niedersächsische Hochschulen [WWW Document]. URL https://www.mwk.niedersachsen.de/startseite/service/presseinformationen/39-mio-euro-an-niedersaechsische-hochschulen--166152.html (accessed 10.10.19).

MWK Niedersachsen, VolkswagenStiftung, 2015. Wissenschaft für nachhaltige Entwicklung. Ausschreibung 2015.

MWK Niedersachsen, VolkswagenStiftung, 2014. Wissenschaft für nachhaltige Entwicklung. Ausschreibung 2014.

Neef, A., Neubert, D., 2011. Stakeholder participation in agricultural research projects: a conceptual framework for reflection and decision-making. Agriculture and Human Values 28, 179–194. https://doi.org/10.1007/s10460-010-9272-z

Newig, J., Jahn, S., Lang, D.J., Kahle, J., Bergmann, M., 2019. Linking modes of research to their scientific and societal outcomes. Evidence from 81

sustainability-oriented research projects. Environmental Science & Policy 101, 147–155.

Noblit, G.W., Hare, R. Dwight, Hare, R. D., 1988. Meta-ethnography: Synthesizing qualitative studies. SAGE, Newbury Park (o.a.).

Novy, A., Beinstein, B., Voßemer, C., 2008. Methodologie transdisziplinärer Entwicklungsforschung.

Nowotny, H., 1976. Social aspects of the nuclear power controversy. IIASA Laxenburg.

Nowotny, H., Scott, P., Gibbons, M., 2003. Introduction: "Mode 2" Revisited: The New Production of Knowledge. Minerva 41, 179–194.

Nowotny, H., Scott, P., Gibbons, M., 2001. Re-thinking science: Knowledge and the public in an age of uncertainty. SciELO Argentina.

Oberlack, C., Breu, T., Giger, M., Harari, N., Herweg, K., Mathez-Stiefel, S.-L., Messerli, P., Moser, S., Ott, C., Providoli, I., 2019. Theories of change in sustainability science: Understanding how change happens. GAIA-Ecological Perspectives for Science and Society 28, 106–111.

O'Neill, J., 2008. Happiness and the good life. Environmental Values 17, 125–144.

Onwuegbuzie, A.J., Leech, N.L., Collins, K.M., 2012. Qualitative analysis techniques for the review of the literature. The qualitative report 17, 1.

Paina, L., Wilkinson, A., Tetui, M., Ekirapa-Kiracho, E., Barman, D., Ahmed, T., Mahmood, S.S., Bloom, G., Knezovich, J., George, A., 2017. Using Theories of Change to inform implementation of health systems research and innovation: experiences of Future Health Systems consortium partners in Bangladesh, India and Uganda. Health research policy and systems 15, 109.

Patton, M.Q., 1999. Enhancing the quality and credibility of qualitative analysis. Health services research 34, 1189.

Pearce, B.J., Ejderyan, O., 2019. Joint problem framing as reflexive practice: honing a transdisciplinary skill. Sustain Sci. https://doi.org/10.1007/s11625-019-00744-2

Pellizzoni, L., 2003. Uncertainty and participatory democracy. Environmental Values 12, 195–224. https://doi.org/0.3197/096327103129341298

Penfield, T., Baker, M.J., Scoble, R., Wykes, M.C., 2014. Assessment, evaluations, and definitions of research impact: A review. Research evaluation 23, 21–32.

Pohl, C., Hadorn, G.H., Zimmermann, A.B., 2007. Principles for designing transdisciplinary research. oekom Munich.

Pohl, C., Rist, S., Zimmermann, A., Fry, P., Gurung, G.S., Schneider, F., Speranza, C.I., Kiteme, B., Boillat, S., Serrano, E., 2010. Researchers' roles in knowledge co-production: experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. Science and Public Policy 37, 267–281. https://doi.org/10.3152/030234210X496628

Polk, M., 2014. Achieving the promise of transdisciplinarity: a critical exploration of the relationship between transdisciplinary research and societal problem solving. Sustain Sci 9, 439–451. https://doi.org/10.1007/s11625-014-0247-7

Polk, M., Knutsson, P., 2008. Participation, value rationality and mutual learning in transdisciplinary knowledge production for sustainable development. Environmental Education Research 14, 643–653. https://doi.org/10.1080/13504620802464841

Popa, F., Guillermin, M., Dedeurwaerdere, T., 2015. A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science. Futures 65, 45–56. https://doi.org/10.1016/j.futures.2014.02.002

Potthast, T., 2015. Ethics in the Sciences beyond Hume, Moore and Weber: Taking Epistemic-Moral Hybrids Seriously, in: Ethics of Science in the Research for Sustainable Development. Nomos Verlagsgesellschaft mbH & Co. KG, pp. 129–152.

Putnam, H., 2002. The collapse of the fact/value dichotomy and other essays. Harvard University Press.

Raymond, C.M., Fazey, I., Reed, M.S., Stringer, L.C., Robinson, G.M., Evely, A.C., 2010. Integrating local and scientific knowledge for environmental management. Journal of environmental management 91, 1766–1777. https://doi.org/10.1016/j.jenvman.2010.03.023

Reckwitz, A., 2002. Toward a Theory of Social Practices: A Development in Culturalist Theorizing. European Journal of Social Theory 5, 243–263. https://doi.org/10.1177/13684310222225432

Reddy, D., 2019. Speech made at the UN Climate Action Summit 22 September 2019. Launch of the report "United in Science". [WWW Document]. International Science Council. URL https://council.science/current/news/we-can-succeed-says-isc-president-at-launch-of-the-report-united-in-science-at-the-un-summits/ (accessed 10.10.19).

Reed, M.S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C.H., Stringer, L.C., 2009. Who's in and why? A typology of stakeholder analysis methods for natural resource management. Journal of environmental management 90, 1933–1949.

Renner, R., Schneider, F., Hohenwallner, D., Kopeinig, C., Kruse, S., Lienert, J., Link, S., Muhar, S., 2013. Meeting the challenges of transdisciplinary knowledge production for sustainable water governance. Mountain Research and Development 33, 234–247. https://doi.org/10.1659/MRD-JOURNAL-D-13-00002.1

Robinson, J., Tansey, J., 2006. Co-production, emergent properties and strong interactive social research: the Georgia Basin Futures Project. Science and Public Policy 33, 151–160.

Rohe, W., 2015. Vom Nutzen der Wissenschaft für die Gesellschaft: Eine Kritik zum Anspruch der transformativen Wissenschaft. GAIA-Ecological Perspectives for Science and Society 24, 156–159.

Roosth, S., Silbey, S., 2009. Science and Technology Studies: From Controversies to Posthumanist Theory, in: The New Blackwell Companion to Social Theory. Turner, B.S., Oxford, pp. 451–475.

Rosendahl, J., Zanella, M.A., Rist, S., Weigelt, J., 2015. Scientists' situated knowledge: Strong objectivity in transdisciplinarity. Futures 65, 17–27. https://doi.org/10.1016/j.futures.2014.10.011

Rubio, F.D., Baert, P., 2012. The politics of knowledge. An introduction, in: The Politics of Knowledge. Routledge, Oxon.

Said, E., 1978. Orientalism: Western Conceptions of the Orient. London: Kegan Paul.

Salleh, A., 2015. Neoliberalism, scientism and Earth System Governance, in: The International Handbook of Political Ecology. Edward Elgar Publishing.

Schatzki, T.R., Knorr-Cetina, K., Von Savigny, E., 2001. The practice turn in contemporary theory. Routledge, London.

Schiffer, E., Hauck, J., 2010. Net-Map: Collecting Social Network Data and Facilitating Network Learning through Participatory Influence Network Mapping. Field Methods 22, 231–249. https://doi.org/10.1177/1525822X10374798

Schikowitz, A., 2019. Creating relevant knowledge in transdisciplinary research projects - Coping with inherent tensions. Journal of Responsible Innovation 1–21. https://doi.org/10.1080/23299460.2019.1653154

Schmidt, L., Neuburger, M., 2017. Trapped between privileges and precariousness: Tracing transdisciplinary research in a postcolonial setting. Futures 93, 54–67. https://doi.org/10.1016/j.futures.2017.07.005

Schmidt, L., Pröpper, M., 2017. Transdisciplinarity as a real-world challenge: a case study on a North–South collaboration. Sustainability Science 12, 365–379. https://doi.org/10.1007/s11625-017-0430-8

Schneider, F., 2015. Exploring sustainability through stakeholders' perspectives and hybrid water in the Swiss Alps. Water Alternatives 8, 280–296.

Schneider, F., Buser, T., 2018. Promising degrees of stakeholder interaction in research for sustainable development. Sustainability Science 13, 129–142. https://doi.org/10.1007/s11625-017-0507-4

Schneider, F., Buser, T., Keller, R., Tribaldos, T., Rist, S., 2019a. Research funding programmes aiming for societal transformations: ten key stages. Sci Public Policy 46, 463–478. https://doi.org/10.1093/scipol/scy074

Schneider, F., Kläy, A., Zimmermann, A.B., Buser, T., Ingalls, M., Messerli, P., 2019b. How can science support the 2030 Agenda for Sustainable Development? Four tasks to tackle the normative dimension of sustainability. Sustainability Science 14: 1593. https://doi.org/10.1007/s11625-019-00675-y

Schneider, F., Rist, S., 2014. Envisioning sustainable water futures in a transdisciplinary learning process: combining normative, explorative, and participatory scenario approaches. Sustainability science 9, 463–481. https://doi.org/10.1007/s11625-013-0232-6

Schneidewind, U., Wissel, C. von, 2015. Transformative Wissenschaft: warum Wissenschaft neue Formen der Demokratisierung braucht. Forum Wissenschaft 4.

Scholz, R., Steiner, G., 2015a. The real type and ideal type of transdisciplinary processes: part I—theoretical foundations. Sustainability Science 10, 527–544. https://doi.org/10.1007/s11625-015-0326-4

Scholz, R., Steiner, G., 2015b. The real type and ideal type of transdisciplinary processes: part II—what constraints and obstacles do we meet in practice? Sustain Sci 10, 653–671. https://doi.org/10.1007/s11625-015-0327-3

Scholz, R., Steiner, G., 2015c. Transdisciplinarity at the crossroads. Sustain Sci 10, 521–526. https://doi.org/10.1007/s11625-015-0338-0

Scholz, R.W., 2017. The normative dimension in transdisciplinarity, transition management, and transformation sciences: New roles of science and universities in sustainable transitioning. Sustainability 9, 991. https://doi.org/10.3390/su9060991

Scholz, R.W., Lang, D.J., Wiek, A., Walter, A.I., Stauffacher, M., 2006. Transdisciplinary case studies as a means of sustainability learning: Historical framework and theory. International Journal of Sustainability in Higher Education 7, 226–251.

Shdaimah, C., Stahl, R., 2012. Power and conflict in collaborative research, in: Real Social Science: Applied Phronesis. Flyvbjerg, Bent; Landman, Todd; Schram, Sanford, Cambridge, pp. 122–137.

Shinn, T., 2002. The triple helix and new production of knowledge: prepackaged thinking on science and technology. Social studies of science 32, 599–614.

Shirk, J.L., Ballard, H.L., Wilderman, C.C., Phillips, T., Wiggins, A., Jordan, R., McCallie, E., Minarchek, M., Lewenstein, B.V., Krasny, M.E., 2012. Public participation in scientific research: a framework for deliberate design. Ecology and Society 17, 29.

Shove, E., 2010. Beyond the ABC: climate change policy and theories of social change. Environment and planning A 42, 1273–1285.

Siew, T.F., Aenis, T., Spangenberg, J.H., Nauditt, A., Döll, P., Frank, S.K., Ribbe, L., Rodriguez-Labajos, B., Rumbaur, C., Settele, J., Wang, Jue, 2016. Transdisciplinary research in support of land and water management in China and Southeast Asia: evaluation of four research projects. Sustainability Science 813–829. https://doi.org/10.1007/s11625-016-0378-0

Silverman, D., 2013. Doing qualitative research: A practical handbook. SAGE Publications Limited.

Slaughter, S., Leslie, L.L., 2001. Expanding and Elaborating the Concept of Academic Capitalism. Organization 8, 154–161. https://doi.org/10.1177/1350508401082003

SNSF, 2019a. National Research Programmes [WWW Document]. URL http://www.snf.ch/en/researchinFocus/nrp/Pages/default.aspx#Current%20N RP (accessed 10.4.19).

SNSF, 2019b. NRP 71 Managing Energy Consumption - [WWW Document]. URL http://www.snf.ch/en/researchinFocus/nrp/nrp-71-managing-energy-consumption/Pages/default.aspx (accessed 10.8.19).

Spaapen, J., Dijstelbloem, H., Wamelink, F., 2007. Evaluating research in context: a method for comprehensive assessment. Consultative Committee of Sector Councils for Research and Development (COS).

Spaapen, J., Van Drooge, L., 2011. Introducing 'productive interactions' in social impact assessment. Research Evaluation 20, 211–218. https://doi.org/10.3152/095820211X12941371876742

Spangenberg, J.H., 2011. Sustainability science: a review, an analysis and some empirical lessons. Environmental Conservation 38, 275–287. https://doi.org/10.1017/S0376892911000270

Stauffacher, M., Flüeler, T., Krütli, P., Scholz, R.W., 2008. Analytic and dynamic approach to collaboration: a transdisciplinary case study on sustainable landscape development in a Swiss prealpine region. Systemic Practice and Action Research 21, 409–422. https://doi.org/10.1007/s11213-008-9107-7

Steelman, T., Nichols, E.G., James, A., Bradford, L., Ebersöhn, L., Scherman, V., Omidire, F., Bunn, D.N., Twine, W., McHale, M.R., 2015. Practicing the science of sustainability: the challenges of transdisciplinarity in a developing world context. Sustainability Science 10, 581–599. https://doi.org/10.1007/s11625-015-0334-4

Stirling, A., 2014. Transforming power: Social science and the politics of energy choices. Energy Research & Social Science 1, 83–95. https://doi.org/10.1016/j.erss.2014.02.001

Stirling, A., 2008. "Opening up" and "closing down" power, participation, and pluralism in the social appraisal of technology. Science, technology & human values 33, 262–294. https://doi.org/10.1177/0162243907311265

Stokols, D., 2006. Toward a science of transdisciplinary action research. American journal of community psychology 38, 63–77. https://doi.org/10.1007/s10464-006-9060-5

Stokols, D., Fuqua, J., Gress, J., Harvey, R., Phillips, K., Baezconde-Garbanati, L., Unger, J., Palmer, P., Clark, M.A., Colby, S.M., 2003. Evaluating transdisciplinary science. Nicotine & Tobacco Research 5, S21–S39. https://doi.org/10.1080/14622200310001625555

Strohschneider, P., 2014. Zur Politik der Transformativen Wissenschaft, in: Die Verfassung Des Politischen. Springer, pp. 175–192.

Swiss Federal Department of the Environment, Transport, Energy and Communications, 2019. Energy Strategy 2050 [WWW Document]. URL

https://www.uvek.admin.ch/uvek/en/home/energie/energiestrategie-2050.html (accessed 11.6.19).

Swyngedouw, E., 2015. Depoliticized Environments and the Promises of the Anthropocene, in: The International Handbook of Political Ecology. Edward Elgar Publishing.

Swyngedouw, E., 2011. Depoliticized Environments: The End of Nature, Climate Change and the Post-Political Condition. Royal Institute of Philosophy Supplements 69, 253–274. https://doi.org/10.1017/S1358246111000300

Talwar, S., Wiek, A., Robinson, J., 2011. User engagement in sustainability research. Science and Public Policy 38, 379–390.

Tejada, G., Cracco, M., Bouleau, C.R., Bolay, J.-C., Hostettler, S., 2019. Testing Analytical Frameworks in Transdisciplinary Research for Sustainable Development. Sustainability 11, 4343. https://doi.org/10.3390/su11164343

Thompson, M.A., Owen, S., Lindsay, J.M., Leonard, G.S., Cronin, S.J., 2017. Scientist and stakeholder perspectives of transdisciplinary research: Early attitudes, expectations, and tensions. Environmental Science & Policy 74, 30–39. https://doi.org/10.1016/j.envsci.2017.04.006

Tötzer, T., Sedlacek, S., Knoflacher, M., 2011. Designing the future—A reflection of a transdisciplinary case study in Austria. Futures 43, 840–852. https://doi.org/10.1016/j.futures.2011.05.026

Tritter, J.Q., McCallum, A., 2006. The snakes and ladders of user involvement: Moving beyond Arnstein. Health Policy 76, 156–168.

Tsouvalis, J., Waterton, C., 2012. Building 'participation' upon critique: The Loweswater care project, Cumbria, UK. Environmental Modelling & Software 36, 111–121. https://doi.org/Acknowledgements References Figures (1) Fig.1. Objects playing their role in the Loweswater Care Project Elsevier Environmental Modelling & Software Volume 36, October 2012, Pages 111-121 Environmental Modelling & Software Building 'participation' upon critique: The Loweswater Care Project, Cumbria, UK https://doi.org/10.1016/j.envsoft.2012.01.018

Turnhout, E., Metze, T., Wyborn, C., Klenk, N., Louder, E., 2020. The politics of co-production: participation, power, and transformation. Current Opinion in Environmental Sustainability 42, 15–21. https://doi.org/10.1016/j.cosust.2019.11.009

United Nations, 2015. Transforming our world: the 2030 agenda for sustainable development, A /RES/70/1. ed, Resolution adopted by the General Assembly. New York.

United Nations, 1992. United Nations Conference on Environment & Development Rio de Janerio, Brazil, 3 to 14 June 1992. Agenda 21.

van den Hove, S., 2006. Between consensus and compromise: acknowledging the negotiation dimension in participatory approaches. Land Use Policy 23, 10–17. https://doi.org/10.1016/j.landusepol.2004.09.001

van der Hel, S., 2018. Science for change: A survey on the normative and political dimensions of global sustainability research. Global Environmental Change 52, 248–258. https://doi.org/10.1016/j.gloenvcha.2018.07.005

Van der Hel, S., 2016. New science for global sustainability? The institutionalisation of knowledge co-production in Future Earth. Environmental Science & Policy 61, 165–175. https://doi.org/10.1016/j.envsci.2016.03.012

van Drooge, L., Spaapen, J., 2017. Evaluation and monitoring of transdisciplinary collaborations. J Technol Transf. https://doi.org/10.1007/s10961-017-9607-7

Van Kerkhoff, L., 2014. Developing integrative research for sustainability science through a complexity principles-based approach. Sustainability Science 9, 143–155.

Van Kerkhoff, L., Lebel, L., 2006. Linking knowledge and action for sustainable development. Annu. Rev. Environ. Resour. 31, 445–477.

van Tulder, R., Keen, N., 2018. Capturing Collaborative Challenges: Designing Complexity-Sensitive Theories of Change for Cross-Sector Partnerships. J Bus Ethics 150, 315–332. https://doi.org/10.1007/s10551-018-3857-7

Vatn, A., 2005. Rationality, institutions and environmental policy. Ecological Economics 55, 203–217.

Vilsmaier, U., Engbers, M., Luthardt, P., Maas-Deipenbrock, R.M., Wunderlich, S., Scholz, R.W., 2015. Case-based mutual learning sessions: knowledge integration and transfer in transdisciplinary processes. Sustainability Science 10, 563–580. https://doi.org/10.1007/s11625-015-0335-3

Vogel, I., 2012. ESPA guide to working with theory of change for research projects.

Völker, T., 2014. "Futuring" in transdisciplinary sustainability research. University of Vienna, Vienna.

Vowe, G., 2008. Politics, Policy, Polity, in: Encyclopedia of Political Communication. SAGE Publications, Inc., Thousand Oaks, pp. 621–621. https://doi.org/10.4135/9781412953993

Walter, A.I., Helgenberger, S., Wiek, A., Scholz, R.W., 2007. Measuring societal effects of transdisciplinary research projects: design and application of an evaluation method. Evaluation and program planning 30, 325–338. https://doi.org/10.1016/j.evalprogplan.2007.08.002

Watermeyer, R., 2014. Issues in the articulation of 'impact': the responses of UK academics to 'impact'as a new measure of research assessment. Studies in Higher Education 39, 359–377.

WBGU, 2011. Welt im Wandel. Gesellschaftsvertrag für eine Große Transformation.

Webber, L.M., Ison, R., 1995. Participatory rural appraisal design: conceptual and process issues. Agricultural systems 47, 107–131. https://doi.org/10.1016/0308-521X(94)P3278-3

Weingart, P., 1997. From "Finalization" to "Mode 2": Old wine in new bottles? Social science information 36, 591–613.

Weingart, P., 1983. Verwissenschaftlichung der Gesellschaft–Politisierung der Wissenschaft. Zeitschrift für Soziologie 225–241.

Weiss, C.H., 1997. Theory-based evaluation: Past, present, and future. New directions for evaluation. https://doi.org/10.1002/ev.1086

White, S.C., 1996. Depoliticising development: the uses and abuses of participation. Development in practice 6, 6–15. https://doi.org/10.1080/0961452961000157564

Whitman, G.P., Pain, R., Milledge, D.G., 2015. Going with the flow? Using participatory action research in physical geography. Progress in Physical Geography 39, 622–639. https://doi.org/10.1177/0309133315589707

Whyte, W.F.E., 1991. Participatory action research. Sage Publications, Inc, Newbury Park (o.a.).

Wickson, F., Carew, A.L., Russell, A.W., 2006. Transdisciplinary research: characteristics, quandaries and quality. Futures 38, 1046–1059.

Wiek, A., Farioli, F., Fukushi, K., Yarime, M., 2012. Sustainability science: bridging the gap between science and society. Sustain Sci 7, 1–4. https://doi.org/10.1007/s11625-011-0154-0

Wiek, A., Talwar, S., O'Shea, M., Robinson, J., 2014. Toward a methodological scheme for capturing societal effects of participatory sustainability research. Research Evaluation 23, 117–132.

Williams, G., 2004. Evaluating participatory development: tyranny, power and (re)politicisation. Third world quarterly 25, 557–578. https://doi.org/10.1080/0143659042000191438

Witzel, A., Reiter, H., 2012. The problem-centred interview. Sage, Los Angeles a.o.

Wolf, B., Lindenthal, T., Szerencsits, M., Holbrook, J.B., Hess, J., 2013. Evaluating Research beyond Scientific Impact: How to Include Criteria for Productive Interactions and Impact on Practice and Society. GAIA-Ecological Perspectives for Science and Society 22, 104–114.

Wolff, M., Cockburn, J., De Wet, C., Carlos Bezerra, J., Weaver, M., Finca, A., De Vos, A., Ralekhetla, M., Libala, N., Mkabile, Q., 2019. Exploring and expanding transdisciplinary research for sustainable and just natural resource management. Ecology and Society 24.

Wolff, S., 2004. Analysis of documents and records. A companion to qualitative research 284–289.

Woolgar, S., Lezaun, J., 2013. The wrong bin bag: A turn to ontology in science and technology studies? Social studies of science 43, 321–340.

Wuelser, G., Pohl, C., 2016. How researchers frame scientific contributions to sustainable development: a typology based on grounded theory. Sustain Sci 11, 789–800. https://doi.org/10.1007/s11625-016-0363-7

Wynne, B., 2007. Public participation in science and technology: performing and obscuring a political–conceptual category mistake. East Asian science, technology and society 1, 99–110. https://doi.org/10.1007/s12280-007-9004-7

Ziegler, R., Ott, K., 2011. The quality of sustainability science: a philosophical perspective. Sustainability: Science, Practice and Policy 7, 31–44.

Zingerli, C., 2010. A Sociology of International Research Partnerships for Sustainable Development. Eur J Dev Res 22, 217–233. https://doi.org/10.1057/ejdr.2010.1

Zscheischler, J., 2017. Transdisciplinary Research in the Field of Land Use Science: Concepts, Practice, and Dimensions of Success. Humboldt Universität Berlin.

Zscheischler, J., Rogga, S., 2015. Transdisciplinarity in land use science – A review of concepts, empirical findings and current practices. Futures, "Advances in transdisciplinarity 2004-2014" 65, 28–44. https://doi.org/10.1016/j.futures.2014.11.005

Zscheischler, J., Rogga, S., Lange, A., 2018. The success of transdisciplinary research for sustainable land use: individual perceptions and assessments. Sustain Sci 1–14. https://doi.org/10.1007/s11625-018-0556-3

PART II: ARTICLES

1 Manuscript I

Bibliographic details:

Fritz, L.; Binder, C.R. 2018. Participation as Relational Space: A Critical Approach to Analysing Participation in Sustainability Research. *Sustainability* 2018, *10*, 2853. DOI: 10.3390/su10082853

Contribution of the doctoral candidate:

The doctoral candidate principally designed and carried out this research and wrote the manuscript. The doctoral candidate developed the conceptual perspective, conducted the literature review and performed the analysis. The co-author supported the interpretation of findings, the visualisation in figure 1 and the discussion of results.

sustainability

MDPI

Article

Participation as Relational Space: A Critical Approach to Analysing Participation in Sustainability Research

Livia Fritz * and Claudia R. Binder [ID]

Swiss Mobiliar Chair in Urban Ecology and Sustainable Living, Laboratory for Human-Environment Relations in Urban Systems (HERUS), Institute of Environmental Engineering (IEE), School of Architecture, Civil and Environmental Engineering (ENAC), École Polytechnique Fédérale de Lausanne (EPFL), GR C1 455 (Bâtiment GR)—Station 2, CH-1015 Lausanne, Switzerland; claudia.binder@epfl.ch

* Correspondence: livia.fritz@epfl.ch; Tel.: +41-216-933-803

check for updates

Abstract: In the field of sustainability, scholars, and policy-makers herald the transformative power of participation in knowledge production. However, a discrepancy between these expectations and the limited understanding of the complex interactions constituting participation processes can be observed. With the aim of critically analysing these complex interactions, this paper develops a conceptual perspective on participation as a relational space which is formed in the interplay of structures and processes. This perspective is applied to the analysis of empirical literature in sustainability research, development research, and science and technology studies. The literature review guided by the proposed conceptualisation systematically draws together the rich experience with participation in knowledge production. Elements constituting participation spaces along the dimensions 'structures' and 'actors' are identified and discussed in relation to 'processes' of space-making: (i) (in)coherences with reference system, (ii) resources, (iii) timing, (iv) expectations, (v) mutual trust, and (vi) worldviews and values. Power relations are found to pervade the three dimensions. Enhanced conceptual-analytical clarity of the elements constituting participation spaces provides a differentiated basis for discussing the transformative power of participatory knowledge production. By stimulating reflexivity on the making of participation, this approach contributes to better understanding when spaces of participation have the capacity to become spaces of transformation.

Keywords: spaces of participation; critical studies of participation; power relations; co-production; transdisciplinary sustainability research; transformation; relational approaches

1. Introduction

The United Nations resolution "Transforming our world: the 2030 Agenda for Sustainable Development" is the latest example in a series of international policy documents that stress the key role of science for sustainable development [1]. Facing complex and highly interconnected sustainability problems such as those embodied in the 17 Sustainable Development Goals of the Agenda 2030, the call for new approaches to science and the production of knowledge has gained momentum. Similar calls for the linking of scientific with 'local' and 'indigenous' forms of knowledge are already present in the Agenda 21 of the Rio Declaration in 1992 [2]. Over the past decades, scholars and policy-makers have increasingly questioned the capacity of 'traditional' disciplinary research alone to provide the kind of evidence needed for governing transformation processes towards sustainability [3,4]. They consider the reconceptualisation of science-society-policy relations indispensable for responding to the 'grand challenges' of climate change, environmental degradation, and rising inequalities within and across societies [5].

140

One part of this re-conceptualisation concerns the opening-up of research processes by including societal actors beyond the traditional scientific sphere [6]. Approaches to participation in knowledge production suggest that the idea of science holding a monopoly over the production of valid, trustworthy knowledge that should 'speak truth to power' fails in contemporary societies. These are characterised by complex problems, where neither science can claim truth nor polity can monopolise power [7]. The associated developments in science policy, and research practices have induced some scholars to announce a 'participatory turn' [8–10], a 'participatory return' [11], and a 'deliberative turn' [12], respectively. In the field of sustainability, participatory approaches, such as transdisciplinary (TD) research and real-world laboratories are seen as key for creating new knowledge, and achieving transformative change and innovation [13–16]. First used some 40 years ago by a physicist and early complexity researcher [17], today's conceptualisations of TD can be grouped into philosophy of science approaches (e.g., [18]) and sociological, actor-orientated approaches. In this article, we are primarily interested in the latter. Concerning these approaches, most scholars agree on three criteria according to which TD (i) departs from 'lifeworld' problems, (ii) integrates different scientific disciplines, (iii) includes non-scientific actors in the production of societally-relevant knowledge [19–21]. In these research areas, methods and tools have been developed with the expectation that the participation of non-scientific actors in research will produce robust knowledge [22], facilitate societal learning [23], foster trust in research results and commitment to the derived policies [24].

So far, scholars provide several tools to distinguish different types of participation and most importantly to categorise them according to motivation [25] and/or intensity of involvement [26]. While their strengths lie in the description and comparison of different forms of participation, they are poorly equipped for analytical enquiries into why participation in knowledge production takes different shapes, leading to different, and not always the desired, outcomes [27]. Furthermore, adopted from political science, commonly used conceptualisations of participation are elusive with regard to the epistemic ends of participation in knowledge production. Accordingly, in studies on the societal contribution of research projects, participation of different societal actors, both in transformative and transformation research [28], has mainly been conceived of as a static input factor into a larger transformation process (e.g., [29]). Hence, a discrepancy between the positive connotations of participation and the limited understanding of the dynamics and complex interactions constituting these knowledge production processes can be observed. In view of the growing number of research funding programmes requiring participation [30], analytical approaches to critically scrutinise participation processes in their complexity seem ever more important [31].

Literature on participation is widely dispersed and more recent approaches to participation in TD sustainability research hardly rely on theoretical and practical reflections derived from participation studies in more established fields. Learning potential has been identified for example for an integration of participation research from development studies (participatory rural appraisal, participatory action research) and science and technology studies (STS) (participatory technology and risk assessment) with sustainability research [32]. Across these fields, critical perspectives on the entanglement of knowledge and power in participation processes and on their embedding in societal structures have emerged [33–36]. In reaction, the need for reconceptualising participation as constructed [37], co-produced [9], and relational [38] has been identified.

In this paper, we follow this critical scholarship on participation and move away from the focus on isolated participation events in sustainability research, towards seeing participation as a relational space entangled with wider science-society relations. We ask which factors constitute and shape forms of participation in knowledge production. Relying on social theories of space, we propose a conceptual perspective that puts the emphasis on the processes of constituting participation. The main aim of this paper is to (i) bring complementary, yet largely parallel bodies of literature on participation in conversation (sustainability research, development research, STS); (ii) draw the contours of a relational perspective on participation as space; and (iii) apply this perspective to systematically integrate the

findings of a qualitative literature review on factors shaping participation in case studies across the three scholarly fields.

This paper presents first ideas on how a shift in conceptual perspectives on participation can address missing dimensions in the current understanding of participatory knowledge production. Fostering conceptual-analytical clarity on the factors shaping participation spaces, this paper provides a differentiated basis for discussing the transformative power of participatory approaches to knowledge production. In scrutinising and problematising the very practice of participation which underpins various approaches to researching and governing sustainability issues, our findings feed into an emerging critical and transformative sustainability science which is sensitive to power dynamics and reflexive towards its own practices [39].

The paper is organised as follows: after a critical analysis of commonly used models of participation, Section 2 draws the contours of a relational perspective on participation as space at the research-practice interface and lays the conceptual foundation for the subsequent literature analysis. Section 3, provides a description of the methods applied. Building on the proposed perspective, Section 4 systematically integrates three bodies of literature with regard to potential factors shaping spaces of participation. Section 5 critically discusses the proposed perspective and outlines its contribution to critical and transformative sustainability sciences, before presenting conclusions.

1.1. Deconstructing Models of Participation

The myriad of discourses on participation in research and governance processes suggests that participation has been introduced in reaction to different kinds of problems. Put simply, in TD sustainability research, discrepancies between what we know about (un)sustainability and how we act are identified. In development research a lack of ownership and empowerment is problematised and with regard to science and technology decreasing public trust in new technologies is observed. Across the three fields participation of heterogeneous actors in the respective processes is seen as the answer to these problems. Accordingly, participation is associated with multiple ends and given diverse social, political and methodological meanings [32]. Despite this plurality there are common grounds when we speak of participation. Models of participation based on the degree of involvement, motivation, and nature of involvement are widely spread.

Across the scholarly fields analysed, several authors take up a vision of participation which was first outlined in the "Ladder of Participation" [40]. Relying on her experience as a community worker in the 1960s, Arnstein [26] categorises eight uses of the term participation arranged in a ladder pattern in which each rung corresponds to the degree of citizen power: manipulation and therapy, informing, consultation, placation and partnerships, delegated power and citizen control. Arnstein's model has marked a particular vision of participatory progress which reflects a linear logic of 'the more participation, the better'. Linked to this growth model, such conceptualisations assume a 'correspondence theory' of an external public, imagined to be waiting in a natural state for mobilisation by participatory methods. Ladder-inspired models are one-dimensional in the way that they conceptualise participation as a function of the degree of power which is intentionally handed over by the power-holding actors [9]. They rely on a realist understanding of 'power over' [41], e.g., the 'powerful' transfer or not some of their power to the initially 'powerless'. Discursive forms of power, such as the various effects emanating from intentional as well as unintentional practices and discourses of participation are omitted [42]. Linked to the dichotomisation of powerful/powerless, the ladder has been criticised for failing to capture the agency of those involved [31,43]. Furthermore, the ladder symbolism implies participation categories as static, which is inapt for grasping the "fluidity and flux of participation in practice" [44] (p. 3).

In TD literature, among those authors who elucidate their understanding of participation, different approaches are observable. In reference to Arnstein, Stauffacher et al. [45] develop a functional-dynamic model to analyse participation of non-scientific actors in TD research along the axes of information, consultation, cooperation, collaboration, empowerment. Schneider and Buser [46]

rely on intensities of involvement to assess the degrees of stakeholder interaction which are the most promising for different types of research projects. Conceptualisations of participation specifically for knowledge production have been developed by Defila et al. [47] and by Boeckmann [48]. With slight variations, they understand participation as a continuum in which the roles of non-scientific actors range from being the object of research to being a partner actively forming the process. Both assume an indirectly proportional link between the number of actors involved and the intensity of involvement. Adaptations of Arnstein's model can also be traced in development research. These include Pretty's typology [49], which conceptualises motivations as crucial in shaping interventions, and White's [50] typology of interests which strives to unfold conflicting ideas about how participation is being used in different process phases. Additionally, in the literature on participation in governance of science and appraisal of technology three- and four-stage classifications based on Arnstein have become widely used [51].

Another common feature of participation and its analysis lies in the importance of intentionality attached to it [25,52]. Analytical attention has been focused on the motivation and rationale underlying participation out of which several categorisations emerged. Fiorino distinguishes between three imperatives underwriting participatory practices: normative (participation as an end in and of itself), substantial (participation aimed at achieving better outcomes), instrumental (participation aimed at securing particular interests) [53], each of which gives rise to different forms of participation. As an alternative to models based on the degree of involvement and type of motivation, respectively, Rowe and Fewer [54] emphasise the nature of involvement. They distinguish three forms of public engagement according to the flow of information: public communication (one-way), public consultation (one-way in the opposite direction), and public participation (two-ways). More recently, relational approaches to participation have been emerging. In STS, a rethinking of public involvement with science and environmental issues as co-produced [9] and of TD processes as 'adventures in relevance' [38] is proposed. These scholars claim that participation should not be taken for granted and identify the need to explore how it is constructed and situated in a wider intellectual environment [10].

The presented models which originate mainly in the field of planning and decision-making provide a valuable starting point for thinking of types and degrees of participation in research. However, they fall short in explaining why in different contexts participation processes evolve differently and do not reflect epistemic ends of knowledge production for sustainability. In particular, ladder-inspired approaches to participation echo ideals of deliberative democracy [55] and are guided by Habermasian principles of ideal speech [56]. Such approaches entail an emphasis on consensus-orientated over conflict-sensitive perspectives [57] and are accompanied by mostly descriptive accounts of the 'what' of participation. The 'how' and 'why' of different forms of participation are under-researched [58]. Participation is explained as a product of intentions of those setting up the process [59] while the context within which the process is embedded as well as actor relationships are neglected [38]. Despite the richness of case studies, single accounts have not systematically been brought together and participation has remained under-theorised [60].

2. Towards a Critical Approach: Reconceptualising Participation as 'Relational Space'

In this section, we shift the perspective away from the imaginaries of ladders and intensities of involvement and reconceptualise participation as a relational space. Upon this basis, we derive elements that are constitutive of participation spaces.

2.1. Conceptualisations of Space

On a metaphorical level many associations that we have with participation allude to a spatial dimension. For instance the idea of 'creating spaces' or 'making space' for different opinions to be expressed, and notions such as 'opening-up' or 'extending' opportunities for different actors to engage in certain activities, in our case, knowledge production, are frequently used in descriptions of participation [44]. Reviewed literature in the three fields provides several spatial analogies and

metaphors, not directly focused on participation, but on related aspects of science-society relations. With their concept of "mode 2" Nowotny et al. [61] propound that the epistemological boundaries between the fields of science and society dissolve at least partially. At their intersection a common space emerges which they call the "agora". With reference to the Greek "political arena and the market place", they depict the interface as "a public space in which 'science meets the public' and in which 'the public speaks back to science'" [61] (p. 247). Other scholars rely on the symbolisms of space as an analytical perspective on social processes. These include Felt et al.'s [62] "epistemic living spaces" and Cornwall's "spaces for transformation" [24]. With regard to participation Gaventa [63] speaks of "invited, claimed and closed spaces", referring to who is involved in setting the cornerstones of participatory processes. He emphasises power relations inherent to participation and stresses the need for asking, who sets the foundations of the space which structure the interactions of participants.

In order to render the metaphor of participation as space operational as our analytical approach, further specification of our understanding of space is required. For such an operationalisation we rely on the German sociologist Martina Löw, who provides a comprehensive "sociology of space" [64]. She builds on work on spatiality by social theorists such as Simmel [65], Foucault [66], Bourdieu [67], Lefebvre [68] and advances an action-theoretical concept of space.

Löw posits that physical and social spaces need to be conceived as two elements of an integrated concept of space which is produced and transformed through performance. At the core of her proposition lies the conceptualisation of space as being relational. She defines relational space as a "[. . .] relational arrangement of social goods and people in places" [69] (p. 200). The notion of arrangement (in the German original *(An)Ordnung*) refers to two aspects simultaneously: the arrangement as *order (Ordnung)* and the process of arranging or *ordering (Anordnung)*.

Hence, a relational arrangement consists of both an action and a structural dimension. *Order* describes the structural dimension. With reference to Giddens, Löw describes structures as rules and resources, which are recursively embedded in institutions [69] (p. 226). Rules refer to the sanctioning of action and the constitution of sense. They are closely tied to resources, which according to Giddens "[. . .] are media through which power is exercised, as a routine element of the instantiation of conduct in social reproduction" [70] (p. 16). Resources can be further distinguished in allocative resources (material resources based on the control of nature) and authoritative resources (symbolic resources based on people) [69].

Relational spaces are also always the result of processes *(ordering)*. Löw identifies two key elements of space-making which form the action dimension in the constitution of space: *synthesis* and *spacing*. Firstly, spaces are not naturally pre-existing, but need to be actively (re)produced through processes of *synthesis*. Via processes of imagination, perception and memory, social goods and people are amalgamated to spaces. Secondly, these processes of *synthesis* are linked to processes of placing. The placing of social goods and people as well as of one-self is called *spacing*. *Spacing* processes are negotiation processes [69]. Both *spacing* and *synthesis* are dependent on action situations which are composed of material and symbolic components. Only what is available in an action situation can be synthesised and placed [71] (pp. 224-5). While people play a more active role than social goods in moving and making decisions, social goods are not passive objects in the constitution of space. Löw relies on the notion of social goods in order to emphasise symbolic aspects of material goods. In road infrastructure, for instance, a street sign is a material good, which is arranged specifically for its symbolic effect. Social goods are mainly arranged in accordance with material properties, though understanding these arrangements requires deciphering their symbolic properties. Social goods have an "external effectuality", for example in odours and sounds, which people perceive in different ways and thus influence the constitution of space [69] (p. 132).

The constitution of space through action usually does not take place in isolation, but is linked through negotiation processes with other actors. The negotiation of power relations is inherent to such processes [64] (p. 228). Bringing together the key notions described above, Löw provides an additional lens on the constitution of space that centres attention on inequality and power. In order

to place social goods in relation to each other, access to those goods is required in the first place). Access possibilities might, however, be asymmetrically distributed and hence also the possibilities of shaping space [69] (p. 178). According to Löw, the opportunities to constitute space are restricted or enhanced due to (i) limited or increased possibilities of utilising social goods ("dimension of wealth"); (ii) limited or broader knowledge or credentials ("dimension of knowledge"); (iii) limited or increased possibilities of utilising social status ("dimension of rank"); and (iv) (non)-membership ("dimension of association") [69] (pp. 177–183).

Drawing on Giddens' structuration theory and Bourdieu's concept of habitus, in the concept of relational space action elements and structural order are understood as being in duality—the "duality of space" [71]. Any scientific analysis of space according to Löw has to consider structures and the characteristics of people and social goods as much as the interrelations amongst them. Only if both are understood and studied concomitantly, it becomes possible to grasp and analyse space. Consequently, space is not static, but dynamically (re-)figured. It furthermore is not absolute, but relative to who looks at it and might be perceived differently depending on actors' positions [69] (Table 1).

Table 1. Key elements in the constitution of relational space according to Martina Löw [69].

Structures *(orders)*		Bodies		Processes *(ordering)*		Access Possibilities
Institutions	Social Goods	People	Synthesis	Spacing		Dimensions of Inequality
Structures are rules/norms and resources embedded in institutions; spatial structures are a form of societal structures; structural principles e.g., class and gender permeate all structures/actions	Social goods have both symbolic and material dimensions, e.g., a street sign; some are primarily material, e.g., a beamer in an arrangement 'meeting room'; others are primarily symbolic e.g., values, songs	Living beings who are arranged with social goods	Processes of perception, imagination and memory, guided by notions of space and habitus	Processes of placing people and social goods or of being placed, includes institutionalised and countercultural action		Wealth dimension: possibilities of utilising social goods; financial resources; knowledge dimension: knowledge and credentials; rank dimension: possibilities of utilising social status; association dimension: (non-)membership

2.2. Implications for Studying Spaces of Participation

In this sub-section we draw from Löw's concept of relational space and deduct a relational approach to studying participation. We adopt Löw's conceptualisation of the duality of structures *(order)* and actions *(ordering)* as the cornerstone of space-making. In analogy, in a participation process the scientific and non-scientific actors involved actively create a space for their interaction. This space is co-constituted by the surrounding societal structures.

Figure 1 schematically represents a process of space-making involving two persons. The actors (P1 and P2) involved in a research project enter into an action situation and position themselves therein (*spacing*). The process of entering into the action situation is determined by the characteristics of the actors as well as by the rules and norms in which they are embedded and the resources that are at their disposal. In this process of *spacing* also social goods are positioned. Once in the action situation processes of *synthesis* start. Through processes of perception actors link symbolic and material goods as well as other people to yield a space. During these processes of *synthesis*, they create a space within which participation can take place—the participation space. It becomes clear that depending on the constellation of actors and structures, different spaces of participation emerge from *spacing* and *synthesis* (Figure 1). An additional aspect is that these two key processes of *spacing* and *synthesis* (*orderings*) are shaped by and actively shape the surrounding structures (*orders*).
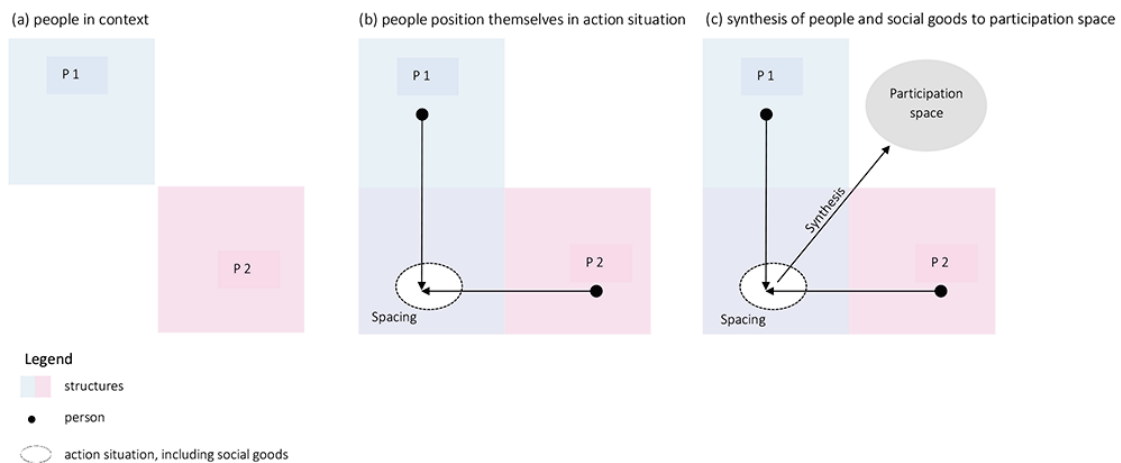
Figure 1. Conceptualising the constitution of a relational participation space (own illustration).

Based on this conceptual approach we derive the following analytical categories for studying participation as relational space (Table 2):

- *Rules and norms* are key elements in the constitution of participation spaces. For example, norms of how to do research influence the figuration of participation spaces. An analysis of participation, thus, needs to take into account its embeddedness in the respective societal structures (*orders*).
- *Resources* are closely tied to structures (*orders)* and recursively embedded in the institutions established in a field. An analysis of participation spaces requires an assessment of the kind of resources available.
- *Actor characteristics and social goods* shape arrangements and the figuration of spaces. Accordingly, an analysis of participation spaces needs to grasp which kinds of actors as well as material and symbolic goods are involved.
- *Spacing and synthesis* are the processes by which relational participation spaces emerge and become functional (*ordering*). Thus, analysing participation as space requires studying how actors and social goods position themselves/are placed (*spacing*) in an action situation. Concomitantly, processes of perception and imagination need to be studied through which people and social goods are combined to yield spaces of participation (*synthesis*).
- Across these four categories, mechanisms of inclusion and exclusion take place. Analysing the constitution of participation spaces requires to pay attention to *access possibilities*, determined, for example, by the distribution of resources amongst actors.

Table 2 displays the analytical questions that help us identify and systematically integrate the key elements shaping relational participation spaces from across the three scholarly fields.

Table 2. Analytical questions for analysis of constitution of participation spaces adapted from Martina Löw's relational space (own representation).

Dimension	Key Elements Adapted for Studying Participation as Relational Space	Analytical Questions for Participation as Relation Space
I. Structures *(orders)*	Rules and norms	Which rules and norms do actors who are involved in the making of spaces of participation relate to? Which ways of functioning, of doing research or of interacting with researchers have they routinized? Which new rules have to be created for spaces of participation? According to which rules are resources distributed amongst actors?
	Resources	Which resources are important to shape spaces of participation? Which resources are available? Which actors can rely on these resources?
II. Actors	People and social goods	What kind of people create spaces of participation? Which kind of material and symbolic goods are available in an action situation?
III. Processes *(ordering)*	Synthesis and spacing	How are people and social goods positioned in relation to each other/how do they position themselves? How close or how far away from each other are the actors (e.g., with regard to their perceptions and expectations) and how does this distance/closeness change throughout the process? Which people and social goods are synthesised to spaces of participation? How are people and social goods linked to yield spaces of participation?
Transversal	Access possibilities	Which mechanisms of inclusion and exclusion take place in the constitution of spaces of participation? Which role do wealth, knowledge, rank and association play?

3. Materials and Methods

This paper is based on a qualitative literature review of participation in knowledge production in sustainability research, development studies, and STS. In this section, criteria for selecting these three bodies of literature, the analytical procedure, and the types of material used are outlined.

3.1. Selection of Bodies of Literature

The focus lies on TD literature as a core discourse on participation in knowledge production in sustainability research. Literature from two other scholarly fields is included which are essential with regard to participation in knowledge production: (i) participation in development research and (ii) participation in STS. This choice is motivated by their relation to two of the key components of TD sustainability research as identified in the introduction:

(i) TD sustainability research is grounded in lifeworld problems and strives to provide solutions; what is considered a desirable solution is normatively guided by some idea of sustainability. Similarities to development research can be found, where participatory approaches strive at researching lifeworld problems and offering solutions guided by what is considered to be desirable development. A tradition of participation and inclusion of local knowledge in participatory rural appraisal (PRA) and participatory action research (PAR) has been formed over the past 50 years [72,73].

(ii) TD sustainability research consists of knowledge production processes and aims at integrating different forms of expertise. STS provides a wealth of experience in studying the mechanisms of science and practices of producing knowledge. Participation of heterogeneous actors in science and technology has become a key concern of STS [74]. Next to empirical analyses of "mode 2" research scholarly interest includes participation of "non-certified experts" [75] in technology and risk assessments. The latter emerged from the 1970ies onwards in reaction to public controversies surrounding techno-scientific programmes (e.g., nuclear power). Participatory assessments aim

to involve "assessors other than scientists [. . .] as fully-fledged social actors who bring not only their professional expertise (as farmers, campaigners, planners, business people, interest groups, etc.) to bear on the assessment but also their social expertise and experience" [76].

Despite their specificities, across the three fields participatory approaches deliberatively blur the boundaries and challenge the 'traditional' division of labour between research and practice.

3.2. Selection and Description of Material

In order to select publications on participation and similar practices under different headings in the three fields, a two-step procedure was followed. In a first exploratory step, a keyword search in 'google scholar' and 'web of science' using combinations of the following keywords was conducted: "participation, or transdisciplinary or co-production" and "sustainability research/science, or development studies/research or science and technology studies or technology assessment". Due to the high heterogeneity of meanings given to these notions, this step served exclusively as a basis for identifying an initial set of publications (e.g., meta reviews) and to become familiar with the use of terminology across the fields. In a second step, a snowball sampling approach was followed [77], whereby references provided in the initial set of publications led to the next set of publications. Due to the aim of bringing TD sustainability scholarship into conversation with parallel, but also earlier scholarship on participation, no specific time period was set for the inclusion of publications. Yet, only publications published up to 2017 were considered (Table 3). The earliest publication included in the sample is a PRA study from 1991 and the most recent ones are studies from the field of TD in sustainability research from 2017.

Table 3. Main criteria applied for inclusion/exclusion of publications.

Criterion for Inclusion of Publication	Explanation
Topical focus	Sustainability-related (no sectoral focus set), development-related (focused on developing countries and/or North-South context), science and technology-related (focused on assessment of scientific, technological issues), self-declared;
Minimum definition of participation in knowledge production	*Participation:* In order to operationalize the concept for the literature review, we set the following minimum criteria (i) definitorial moment and (ii) structured process. We understand participation as a spectrum including different forms of interaction between actors from the research and the respective practice field [47]. Participation starts where some degree of influence over the processes is passed onto those participating. This presupposes a decision of the initial group of actors to 'invite publics' [11]. In this understanding participation processes are structured processes;
	Knowledge production: We focus on participation in processes aimed at producing new knowledge. We rely on Mackinson et al. [78] to distinguish these processes from policy processes primarily aimed at taking decisions;
Type of data I: case study-based or empirical study	Single and multiple case studies, empirical investigations about participation in knowledge production and research; similar entities of research in terms of scope and complexity: focus on concrete projects; theoretical reflections and discussion of ideal-typical processes are excluded; case studies that exclusively discuss the research output, but not the participatory process, are not considered due to a lack of data;
Type of data II: review	Publications that deliver meta-analyses, research syntheses, and critical evaluations of existing publications in the respective fields;
Time-span: published up to 2017	The time-span of the qualitative review was deliberately wide so as to account for different traditions in the respective fields.

Following the principle of saturation [79], 79 articles were reviewed (Table 4). The material includes monographs and edited volumes, journal publications, working papers and one project report. This variety allows us to take account of different publishing traditions in the three fields. Including sources beyond peer-reviewed journal publications has been considered of particular importance for studying TD processes [80]. Depending on the self-declared field to which the authors

contribute, we attributed publications to one of the three fields. Where differences were not evident, we additionally considered the location of the case study (for development research), institutional affiliation of authors and journal. Since we are interested in participation processes (and not theoretical ideal-types) empirical and case study-based literature was selected. Due to the diversity between and within participatory approaches, similar reviews have identified the empirical and case study level as the most meaningful entity of analysis [81]. While case study is an elastic notion, it is here used to describe research in which one or several knowledge production projects are analysed in-depth or used in an exemplary way. Both self-reflections by researchers on their projects and empirical analyses of cases conducted by third parties are included. The cases cover various geographical regions and thematic foci in the area of developmental, environmental, and technological issues. In addition, the few available meta-analyses, as well as empirical enquiries that are not based on specific (own or third-party) projects, but address participation in empirical studies (e.g., interview and survey-based investigations), were considered. For the discussion and introduction, we included additional literature to contextualise our approach.

3.3. Analytical Procedure

Our approach is based on a qualitative in-depth analysis of each publication and applies a synthetic approach for qualitative studies [82]. Firstly, literature was examined and categorised by basic characteristics, i.e. publication category, main scholarly field, aim of the paper, type of actors involved, notion of participation used. Secondly, we extracted the empirical investigations relevant to understanding TD, participatory, knowledge production processes and the factors that shape them. While the suggested perspective on participation as relational space (Table 2) provided the frame for the analysis of the material, the sub-categories for elements presented in the results section were inductively derived from the analysis. A statement was considered a potential factor if explicitly mentioned by the authors as:

- a condition for success or failure of a participation process;
- a challenge to engagement;
- a (un)favourable precondition;
- having had an impact on the process; and
- guiding principles in order to achieve a 'good' process.

In an iterative process, we analysed, clustered, and discussed the empirical findings in relation to the conceptual perspective.

Table 4. Types and number of articles according to participation approach and scholarly field.

Field/Approach and Type of Articles	Sustainability Research	Development Research	Science and Technology Studies
Main approaches	Transdisciplinary research	Participatory rural appraisal (PRA), participatory action research (PAR); transdisciplinary research	Participatory risk assessment, participatory technology assessment; public engagement
Review articles	7	/	1
Case study-based articles (incl. self-reflections)	28	12	7
Other empirical articles	9	3	1
Additional	1	7	3

4. Results

This section presents the results of the qualitative review of empirical and case study literature in three scholarly fields. Based on our conceptual perspective, we group the factors which are found to shape spaces of participation along the dimensions 'structures' and 'actors' and explore their role for 'processes' (Figure 1, Table 2). The dimension 'structures' refers to the systemic context within

which action situations are embedded. Structural factors are grounded in the academic, but also in the respective practice field and are captured in structural and procedural aspects of research projects. The 'actors' dimension assembles factors which are tied to characteristics of individuals, as well as material and symbolic elements. The dimension 'processes' conceptually links the findings of the literature review to the key processes of space-making and explores the meaning of each element for *spacing* and *synthesis.* Table 5 summarises the findings and outlines their relation to the (re-)figuration of the participation space.

4.1. Dimension I: Structures

4.1.1. (In)Coherence with Wider Reference System

Numerous publications, particularly in the fields of sustainability research and STS, refer to the influence of the institutional setting and established structures within which TD and participatory research practices take place [83–85]. The fundamental importance of the wider context of science and technology governance lies both in its role in delimiting participatory processes and in being reciprocally shaped by their outcomes [51]. When it comes to the practicability of opening-up research, numerous challenges are identified. Many of these relate to the fundamentals of the academic system which are perceived as being constraining and in contradiction with participation spaces. The following tensions with the dominant structures are discussed: (i) participatory and integrative research vs. disciplinary career paths; (ii) the need to communicate findings to the involved non-scientific actors in a comprehensible form vs. the academic requirement of publishing in highly specialised, high-ranking scientific journals; and (iii) participatory processes are time-consuming vs. time constraints in externally-financed projects [6,85–91]. In a PRA study from 1990 similar tensions are discussed between the traditional criteria of project assessment and the potential merits of PRA [92]. This perceived inflexibility of the traditional structures is interpreted as an expression of the dominance of positivist epistemologies in scientific environments [93] and as a reflection of research traditions circumscribed by epistemological frameworks of highly specialised disciplines [92]. Schmid and Pröpper [89] trace these understandings of science in funding programmes and reward systems and argue that the influence of the science funding body over the TD process from its conception onwards determines the discourse on structural challenges. Felt et al. [59] (p. 4) find that also programmes explicitly designed for participatory or TD research "[. . .] remain limited in scope as they operate in an environment in which this kind of cross-boundary work does not fit the established standards". These fields of tension suggest that researchers are exposed to conflicting reference systems [84,94,95] which negatively affects their satisfaction as well as project effectiveness [95]. In reaction, some scholars call for the establishment of integrated institutions as a supplement to the disciplinary-based structures of research systems [96]. In an analysis of five projects embedded in a TD centre which was designed to act as a boundary organisation, commonly found challenges of insufficient participation and unbalanced problem ownership were not detected. However, this institutionalisation is found to entail new hybrid problems with regard to knowledge transfer and scalability [97].

Just as the scientific field, the idiosyncrasies of the respective practice field, in which participating non-scientific actors are embedded, might more or less encourage participating in knowledge production processes. In a study of PRA, Holmes [98] states that cultural traditions in the respective community influence participatory appraisals, but does not explicitly describe the nature of this impact. Furthermore, the kind of democratic culture in which a participatory endeavour is set might influence the motivation and ease of actors to participate [42,51,99]. With regard to TD processes Polk [100] (p. 12) stresses that "[p]olitical organizations have specific mandates, regulations and procedures" which differ from those of academic institutions. With the exception of such comments, the institutional norms that non-scientific actors adhere to have hardly been discussed in the TD literature reviewed.

Role for processes (spacing, synthesis): Regarding the constitution of participation spaces, these structural elements provide the frame for processes of synthesis and spacing (Figure 1). The norms to

which scientific and non-scientific actors adhere affect which kind of participation is conceivable and how they position themselves in the action situation. Routines affect which elements actors synthesise by default to a participation space. In relation to these norms, scientific and non-scientific actors (re-)draw the boundaries between research and practice. Perceived incompatibilities of rule-sets lead to a clear delimitation of a participation space or might preclude the emergence of a participation space.

4.1.2. Financial, Time, and Social Resources

The availability of, and access to, resources is discussed with regard to success or failure of participation in knowledge production [37]. Time and financial resources are brought forward as decisive, but also competences are addressed as resources [101]. Scarcity of time for defining participatory activities, including time-consuming knowledge integration tasks, as well as rigid timelines, are seen as key issues constraining participation [45,93,102–105]. Felt et al. specify that "[. . .] what is regarded as an adequate duration and temporal structure of participatory events obviously impacts the possible ways in which matters of concern take form" [106] (p. 183). Likewise, the opportunity costs for participating non-scientific actors might be high and are often underestimated by the scientific counterparts [104,107,108]. Depending on the setting, opportunity costs vary, for example, in accordance with seasonality [98] or the priorities of those who are expected to participate might be with other issues [109]. Linked to time resources, the availability and distribution of financial resources is more or less conducive to certain forms of participation [110–114]. Financial restrictions during the development of research proposals shape the way the problem is defined and has repercussions on who is involved in this step [89]. The extent to which financial incentives are offered to participants shapes their capacity to engage and influences the participation process [87,104]. In the literature on participation in technology assessment, some authors take a critical stance on financial compensation. In a study on participation in the development of a local waste strategy, no evidence is found that financial compensation of those invited to participate would have increased their motivation or fundamentally altered the process [115].

In addition to financial and time resources, competences, and social capital of participants in the knowledge production process are considered resources shaping participation [6,104,116]. Tied to the institutional embedding of scientific actors, the specialised nature of scientific disciplines that most professionals are trained in rarely provides them with the skills needed for collaboration in heterogeneous teams [92].

Role for processes (spacing, synthesis): Financial, time, and social resources provide the conditions for actors to position themselves closer to, or with greater distance to, each other. The availability of resources affects the scope of the participation space (e.g., how many people can be mobilised; how often can meetings be arranged). The distribution of resources which is tied to rules and norms shapes the capacities of actors to actively engage in the making of participation spaces through synthesis.

4.1.3. Timing of Participation

The point in time when participation first occurs in a project is found to shape the evolution and outcomes of participation. The relevance of the timing of first involvement lies in the circumstance which actors take part in the initial definition of participation spaces. With regard to participation in technology assessments, partaking in front-end framing allows to influence the definition of problems and the design of alternative courses of action, rather than to only opt for predefined alternatives [99,117]. TD literature suggests that often initial project ideas originate in an academic context, with researchers then approaching whom they consider relevant non-scientific participants. These are typically taken on board after the funding proposals have been submitted and accepted [59,83,88,118]. Some authors ascribe this phenomenon to an incompatibility of co-design of project ideas and proposal-based research funding mechanisms [89,91,119]. The repercussions of late first involvement are controversially discussed. Numerous authors argue that whoever initially

formulates the problem owns the process [120]. Not involving non-scientific actors in the initial phases of a project results in unbalanced problem ownership [45,87,91,101,118,120,121]. Early involvement is associated with increased legitimacy and relevance [90] and higher implementation chances for results [122]. In contrast, in an interview study with both scientific and non-scientific actors in TD projects, Di Giulio and Defila [123] find no evidence of such a path dependency with regard to the moment of first involvement. They show that involvement at a later stage is not necessarily perceived as problematic and matches the preferences of non-scientific participants who welcomed a traditional division of labour between scientific and non-scientific actors in early project phases. These controversial results illustrate the need for better understanding the reference system of non-scientific actors and their conception of science-practice relations.

Role for processes (spacing, synthesis): Timing is decisive for the question of who is entitled to pre-arrange social goods and to set the cornerstones of the participation space within a project (e.g., design of procedural aspects). As in early stages of knowledge production, the elements of the problem definition are set, the moment in time when involvement occurs affects the context in which the participation space is inscribed. By pre-defining and ascribing roles to different actors, those not involved in initial steps are passively positioned. Depending on the expectations of an actor this might (not) be perceived as undesirable.

4.2. Dimension II: Actors

4.2.1. Expectations and Motivations

Expectations of participants, the compatibility of different expectations and the degree to which they are met by the research process shape the interactions of heterogeneous actors [91,113,123]. Several challenges are addressed with regard to the ways in which expectations shape participation spaces. Renner et al. [122] report that scientists perceived the expectations of non-scientific participants to exceed general research requirements and to be poorly aligned with the scientific requirements that they had to fulfil. Regarding the management of expectations, they find that the diversity of worldviews present in a project increases the danger of discrepancy between expectations of scientific and non-scientific actors and negatively impacts on collaboration. Others mention challenges of sustaining the interest of non-scientific participants over the course of a project [87] and of reconciling open-ended research processes with clear expectations on process outcomes by non-scientific actors involved (e.g., of political actors) [90]. On the example of a TD development project, Habermann et al. [124] illustrate that unrealistically high expectations of local actors led to disappointment and reduced motivation for collaboration. McKee at al. [104] show that expectations of non-scientific actors can last beyond the official project end. In their case studies, researchers were seen as a precondition for the continuation of the process and expected to assume the roles of coordinators of dialogue. The dual role of researchers and possible incompatibilities of expectations can be particularly challenging when "[t]he researcher's primary interest is to understand stakeholders' perspectives on the topic, therefore by sharing their opinion this outcome would not be achieved" [104] (p. 95). Expectations are linked to ownership and the motivation to engage in the making of participation spaces. Lacking ownership of and interest in the TD process on the side of non-scientific actors is found to be due to frustration and dissatisfaction because they "could not see any changes, only talking" [89] (p. 374). A self-reflection study including the view of the "practice partner", who was officially co-leader of the project, finds that the timeliness of an issue addressed positively affects the motivation and commitment of "practice partners" [102]. Overall, emphasis lies on how to manage expectations and less on the nature of expectations and motivations. Several authors consider the management of expectations from the very beginning as key to 'successful' processes [48,111]. In addition to expectations with regard to the process and its outcomes, expectations towards the respective others and the perceptions of their expertise might shape interactions between the actors involved [107]. In conceptualisations of

participation in technology and risk assessment, the underlying motivation of those setting up the process play a prominent role [52] and serve as a basis of categorisations [25].

Role for processes (spacing, synthesis): Expectations of actors regarding the nature and the outcomes of the process shape the ways in which they position themselves in an action situation. The higher the perceived potential of the process, the closer actors might try to move towards the others. Expectations also shape perceptions of what the space should look like and suggest which other actors or which elements of a topic are synthesised. Expectations can change over the course of the project. If they are not fulfilled, actors might change their positions and move towards the periphery of the space. The greater expectations diverge the higher the likelihood of ruptures in the participation space. Consequently, commitment of actors to engage in the participation space and to take ownership for follow-up steps might decrease.

4.2.2. Mutual Trust

Development of trust between actors is highlighted as a precondition and success factor for participation [57,60]. Renner et al. [122] report that the absence of mutual trust among local partners and scientists lead to interrupted or declining participation of non-scientific actors. Similarly, in an empirical study on the roles of community development workers in PRA, the nature of the relations and the degree of trust between the community development worker and community are found to be key in enabling and preventing exchange [98]. The development of trust on the side of non-scientific participants relates to whether the researchers are perceived as being competent and capable of solving the problem that non-scientific actors face [114,125]. Furthermore, Maclure et al. [92] illustrate that the extent to which non-scientific actors, in their case farmers, feel they can impact on the process, shapes confidence-building and commitment. Mutual trust is seen as a precondition, as a deep-seated challenge and as potential outcome of TD processes [93]. In their reflections on a TD visioning process, McKee et al. [104] (p. 94) argue that "[. . .] previous working relationships could generate more confidence that the overall TD process would be worthwhile for stakeholders and viewed as an opportunity for further interaction with academia, since the relationship precedes and exceeds the project timeframe". In addition to long lasting contacts, engaging on "equal footing" is described as essential for building trust [89]. In a study on ten TD collaborations, three strategies for building trust are identified: building on existing relationships, the use of intermediaries and guarantors and building trust through the project [126]. Reflecting on a PAR project, Dewulf et al. [127] highlight the importance of shared experience and common practice in order to allow tacit knowledge to be exchanged. In their experience with the participation of indigenous farmers in a project on irrigation systems in Ecuador, direct interaction between "communities of practice" cannot be replaced by intermediaries. Furthermore, the "chemistry" between actors and the extent to which personal characteristics of scientific and non-scientific actors in the team match influence their interactions [101]. Bell et al. [58] demonstrate the importance of group dynamics in shaping outcomes of participation.

Role for processes (spacing, synthesis): Scientific and non-scientific actors who are socially close to each other or who know each other leave less space between each other than do social strangers. The boundaries of this space in-between becomes tangible when one person transgresses them. This can lead to a distancing of the others. Trust in the competences and reliability of the others affects the extent to which the contributions of other participants are considered in the process of synthesis. Throughout the processes, trust can grow or decrease depending on the experience gained. The stronger the ties between the actors, the higher the capacity of the participation space to refigure in case of a changing context.

4.2.3. Worldviews and Values

The role of values and worldviews in shaping interactions of scientific and non-scientific actors is addressed in particular in sustainability and development research. When it comes to framing and solving sustainability problems different societal groups and actors express diverse and sometimes

incommensurable values [14,128,129]. What is perceived as sustainable in a specific situation might vary considerably among actors and is likely to involve trade-offs. This plurality of values and perspectives feeds into the constitution of participation spaces [90,130,131]. Rosendahl et al. [35] understand situations of incongruity between non-scientific actors and researchers as an expression of pre-existing perceptions of the issue at stake. They highlight that researchers also hold positions in the "social matrix" and implicitly or explicitly bring their values into the research. The positions of researchers on how to deal with diverging worldviews and if and how participatory processes should strive for consensus differ. Some state that TD needs to cope with reconciling and assimilating competing worldviews [93]. Others argue that denying incommensurability in order to fulfil the principle of equal stance leads to a neglect of diversity and entails the translation of discordant knowledge into the dominant one [117,132]. In an interview study on the effectiveness of participatory appraisal of science and technology, one participatory process expert puts the fine line between finding common grounds while embracing difference in a nutshell: "[. . .] being collegial and co-operating to understand each other [. . .] [is desirable]. But if you push that too strongly then you are actually pushing a hegemonic sort of model" [117] (p. 173). In a comparison of 15 TD projects, the relation between partner diversity (including "values, norms and/or goals of partners", "view on science-society nexus") and project performance is found to be ambiguous. While the authors' analysis suggests negative effects of higher partner diversity, interview partners stressed the positive effects of diversity on creativity and conflict prevention [95]. In another TD study conducted within a boundary organisation, the scientific and non-scientific actors found constructive ways of dealing with diverging worldviews and diverse backgrounds. The authors see this as a reflection of "[. . .] norms regarding how to handle different and conflicting opinions within the temporary practice" [133] (p. 394).

Role for processes (spacing, synthesis): The role of worldviews and values for space-making is two-fold. Firstly, worldviews and values frame the ways in which scientific and non-scientific participants make sense of their environment. They guide actors in deciding which elements of a topic and which kind of knowledge are important and which changes in their environment are desirable. These decisions are critical for the ways in which actors synthesise elements to a participation space. Worldviews and values also play a role in how actors position themselves, e.g., if two actors share the perception of the problem they might move closer to one another. Secondly, worldviews and values are symbolic goods that are synthesised to a participation space.

4.3. Power Relations [Transversal]

Across the three fields scholars identify the need to further investigate unbalanced power relations and ways of addressing them [60,72,85,86,125,134–136] and find that power relations influence the nature and process of participation [89,119,122]. Questions of power concern both relations between scientific and non-scientific actors and within non-scientific actor groups which might include heterogeneous actors, such as farmers and policy-makers [14].

The most visible form of power manifests itself in the distribution of resources. In a north-south TD collaboration, unequal starting positions and access to resources among African partners are found to have weakened ownership and commitment [89]. Similarly, Raymond et al. [137] attribute scientific dominance in two projects aimed at integrating local and scientific knowledge for environmental management to the unequal distribution of external funding. Even if all research phases are conducted jointly with partners, some actors might be more powerful than others, for example when researchers hold the coordination function and are in charge of time schedules [35]. Additionally, macro-societal structures, such as gender relations, might imply power relations amongst participants. This is, for instance, observed in an empirical study on PRA projects when women are not at ease to speak and share their experience in workshop settings [98]. Linked to the reproduction of macro-societal power relations, group dynamics embody another manifestation of power in participatory processes [58]. In an observation of TD case-based mutual learning sessions, the authority of some actors is found to be tied to their expertise or profound knowledge of the given issue. In the intercultural and

international setting of this study, differences in discussion cultures are found to favour dominance of some actors [105]. Dominance of one or several individuals is observed both within a single action situation (e.g., a workshop) and over the course of a 3–4 years TD processes [133].

Most prominently in development research, the widespread adoption of participatory approaches was accompanied by critical voices on the concept and practice of participation [55,138–140]. The critique falls into two groups and puts power centre stage: (i) an internal critique of techniques and methods aimed at ameliorating practices of participation; (ii) a fundamental critique which unfolds power effects of participatory discourses [141]. In internal critiques of PRA processes reflexivity with regard to societal power relations is called for which are found to have "[. . .] implications in [sic] the nature of involvement" [120] (p. 112). Representatives of the radical critique provocatively ask if participation has become "the new tyranny" [139]. Similarly, in the two other fields some scholars call for the use of facilitation techniques in mediating power dynamics. For example reserved participants should be actively encouraged to express themselves in action-oriented sustainability research [136]. Others argue that theories of public deliberation in the appraisal of science and technology should be refined so as to explicitly highlight "[. . .] power relations and exclusions through confrontation, antagonism, and the exploration of difference" [117] (p. 179). In a network-based approach to knowledge systems, Munoz-Erickson et al. [142] observe that the knowledge of those holding power over resources was dominant. Knowledge about the issue under investigation had passed through the filter of values of the powerful actors. Thus, examining power becomes key to understanding "[. . .] why more science does not necessarily lead to change and innovation" [142] (p. 189). In their case study the drawing of boundaries between different epistemic cultures emerged as a strategy to manage power. This boundary-work, however, entailed the privileged treatment of some expertise [142]. Along these lines, McKee et al. [104] (p. 95) stress that when "[. . .] knowledge of researchers is highly valued [. . .] there is a tendency for non-academic participants to become passive receivers of information". In such a situation greater authority is ascribed to scientific knowledge. Process design should facilitate the articulation of epistemological distinctions from the outset as to avoid imbalanced power relations [120]. Discussing collaborative research, Shdaimah and Stahl [57] suggest analysing power and control not only as a problem to be solved, but as an element inherent by default to collaboration processes.

Role for processes (spacing, synthesis): Power relations pervade synthesis and spacing and are reproduced or disrupted through them. In the case of an asymmetrical distribution of resources, those with fewer resources have limited opportunities to actively shape the constitution of a participation space. Possibilities of access to a participation space are also organised by way of knowledge. Exclusionary mechanisms are at play when some forms of knowledge are perceived as more credible and others as less valid or trustworthy. The norms that govern a participation space can favour the ways of reasoning, expressing, and behaving of one person/group. Those who do not dispose of resources, or whose resources are less recognised, can still be part of the participation space, but have limited possibilities of shaping its constitution. By determining who can effectively negotiate the design and use of space, access possibilities affect the extent to which figurations of a participation space break loose of societal structures and dominant discourses.

Table 5. Overview of results in relation to key elements in the constitution of relational participation spaces (authors' own compilation).

Dimension	Key Element of Relational Space (Table 2)	Element in Literature	Role for (re-)figuration of Space via Processes of Spacing and Synthesis (III)	References
I. Structures	Rules and norms	(In)Coherence with wider reference system	Affects via rules and norms which figurations of a participation space are conceivable and which elements actors synthesise; the norms to which actors adhere affect how they position themselves; incompatibilities of rule-sets lead to a clear delimitation of the participation space;	[6,42,51,59,83–100]
	Resources	Financial, time and social resources	Affects possibilities and capacities of actors to actively shape the participation space; affects the degree of engagement of actors and results in different degrees of (a)symmetry of space; affects whether actors position themselves/are positioned at the core or periphery of the participation space;	[37,45,87,89,92,93, 101–115]
	Resources	Timing of participation	Affects who is entitled to set the cornerstones of the participation space; affects through synthesis in which context the participation space is inscribed; by ascribing roles to different actors, those not involved in initial steps are passively positioned; might affect the extent to which actors identify with the aims and formats of participation;	[45,59,83,87–99,101, 117–123]
II. Actors	People social goods	Expectations and motivations	Affects synthesis via perceptions of what is an adequate dimension of the participation space to reach a specific aim; incongruence of expectations can lead to controversies and ruptures in the participation space; affects commitment of actors to engage in the participation space and possibly ownership for follow-up steps;	[25,48,52,87,89–91, 102,104,107,111, 113,122–124]
	People and social goods	Mutual trust	Affects distance between actors and whether the knowledge of others is synthesised; affects via the nature of ties between actors the capacity of the participation space to refigure in case of changing contexts; affects the likelihood of institutionalisation of the participation space;	[57,58,60,89,92,93, 98,101,104,114,122, 125–127]
	People and social goods	Worldviews and values	Affects potential conflicts of appropriation of the participation space; which worldviews are effectively synthesised, relates to capabilities of actors to articulate them; depending on the implicit norms with regard to participation, controversy might be embraced or deemed problematic; affects which discourses outcomes feed into;	[14,35,90,93,95,117, 128–133]
Transversal	Resources, rules and norms, people and social goods	Power relations	Affects the continuous negotiation processes inherent to the figuration of a participation space; affects the degree to which these figurations reproduce or disrupt societal structures and/or dominant discourses; affects via the distribution of resources and the validation of knowledge, inequalities among actors and their capacity to produce figurations of the participation space that other participants share;	[14,35,55,57,60,72, 85,86,89,98,104,105, 117,119,120,122, 125,133–142]

5. Discussion

In this section, we conceptually link the core dimensions constituting relational spaces of participation and critically discuss the contribution of the proposed perspective to the emerging field of critical and transformative sustainability sciences, as well as its practical applicability.

5.1. Participation as Relational Space: Linking Structures, Actors, Processes

In this paper, we deconstructed the dominant imagination of participation as ladder and its analytical focus on intensities of involvement. We reconceptualised participation as a relational space and looked at how it is figured and refigured in an interplay of structures and processes.

The findings of the qualitative literature review (Table 5) allow us to substantiate the conceptual approach presented (Figure 1). They show that several structural elements shape the positioning of scientific and non-scientific actors in an action situation (*spacing*). In the case of scientific actors, norms of 'sound' research practice, routinized ways of generating knowledge, and academic reward systems pre-arrange which social goods and people are perceived as being part of the situation. In tendency, actors position themselves in a way that allows them to uphold the requirements of their reference systems. The perceived incompatibilities with the wider academic system identified in the literature review might lead to greater distances and weaker ties between participants. In case of incompatibilities between the reference systems of scientific and non-scientific actors, actors might not find common ground in negotiating their positions. Closely tied to the institutional context, in most cases reviewed the distribution of resources for engaging in participation spaces is unequal. Whether a participation space is primarily embedded in a research setting or rooted in a specific practice field marks an important difference. Related to how the actors interpret the rules and norms, the characteristics of actors, as well as the available social goods shape processes of *spacing*. Expectations with regard to the process and its outcomes, worldviews, and values of actors, as well as prior experience in collaborating are found to be critical in this regard. Two actors who share a problem perception, hold the same vision of change and/or value the knowledge of the respective other, might position themselves closer to each other. The higher the expectations, the closer actors might try to move towards one another. How close they step together is also determined by the level of mutual trust. While conceptually separate, the processes of *spacing* and *synthesis* mostly take place in parallel in the constitution of participation spaces. Actors combine social goods, e.g., worldviews values, as well as other actors to yield a participation space. Which worldviews, values and knowledge are synthesised to a participation space affects into which discourses outcomes eventually feed. In this negotiation process unequal possibilities of constituting a participation space, e.g., due to limited access to resources, play an important role. The decisions on who and what is synthesised to a participation space are tied to the structural and actor-related elements mentioned (Table 5). Depending on the constellation of elements, the spaces of participation that emerge from *spacing* and *synthesis* take different shapes. These shapes can change throughout a project, as trust increases/decreases, expectations are fulfilled/disappointed or worldviews aligned/conflicting.

An additional aspect of the conceptual approach to participation as relational space is that *spacing* and *synthesis* are shaped by and actively shape the surrounding structures. In the short-term, within the duration of one project, our review did not provide examples of how norms and rules change. Over the long-haul, as alternative ways of synthesising spaces of participation are shared and reproduced by a growing number of actors, rules, norms and resources might transform. Our findings show that when looking beyond one specific action situation to the wider landscape of participation in research some examples can be found. Signs of how *synthesis* and *spacing* in a longer time horizon relate back to the surrounding structures can be seen in those cases in our literature review in which boundary organisations have been set up.

5.2. Contribution to Critical and Transformative Sustainability Sciences

The diverse elements that we identified in the literature review as shaping participation show the need for greater differentiation when we speak of participation and its role for producing 'socially robust' knowledge and for facilitating desired change processes. In particular, in the field of sustainability science this implies a clarification of whether we speak of participation primarily with regard to achieving change (e.g., transformative approach) or of participation with primarily epistemic ends (e.g., descriptive-analytical approach) [28]. Critique as method of descriptive distinguishing and

a movement of differentiation has been considered key to critical sustainability sciences [143] and can help us to foster dialogue between transformative and descriptive-analytical approaches [144]. The problematisation of discourses and buzzwords constitutes an integral feature of critical social sciences [40]. The proposed perspective on participation as a relational space contributes to such a critical approach along the core dimensions of space-making: (i) *structures*: the politics of participation and the role of power, (ii) *actors*: 'situatedness' and the notion of agency, (iii) *processes*: from static input to dynamic process, and (iv) reflexivity and practical applicability.

5.2.1. Structures: the Politics of Participation and the Role of Power

Critical sustainability sciences require critical participation studies. In drawing attention to the figuring and refiguring of spaces of participation, the perspective on participation as relational space opens up the opportunity to address critical questions about the politics of and power inherent to participation.

The embeddedness of participation spaces in wider institutional landscapes requires paying attention to the politics of participation [145] and the normative dimensions inherent to all phases of participatory and TD sustainability research [146]. By emphasising the duality of structures and processes the proposed perspective helps to critically scrutinise the very norms, rules and resources that shape participation spaces and asks to which forms of interaction these are conducive. At the same time, this duality incites us to examine how spaces of participation shape norms and rules, e.g., of what 'good' and/or societally relevant research consists of and of how to assess the quality of expertise [75]. If fundamentally new rules emerge countercultural spaces might be formed which deliberatively break with routinized practices. In the literature reviewed, the rule-sets within which participation spaces are embedded are described as discouraging the emergence of open and interactive spaces. In extreme cases, incompatibilities of rule-sets render impossible the emergence of a participation space. Furthermore, the norms that govern a participation space can favour the habitus of one person/group and might lead to asymmetrical interactions. In drawing attention to these elements, the proposed perspective joins the call for conceiving participation not merely as a managerial-organisational challenge, but as an intrinsically political act [141,147].

Understanding whose reality and knowledge counts [34] in critical and transformative sustainability sciences, unequivocally means addressing power [39]. The proposed perspective moves power to centre stage. The constitution of participation spaces is linked through negotiation processes to other spaces and includes debates about purpose and means of societal transformation [148]. In sustainability research the definition of sustainability or the weighting of elements of sustainability as much as the decisions on whose worldviews are synthesised embody such negotiations. Our findings show that in TD sustainability research primarily the distribution of resources amongst participants is discussed as a manifestation of power. Discursive, as well as productive forms of power (e.g., "power with" [149]) are not empirically addressed in depth. Neglecting or negating power asymmetries between participants might weaken the transformative potential of participatory research [35,60]. Seen from the perspective of participation as relational space, *synthesis* processes which are dominated by those holding the resources or the most normalised knowledge might hamper or even preclude the development of mutually shared perceptions of a participation space. A participation space that is shaped by one perspective is limited in the social goods, worldviews and values that are synthesised. Concomitantly the knowledge of less powerful actors might not be synthesised and innovation might be inhibited [142]. Our findings show that institutionalised practices of applying for project funding lead to a de facto exclusion of non-scientific actors from setting the cornerstones of participation spaces. By ascribing roles to actors, those not involved at this stage are passively positioned. Whether or not this is perceived as problematic depends on the motivations and expectations of the respective actors. By determining who negotiates the design and use of the participation space, power affects its potential to disrupt societal structures and dominant discourses. In case of highly unequal power relations, the capacity of a participation space to transform the societal status quo in which it is embedded is low.

The proposed perspective provides guidance for a comprehensive study of power, taking into account mechanisms of inclusion and exclusion in the constitution of participation spaces. With regard to knowledge production processes, the four access possibilities (Table 2) are particularly useful to reflect on which knowledge is credible and in how far credibility is linked to association and membership of a specific group (e.g., academia). Addressing these issues is important to understand which expertise can be articulated and synthesised in a participation space, and/or which avenues for action are opened up/closed down [52].

5.2.2. Actors: 'Situatedness' and the Notion of Agency

One of the strengths of conceptualising participation with the help of Löw's sociology of space, lies in the relationality of the approach. Assuming that spaces of participation are not absolute forces us to consider that they might be experienced, perceived and delimited differently, depending on how *synthesis* takes place. Our literature review suggests that with a few exceptions e.g., [47,93,102,133] perspectives of non-scientific actors on participation and their embedding in wider institutional landscapes have been marginalised in scholarship on TD sustainability research. Greater sensitivity towards diverse perceptions and ways of synthesising might allow to better plan for results that are relevant for moving towards a more sustainable state. Focusing on the process of *spacing* and *synthesis* contributes to rethink actor understandings that underpin common conceptualisations of participation. A relational approach means seeing non-scientific participants not as passively waiting in a natural state to be mobilised [9], but as active agents in the making of participation. It incites us to study not only the perspectives and motivations of the 'architects of participation' [59], but also the active positioning and ways of synthesising of non-scientific actors, their strategies to appropriate and shape participation spaces in order to influence their desired outcomes. Paying attention to the 'situatedness' of actors and actor relationships [38,44,134], entails moving beyond the dichotomisation of powerful/powerless actors as suggested by the metaphor of ladders. By highlighting the positioning of actors in relation to one another the proposed perspective opens up questions of identity construction [150] and otherness [151]. Furthermore, by stressing the role and 'effectuality' of social goods analysing participation as relational space calls for a wider understanding of actors, encompassing non-human and material elements. By highlighting the importance of positions, the relational approach also contributes to studying the 'situatedness' of knowledge [152] and its context-dependency. Contributing to such an understanding, our approach to studying participation allows conceiving of knowledge as positioned in participation spaces and, at the same time, as flowing between actors and institutions in processes of *synthesis* [153].

5.2.3. Processes: from Static Input to Dynamic Process

Understanding sustainability as an evolving process [143] requires critical and transformative sustainability sciences to be attentive to dynamics inherent to participation. So far, the dynamic nature of participation has hardly been captured in conceptual approaches [31] and weakly reflected in studies on the transformative effects of TD sustainability research [29]. Conceiving participation as a dynamic and complex process itself rather than as static input is prerequisite for better understanding when it leads to transformation and when it perpetuates an unsustainable status quo [27]. Relational spaces of participation are figured in action and are inherently dynamic. When studying participation as a relational space we found in our literature review that some participation elements are particularly dynamic, whereas others tend to be more stable. For instance, priorities of actors might change over time and expectations unmet at some stage of the process reduce commitment and motivation of actors to the process and its outcomes. Additionally, trust amongst actors might grow and enhance their commitment to take follow-up decisions based on process results. In contrast, rules and norms in the reference system tend to be stable over the course of a project. Our approach of participation as relational space posits that depending on the constellation of elements synthesised in a situation, participation takes different forms. These render some outcomes more likely than others.

A constellation of elements, however, evolves with changes in its elements. Hence, the proposed approach allows us to consider the procedural nature of participation in both, primarily knowledge production and primarily action-orientated processes. In the short-term, the actors involved might be able to directly steer the dynamic elements. The more static structural elements might not be transformed by refining the formats of involvement and require a reflexive approach towards the ways in which the actors interpret and act upon structures [9].

5.2.4. Reflexivity and Practical Relevance

Reflexivity is a key element of critical research traditions [35] and the starting point for transformative approaches [16]. It can act as a bridging concept and inform the development of critical and transformative sustainability sciences. The multidimensional analytical grid presented (Table 2) can stimulate and guide reflexivity at different stages of the process: prospectively, when planning participation and retrospectively, when analysing participation. For those engaged in participatory knowledge production, it offers new ways of configuring the spaces between research and practice. Ex ante, the analytical categories provide guidance on which structural, process, and actor-related elements might shape the participation process. The perspective helps to differentiate between dynamic elements which can be actively addressed in planning and designing processes and more stable elements which require primarily a critical-reflection on the preconditions that frame actors' *positioning* and *synthesis*. Retrospectively, the analytical categories can structure a self-reflection on how the different elements and their relations affected the figuration of the participation space and the outcomes it produced. By proposing a change in perspective, the presented conceptualisation can also support research funding bodies and those reviewing research proposals to gain a fresh look at participation. For research funding bodies, in particular the dimension 'structures' of the proposed grid can support reflection on targeted funding requirements. During the assessment of research proposals, the perspective can complement the assessment of expected intensities of involvement (metaphor of the ladder) with a systemic view on the planned participation (metaphor of space). The proposed grid provides those reviewing the potential of a TD research project with critical questions for assessing whether the key elements of the structural, actor, and process dimensions are adequately considered in the process design.

6. Conclusions

In this paper, we developed a conceptual perspective for the analysis of participation in sustainability research. Adapting from Martina Löw's sociology of space, we conceived of participation in knowledge production as a relational space which is produced in the interplay of structures and actions. For studying the process of constructing participation, we proposed an analytical grid along the elements: rules/norms and resources (structures), people and social goods (actors), and *synthesis* and *spacing* (processes). Guided by this conceptualisation, literature on participation in sustainability research, STS and development studies was analysed. Despite the plurality of approaches and the specificities of each, drawing together experience from these diverse fields holds great potential for mutual learning with regard to factors that impinge on practices of participation. In particular, when moving beyond ideal-typical and theoretical reflections, boundaries blur and ways of addressing challenges in one field might be useful for other fields. Integrating empirical findings from the three fields, we identified several groups of elements along the dimensions 'structures' and 'actors' as potentially shaping participation spaces in knowledge production: (i) (in)coherences with reference system, (ii) resources, (iii) timing of participation, (iv) expectations, motivations, (v) mutual trust, (vi) worldviews and values. In addition, power relations were identified as interacting with elements across these dimensions. Relational spaces of participation are constituted through processes. Each of the elements affects the ways in which scientific and non-scientific actors position themselves in an action situation (*spacing*) and integrate them to yield a participation space (*synthesis*). The figuration of a participation space can dynamically change throughout a project, for example when

trust increases/decreases, expectations are fulfilled/disappointed or worldviews aligned/conflicting. Structural elements such as rules and norms in the academic system tend to be more stable in the short term and require reflexivity with regard to the ways in which they frame each actor's positioning and synthesis. In extreme cases, incompatibilities of rule-sets preclude the emergence of a participation space. Furthermore, in case of highly unequal power relations, the capacity of a participation space to disrupt or transform the societal status quo in which it is embedded is low. Studying the elements identified (and possible additional ones) concomitantly we can arrive at a meaningful interpretation of the constitution of participation spaces. The need for further refinement notwithstanding, the proposed perspective on participation as relational space has the potential of being a useful step towards better understanding in which situations spaces of participation have the capacity to become spaces of transformation and change.

References

1. United Nations. A /RES/70/1—Transforming Our World: The 2030 Agenda for Sustainable Development. In *Resolution Adopted by the General Assembly*; United Nations: New York, NY, USA, 2015.

2. United Nations. *United Nations Conference on Environment & Development Rio de Janerio, Brazil, 3 to 14 June 1992. Agenda 21*; United Nations: New York, NY, USA, 1992.

3. Kates, R.W. What kind of a science is sustainability science? *Proc. Natl. Acad. Sci. USA* **2011**, *108*, 19449–19450. [CrossRef] [PubMed]

4. Miller, T.R.; Wiek, A.; Sarewitz, D.; Robinson, J.; Olsson, L.; Kriebel, D.; Loorbach, D. The future of sustainability science: A solutions-oriented research agenda. *Sustain. Sci.* **2014**, *9*, 239–246. [CrossRef]

5. European Commission. Horizon 2020. Work Programme 2016–2017. 16. Science with and for Society. European Commission Decision C(2017)2468 of 24 April 2017. 2015. Available online: http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-swfs_en.pdf (accessed on 10 August 2018).

6. Cornell, S.; Berkhout, F.; Tuinstra, W.; Tàbara, J.D.; Jäger, J.; Chabay, I.; de Wit, B.; Langlais, R.; Mills, D.; Moll, P. Opening up knowledge systems for better responses to global environmental change. *Environ. Sci. Policy* **2013**, *28*, 60–70. [CrossRef]

7. Hoppe, R. Policy analysis, science and politics: From 'speaking truth to power' to 'making sense together.'. *Sci. Public Policy* **1999**, *26*, 201–210. [CrossRef]

8. Bäckstrand, K. Civic science for sustainability: Reframing the role of experts, policy-makers and citizens in environmental governance. *Glob. Environ. Politics* **2003**, *3*, 24–41. [CrossRef]

9. Chilvers, J.; Kearnes, M. *Remaking Participation: Science, Environment and Emergent Publics*; Routledge: London, UK; New York, NY, USA, 2015; ISBN 1-135-08470-X.

10. Jasanoff, S. Technologies of humility: Citizen participation in governing science. *Minerva* **2003**, *41*, 223–244. [CrossRef]

11. Wynne, B. Public participation in science and technology: Performing and obscuring a political–conceptual category mistake. *East. Asian Sci. Technol. Soc.* **2007**, *1*, 99–110. [CrossRef]

12. Dryzek, J.S. *Deliberative Democracy and Beyond: Liberals, critics, Contestations*; Oxford University Press: Oxford, UK, 2000; ISBN 978-0-19-925043-1.

13.   Glass, J.H.; Scott, A.J.; Price, M.F. The power of the process: Co-producing a sustainability assessment toolkit for upland estate management in Scotland. *Land Use Policy* **2013**, *30*, 254–265. [CrossRef]

14.   Pohl, C.; Rist, S.; Zimmermann, A.; Fry, P.; Gurung, G.S.; Schneider, F.; Speranza, C.I.; Kiteme, B.; Boillat, S.; Serrano, E. Researchers' roles in knowledge co-production: Experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. *Sci. Public Policy* **2010**, *37*, 267–281. [CrossRef]

15.   Schneidewind, U.; Singer-Brodowski, M. *Transformative Wissenschaft: Klimawandel im Deutschen Wissenschafts-und Hochschulsystem*; Metropolis Marburg: Weimar (Lahn), Germany, 2013; ISBN 3-7316-1003-5.

16.   Schneidewind, U.; Singer-Brodowski, M. Vom experimentellen Lernen zum transformativen Experimentieren: Reallabore als Katalysator für eine lernende Gesellschaft auf dem Weg zu einer Nachhaltigen Entwicklung. *Z. Wirtsch. Unternehmensethik* **2015**, *16*, 29–51.

17.   Jahn, T. Transdisciplinarity in the practice of research. In *Transdisziplinäre Forschung: Integrative Forschungsprozesse Verstehen und Bewerten*; Campus Verlag: Frankfurt am Main, Germany, 2008; pp. 21–37.

18.   Mittelstraß, J. Wohin geht die Wissenschaft? Über Disziplinarität, Transdisziplinarität und das Wissen in einer Leibniz-Welt. *Konstanz. Bl. Für Hochschulfragen* **1989**, *26*, 97–115.

19.   Hadorn, G.H.; Hoffmann-Riem, H.; Biber-Klemm, S.; Grossenbacher-Mansuy, W.; Joye, D.; Pohl, C.; Wiesmann, U.; Zemp, E. *Handbook of Transdisciplinary Research*; Springer: Zurich, Switzerland, 2008; ISBN 1-4020-6698-8.

20.   Scholz, R.W.; Lang, D.J.; Wiek, A.; Walter, A.I.; Stauffacher, M. Transdisciplinary case studies as a means of sustainability learning: Historical framework and theory. *Int. J. Sustain. High. Educ.* **2006**, *7*, 226–251. [CrossRef]

21.   Hansson, S.; Polk, M. Assessing the impact of transdisciplinary research: The usefulness of relevance, credibility, and legitimacy for understanding the link between process and impact. *Res. Eval.* **2018**, *27*, 132–144. [CrossRef]

22.   Nowotny, H. Democratising expertise and socially robust knowledge. *Sci. Public Policy* **2003**, *30*, 151–156. [CrossRef]

23.   Garmendia, E.; Stagl, S. Public participation for sustainability and social learning: Concepts and lessons from three case studies in Europe. *Ecol. Econ.* **2010**, *69*, 1712–1722. [CrossRef]

24.   Gross, M.; Hoffmann-Riem, H. Ecological restoration as a real-world experiment: Designing robust implementation strategies in an urban environment. *Public Underst. Sci.* **2005**, *14*, 269–284. [CrossRef]

25.   Renn, O.; Schweizer, P.-J. Inclusive risk governance: Concepts and application to environmental policy making. *Environ. Policy Gov.* **2009**, *19*, 174–185. [CrossRef]

26.   Arnstein, S.R. A ladder of citizen participation. *J. Am. Inst. Plan.* **1969**, *35*, 216–224. [CrossRef]

27.   Kropp, C. Demokratische Planung der Klimaanpassung? Über die Fallstricke partizipativer Verfahren im expertokratischen Staat. In *Partizipation und Klimawandel–Ansprüche, Konzepte und Umsetzung*; Oekonom: München, Germany, 2013; pp. 55–74. ISBN 978-3-86581-454-8. (In German)

28.   Wittmayer, J.; Hölscher, K. *Transformation Research: Exploring Methods for an Emerging Research Field*; Texte; Umweltbundesamt: Dessau-Roßlau, Germany, 2018.

29.   Walter, A.I.; Helgenberger, S.; Wiek, A.; Scholz, R.W. Measuring societal effects of transdisciplinary research projects: Design and application of an evaluation method. *Eval. Program. Plan.* **2007**, *30*, 325–338. [CrossRef] [PubMed]

30.   Van der Hel, S. New science for global sustainability? The institutionalisation of knowledge co-production in Future Earth. *Environ. Sci. Policy* **2016**, *61*, 165–175. [CrossRef]

31.   Collins, K.; Ison, R. Dare We Jump off Arnstein's Ladder? Social Learning as a New Policy Paradigm. In Proceedings of the PATH (Participatory Approaches in Science & Technology) Conference, Edinburgh, Scotland, 4–7 June 2006; 2006.

32.   Fritz, L. (De-)Constructing participation in transdisciplinary sustainability research: A critical review of key concepts. In *Schafft Wissen–Gemeinsames und Geteiltes Wissen in Wissenschaft und Technik, Proceedings of the 2. INSIST Conference, 7–8 October 2016*; Engelschalt, J., Maibaum, A., Engels, F., Odenwald, J., Eds.; Social Science Open Access Repository: Munich, Germany, 2018; pp. 106–125.

33.   Kothari, U. Power, knowledge and social control in participatory development. In *Participation: The New Tyranny?* Kothari, U., Cooke, B., Eds.; Zed Books: London, UK, 2001; pp. 139–152.

34.   Chambers, R. *Whose Reality Counts? Putting the FIRST LAST*; Intermediate Technology Publications Ltd. (ITP): London, UK, 1997; ISBN 1-85339-386-X.

35. Rosendahl, J.; Zanella, M.A.; Rist, S.; Weigelt, J. Scientists' situated knowledge: Strong objectivity in transdisciplinarity. *Futures* **2015**, *65*, 17–27. [CrossRef]

36. Chilvers, J.; Burgess, J. Power Relations: The Politics of Risk and Procedure in Nuclear Waste Governance. *Environ. Plan. A* **2008**, *40*, 1881–1900. [CrossRef]

37. Hegger, D.; Lamers, M.; Van Zeijl-Rozema, A.; Dieperink, C. Conceptualising joint knowledge production in regional climate change adaptation projects: Success conditions and levers for action. *Environ. Sci. Policy* **2012**, *18*, 52–65. [CrossRef]

38. Klenk, N.L.; Meehan, K. Transdisciplinary sustainability research beyond engagement models: Toward adventures in relevance. *Environ. Sci. Policy* **2017**, *78*, 27–35. [CrossRef]

39. Brand, U. "Transformation" as a New Critical Orthodoxy: The Strategic Use of the Term "Transformation" Does Not Prevent Multiple Crises. *GAIA-Ecol. Perspect. Sci. Soc.* **2016**, *25*, 23–27. [CrossRef]

40. Huxley, M. Historicizing planning, problematizing participation. *Int. J. Urban Reg. Res.* **2013**, *37*, 1527–1541. [CrossRef]

41. Hayward, C.R. *De-Facing Power*; Cambridge University Press: New York, NY, USA, 2000; ISBN 0-521-78564-2.

42. Cook, B.R.; Kesby, M.; Fazey, I.; Spray, C. The persistence of 'normal' catchment management despite the participatory turn: Exploring the power effects of competing frames of reference. *Soc. Stud. Sci.* **2013**, *43*, 754–779. [CrossRef]

43. Tritter, J.Q.; McCallum, A. The snakes and ladders of user involvement: Moving beyond Arnstein. *Health Policy* **2006**, *76*, 156–168. [CrossRef] [PubMed]

44. Cornwall, A. *Making spaces, changing places: Situating participation in development. IDS Working Paper*; Institute of Development Studies (IDS): Brighton, UK, 2002; Volume 170.

45. Stauffacher, M.; Flüeler, T.; Krütli, P.; Scholz, R.W. Analytic and dynamic approach to collaboration: A transdisciplinary case study on sustainable landscape development in a Swiss prealpine region. *Syst. Pract. Action Res.* **2008**, *21*, 409–422. [CrossRef]

46. Schneider, F.; Buser, T. Promising degrees of stakeholder interaction in research for sustainable development. *Sustain. Sci.* **2018**, *13*, 129–142. [CrossRef]

47. Defila, R.; Di Giulio, A.; Scheuermann, M. *Forschungsverbundmanagement: Handbuch für die Gestaltung inter-und Transdisziplinärer Projekte*; Vdf Hochschulverlag AG: Zurich, Germany, 2006; ISBN 3-7281-3042-7. (In German)

48. Boeckmann, T.; Dorsch, P.; Hoffmann, F.; Ohlhorst, D.; Schumacher, U.; Wulff, J. *Zwischen Theorie und Praxis. Anregungen zur Gestaltung von Wissenschafts-Praxis-Kooperationen in der Nachhaltigkeitsforschung*; Discussion Paper; Zentrum Technik und Gesellschaft: Berlin; Germany, 2005; Volume 17. (In German)

49. Pretty, J.N. Participatory learning for sustainable agriculture. *World Dev.* **1995**, *23*, 1247–1263. [CrossRef]

50. White, S.C. Depoliticising development: The uses and abuses of participation. *Dev. Pract.* **1996**, *6*, 6–15. [CrossRef]

51. Burgess, J.; Chilvers, J. Upping the ante: A conceptual framework for designing and evaluating participatory technology assessments. *Sci. Public Policy* **2006**, *33*, 713–728. [CrossRef]

52. Stirling, A. "Opening up" and "closing down" power, participation, and pluralism in the social appraisal of technology. *Sci. Technol. Hum. Values* **2008**, *33*, 262–294. [CrossRef]

53. Fiorino, D.J. Environmental risk and democratic process: A critical review. *Columbia J. Environ. Law* **1989**, *14*, 501.

54. Rowe, G.; Frewer, L.J. A typology of public engagement mechanisms. *Sci. Technol. Hum. Values* **2005**, *30*, 251–290. [CrossRef]

55. Cornwall, A.; Coelho, V.S. *Spaces for Change? The Politics of Citizen Participation in New Democratic Arenas*; Zed Books: London, UK; New York, NY, USA, 2007; Volume 4, ISBN 1-84277-553-7.

56. Habermas, J. *Theorie des Kommunikativen Handelns*; Suhrkamp: Frankfurt, Germany, 1981. (In German)

57. Shdaimah, C.; Stahl, R. Power and conflict in collaborative research. In *Real Social Science: Applied Phronesis*; Flyvbjerg, B., Landman, T., Schram, S., Eds.; Cambridge University Press: Cambridge, UK, 2012; pp. 122–137. ISBN 978-0-521-46850-3.

58. Bell, S.; Morse, S.; Shah, R.A. Understanding stakeholder participation in research as part of sustainable development. *J. Environ. Manag.* **2012**, *101*, 13–22. [CrossRef] [PubMed]

59. Felt, U.; Igelsböck, J.; Schikowitz, A.; Völker, T. Challenging participation in sustainability research. *J. Deliberat. Mech. Sci.* **2012**, *1*, 4–34. [CrossRef]

60. Elzinga, A. Participation. In *Handbook of Transdisciplinary Research*; Springer: Zurich, Switzerland, 2008; pp. 345–359, ISBN 1-4020-6698-8.

61. Nowotny, H.; Scott, P.; Gibbons, M. *Re-Thinking Science: Knowledge and the Public in an Age of Uncertainty*; SciELO Argentina; Polity: Cambridge, UK, 2001; ISBN 0-7456-2608-4.

62. Felt, U. *Knowing and Living in Academic Research: Convergences and Heterogeneity in Research Cultures in the European Context*; Institute of Sociology of the Academy of Sciences of the Czech Republic: Prague, Czech Republic, 2009; ISBN 80-7330-156-3.

63. Gaventa, J. Finding the spaces for change: A power analysis. *IDS Bull.* **2006**, *37*, 23–33. [CrossRef]

64. Löw, M. *Raumsoziologie*; Suhrkamp Verlag: Frankfurt am Main, Germany, 2013; ISBN 518291068.

65. Simmel, G. *Schriften zur Soziologie: Eine Auswahl*; Suhrkamp Verlag: Frankfurt am Main, Germany, 1983; Volume 434, ISBN 3-518-28034-1. (In German)

66. Foucault, M.; Miskowiec, J. Of other spaces. *Diacritics* **1986**, *16*, 22–27. [CrossRef]

67. Bourdieu, P. *Vom Gebrauch der Wissenschaft. Für eine Klinische Soziologie des Wissenschaftlichen Feldes*; UVK Verlag: Konstanz, Germany, 1998; ISBN 978-3-87940-620-3. (In German)

68. Lefebvre, H. *The Production of Space*; Blackwell: Oxford, UK, 1991; Volume 142, ISBN 978-0-631-18177-4.

69. Löw, M. *The Sociology of Space: Materiality, Social Structures, and Action*; Springer: Berlin, Heidelberg, Germany, 2016; ISBN 978-1-137-48771-1.

70. Giddens, A. *The Constitution of Society: Outline of the Theory of Structuration*; University of California Press: Berkeley, CA, USA, 1984; ISBN 0-520-05292-7.

71. Löw, M. The constitution of space: The structuration of spaces through the simultaneity of effect and perception. *Eur. J. Soc. Theory* **2008**, *11*, 25–49. [CrossRef]

72. Lacroix, L.; Rist, S.; Gerritsen, P.R.; Péclard, D. Social and political participation in sustainable development with a focus on governance. In *NCCR North-South. Research for Sustainable Development: Foundations, Experiences, and Perspectives*; Geographica Bernensia: Bern, Switzerland, 2011; pp. 147–164.

73. Whyte, W.F.E. *Participatory Action Research*; Sage Publications, Inc.: Newbury Park, CA, USA, 1991; ISBN 0-8039-3742-3.

74. Abels, G. Forms and functions of participatory technology assessment—Or: Why should we be more sceptical about public participation? In Proceedings of the Participatory Approaches in Science & Technology (PATH)'Conference, Edinburgh, Scotland, 4–7 June 2006.

75. Collins, H.M.; Evans, R. The third wave of science studies studies of expertise and experience. *Soc. Stud. Sci.* **2002**, *32*, 235–296. [CrossRef]

76. Joss, S. Toward the public sphere—Reflections on the development of participatory technology assessment. *Bull. Sci. Technol. Soc.* **2002**, *22*, 220–231. [CrossRef]

77. Noy, C. Sampling knowledge: The hermeneutics of snowball sampling in qualitative research. *Int. J. Soc. Res. Methodol.* **2008**, *11*, 327–344. [CrossRef]

78. Mackinson, S.; Wilson, D.C.; Galiay, P.; Deas, B. Engaging stakeholders in fisheries and marine research. *Mar. Policy* **2011**, *35*, 18–24. [CrossRef]

79. Onwuegbuzie, A.J.; Leech, N.L.; Collins, K.M. Qualitative analysis techniques for the review of the literature. *Qual. Rep.* **2012**, *17*, 1–28.

80. Brandt, P.; Ernst, A.; Gralla, F.; Luederitz, C.; Lang, D.J.; Newig, J.; Reinert, F.; Abson, D.J.; von Wehrden, H. A review of transdisciplinary research in sustainability science. *Ecol. Econ.* **2013**, *92*, 1–15. [CrossRef]

81. Brinkmann, C.; Bergmann, M.; Rödder, S.; Schuck-Zöller, S. *Zur Integration von Wissenschaft und Praxis als Forschungsmodus–ein Literaturüberblick*; Climate Service Center: Hamburg, Germany, 2015. (In German)

82. Noblit, G.W.; Hare, R.D.; Hare, R.D. *Meta-Ethnography: Synthesizing Qualitative Studies*; Sage: Newbury Park, CA, USA, 1988; Volume 11.

83. Felt, U.; Igelsböck, J.; Schikowitz, A.; Völker, T. Growing into what? The (un-) disciplined socialisation of early stage researchers in transdisciplinary research. *High. Educ.* **2013**, *65*, 511–524. [CrossRef]

84. Kläy, A.; Zimmermann, A.B.; Schneider, F. Rethinking science for sustainable development: Reflexive interaction for a paradigm transformation. *Futures* **2014**, *65*, 72–85. [CrossRef]

85. Wiek, A.; Farioli, F.; Fukushi, K.; Yarime, M. Sustainability science: Bridging the gap between science and society. *Sustain. Sci.* **2012**, *7*, 1–4. [CrossRef]

86. Cvitanovic, C.; Hobday, A.; van Kerkhoff, L.; Wilson, S.; Dobbs, K.; Marshall, N. Improving knowledge exchange among scientists and decision-makers to facilitate the adaptive governance of marine resources: A review of knowledge and research needs. *Ocean Coast. Manag.* **2015**, *112*, 25–35. [CrossRef]

87. Siew, T.F.; Aenis, T.; Spangenberg, J.H.; Nauditt, A.; Döll, P.; Frank, S.K.; Ribbe, L.; Rodriguez-Labajos, B.; Rumbaur, C.; Settele, J.; et al. Transdisciplinary research in support of land and water management in China and Southeast Asia: Evaluation of four research projects. *Sustain. Sci.* **2016**, *11*, 813–829. [CrossRef]

88. Wuelser, G.; Pohl, C. How researchers frame scientific contributions to sustainable development: A typology based on grounded theory. *Sustain. Sci.* **2016**, *11*, 789–800. [CrossRef]

89. Schmidt, L.; Pröpper, M. Transdisciplinarity as a real-world challenge: A case study on a North–South collaboration. *Sustain. Sci.* **2017**, *12*, 365–379. [CrossRef]

90. Robinson, J.; Tansey, J. Co-production, emergent properties and strong interactive social research: The Georgia Basin Futures Project. *Sci. Public Policy* **2006**, *33*, 151–160. [CrossRef]

91. Talwar, S.; Wiek, A.; Robinson, J. User engagement in sustainability research. *Sci. Public Policy* **2011**, *38*, 379–390. [CrossRef]

92. Maclure, R.; Bassey, M. Participatory action research in Togo: An inquiry into maize storage systems. In *Participatory Research*; Sage Publications: Newbury Park, CA, USA, 1990.

93. Thompson, M.A.; Owen, S.; Lindsay, J.M.; Leonard, G.S.; Cronin, S.J. Scientist and stakeholder perspectives of transdisciplinary research: Early attitudes, expectations, and tensions. *Environ. Sci. Policy* **2017**, *74*, 30–39. [CrossRef]

94. Mattor, K.; Betsill, M.; Huayhuaca, C.; Huber-Stearns, H.; Jedd, T.; Sternlieb, F.; Bixler, P.; Luizza, M.; Cheng, A.S. Transdisciplinary research on environmental governance: A view from the inside. *Environ. Sci. Policy* **2014**, *42*, 90–100. [CrossRef]

95. Boon, W.P.; Chappin, M.M.; Perenboom, J. Balancing divergence and convergence in transdisciplinary research teams. *Environ. Sci. Policy* **2014**, *40*, 57–68. [CrossRef]

96. Mauser, W.; Klepper, G.; Rice, M.; Schmalzbauer, B.S.; Hackmann, H.; Leemans, R.; Moore, H. Transdisciplinary global change research: The co-creation of knowledge for sustainability. *Curr. Opin. Environ. Sustain.* **2013**, *5*, 420–431. [CrossRef]

97. Polk, M. Transdisciplinary co-production: Designing and testing a transdisciplinary research framework for societal problem solving. *Futures* **2015**, *65*, 110–122. [CrossRef]

98. Holmes, T. *A Participatory Approach in Practice: Understanding Fieldworkers' Use of Participatory Rural Apprasial in ActionAid The Gambia*; IDS Working Paper; Institute of Development Studies, University of Sussex: Brighton, UK, 2001; Volume 123.

99. Bond, A.; Palerm, J.; Haigh, P. Public participation in EIA of nuclear power plant decommissioning projects: A case study analysis. *Environ. Impact Assess. Rev.* **2004**, *24*, 617–641. [CrossRef]

100. Polk, M. Achieving the promise of transdisciplinarity: A critical exploration of the relationship between transdisciplinary research and societal problem solving. *Sustain. Sci.* **2014**, *9*, 439–451. [CrossRef]

101. Röckmann, C.; van Leeuwen, J.; Goldsborough, D.; Kraan, M.; Piet, G. The interaction triangle as a tool for understanding stakeholder interactions in marine ecosystem based management. *Mar. Policy* **2015**, *52*, 155–162. [CrossRef]

102. Binder, C.R.; Absenger-Helmli, I.; Schilling, T. The reality of transdisciplinarity: A framework-based self-reflection from science and practice leaders. *Sustain. Sci.* **2015**, *10*, 545–562. [CrossRef]

103. Bister, M.; Felt, U.; Strassnig, M.; Wagner, U. Zeit und Partizipation im transdisziplinären Forschungsprozes. In *Transdisziplinäre Praxis. Forschen im Sozial-und Gesundhetiswesen*; Reitinger, Elisabeth: Heidelberg, Germany, 2008; pp. 35–45. ISBN 978-3-89670-903-5. (In German)

104. McKee, A.; Guimaraes, M.H.; Pinto-Correia, T. Social capital accumulation and the role of the researcher: An example of a transdisciplinary visioning process for the future of agriculture in Europe. *Environ. Sci. Policy* **2015**, *50*, 88–99. [CrossRef]

105. Vilsmaier, U.; Engbers, M.; Luthardt, P.; Maas-Deipenbrock, R.M.; Wunderlich, S.; Scholz, R.W. Case-based mutual learning sessions: Knowledge integration and transfer in transdisciplinary processes. *Sustain. Sci.* **2015**, *10*, 563–580. [CrossRef]

106. Felt, U.; Igelsböck, J.; Schikowitz, A.; Völker, T. Transdisciplinary Sustainability Research in Practice: Between Imaginaries of Collective Experimentation and Entrenched Academic Value Orders. *Sci. Technol. Hum. Values* **2016**, *41*, 732–761. [CrossRef]

107. Neef, A.; Neubert, D. Stakeholder participation in agricultural research projects: A conceptual framework for reflection and decision-making. *Agric. Hum. Values* **2011**, *28*, 179–194. [CrossRef]

108. Michener, V.J. The participatory approach: Contradiction and co-option in Burkina Faso. *World Dev.* **1998**, *26*, 2105–2118. [CrossRef]

109. Kesby, M. Spatialising participatory approaches: The contribution of geography to a mature debate. *Environ. Plan. A* **2007**, *39*, 2813–2831. [CrossRef]

110. Angelstam, P.; Andersson, K.; Annerstedt, M.; Axelsson, R.; Elbakidze, M.; Garrido, P.; Grahn, P.; Jönsson, K.I.; Pedersen, S.; Schlyter, P.; et al. Solving problems in social-ecological systems: Definition, practice and barriers of transdisciplinary research. *Ambio* **2013**, *42*, 254–265. [CrossRef] [PubMed]

111. Hanschitz, R.-C.; Schmidt, E.; Schwarz, G. *Transdisziplinarität in Forschung und Praxis: Chancen und Risiken Partizipativer Prozesse*; Springer: Berlin, Heidelberg, Germany, 2009; Volume 5, ISBN 3-531-16029-X. (In German)

112. Paulo Freire Zentrum. *Verstehen, Was wir tun Systematisierung von Erfahrungen als Partizipativer Lernprozess*; Schmid, E., Luger, A., Eds.; Paulo Freire Zentrum: Wien, Austria, 2015; Volume 12, ISBN 978-3-902996-04-6. (In German)

113. Stokols, D. Toward a science of transdisciplinary action research. *Am. J. Community Psychol.* **2006**, *38*, 63–77. [CrossRef] [PubMed]

114. Bayissa, D.D. Scrutinizing Factors Impeding Research-Farmer Relationship in the Context of the Agriculture Innovation System. *Am. J. Bus. Manag.* **2015**, *4*, 180–189. [CrossRef]

115. Petts, J. The public—Expert interface in local waste management decisions: Expertise, credibility and process. *Public Underst. Sci.* **1997**, *6*, 359–381. [CrossRef]

116. Steelman, T.; Nichols, E.G.; James, A.; Bradford, L.; Ebersöhn, L.; Scherman, V.; Omidire, F.; Bunn, D.N.; Twine, W.; McHale, M.R. Practicing the science of sustainability: The challenges of transdisciplinarity in a developing world context. *Sustain. Sci.* **2015**, *10*, 581–599. [CrossRef]

117. Chilvers, J. Deliberating competence: Theoretical and practitioner perspectives on effective participatory appraisal practice. *Sci. Technol. Hum. Values* **2008**, *33*, 155–185. [CrossRef]

118. Lang, D.J.; Wiek, A.; Bergmann, M.; Stauffacher, M.; Martens, P.; Moll, P.; Swilling, M.; Thomas, C.J. Transdisciplinary research in sustainability science: Practice, principles, and challenges. *Sustain. Sci.* **2012**, *7*, 25–43. [CrossRef]

119. Whitman, G.P.; Pain, R.; Milledge, D.G. Going with the flow? Using participatory action research in physical geography. *Prog. Phys. Geogr.* **2015**, *39*, 622–639. [CrossRef]

120. Webber, L.M.; Ison, R. Participatory rural appraisal design: Conceptual and process issues. *Agric. Syst.* **1995**, *47*, 107–131. [CrossRef]

121. Ober, S. Demokratie und Wissenschaft. Eine Beziehung voller Widersprüche. *Forum Wiss.* **2016**, *4*, 9–14. (In German)

122. Renner, R.; Schneider, F.; Hohenwallner, D.; Kopeinig, C.; Kruse, S.; Lienert, J.; Link, S.; Muhar, S. Meeting the challenges of transdisciplinary knowledge production for sustainable water governance. *Mt. Res. Dev.* **2013**, *33*, 234–247. [CrossRef]

123. Di Giulio, A.; Defila, R.; Brückmann, T. "Das ist halt das eine . . . Praxis, das andere ist Theorie"-Prinzipien transdisziplinärer Zusammenarbeit im Forschungsalltag. In *Transdisziplinär forschen-zwischen Ideal und gelebter Praxis: Hotspots, Geschichten, Wirkungen*; Defila, R., Di Giulio, A., Eds.; Campus Verlag: Frankfurt am Main, Germany, 2016; ISBN 3-593-50556-8. (In German)

124. Habermann, B.; Misganaw, B.; Peloschek, F.; Dessalegn, Y. *Inter-and Transdisciplinary Research Methods in Rural Transformation*; Habermann, B., Ed.; Austrian Development Agency: Vienna, Austria, 2013.

125. Bieluch, K.H.; Bell, K.P.; Teisl, M.F.; Lindenfeld, L.A.; Leahy, J.; Silka, L. Transdisciplinary research partnerships in sustainability science: An examination of stakeholder participation preferences. *Sustain. Sci.* **2016**, *12*, 87–104. [CrossRef]

126. Harris, F.; Lyon, F. Transdisciplinary environmental research: Building trust across professional cultures. *Environ. Sci. Policy* **2013**, *31*, 109–119. [CrossRef]

127. Dewulf, A.; Craps, M.; Bouwen, R.; Abril, F.; Zhingri, M. How indigenous farmers and university engineers create actionable knowledge for sustainable irrigation. *Action Res.* **2005**, *3*, 175–192. [CrossRef]

128. Polk, M.; Knutsson, P. Participation, value rationality and mutual learning in transdisciplinary knowledge production for sustainable development. *Environ. Educ. Res.* **2008**, *14*, 643–653. [CrossRef]

129. Popa, F.; Guillermin, M.; Dedeurwaerdere, T. A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science. *Futures* **2015**, *65*, 45–56. [CrossRef]

130. Schneider, F.; Rist, S. Envisioning sustainable water futures in a transdisciplinary learning process: Combining normative, explorative, and participatory scenario approaches. *Sustain. Sci.* **2014**, *9*, 463–481. [CrossRef]

131. Schneider, F. Exploring sustainability through stakeholders' perspectives and hybrid water in the Swiss Alps. *Water Altern.* **2015**, *8*, 280–296.

132. Pellizzoni, L. Uncertainty and participatory democracy. *Environ. Values* **2003**, *12*, 195–224. [CrossRef]

133. Westberg, L.; Polk, M. The role of learning in transdisciplinary research: Moving from a normative concept to an analytical tool through a practice-based approach. *Sustain. Sci.* **2016**, *11*, 385–397. [CrossRef]

134. Cornwall, A. Spaces for transformation? Reflections on issues of power and difference in participation in development. In *Participation: From Tyranny to Transformation*; Hickey, S., Mohan, G., Eds.; Zed Books: London, UK; New York, NY, USA, 2004; pp. 75–91, ISBN 1-84277-460-3.

135. Fazey, I.; Evely, A.C.; Reed, M.S.; Stringer, L.C.; Kruijsen, J.; White, P.C.; Newsham, A.; Jin, L.; Cortazzi, M.; Phillipson, J. Knowledge exchange: A review and research agenda for environmental management. *Environ. Conserv.* **2013**, *40*, 19–36. [CrossRef]

136. Wittmayer, J.M.; Schäpke, N. Action, research and participation: Roles of researchers in sustainability transitions. *Sustain. Sci.* **2014**, *9*, 483–496. [CrossRef]

137. Raymond, C.M.; Fazey, I.; Reed, M.S.; Stringer, L.C.; Robinson, G.M.; Evely, A.C. Integrating local and scientific knowledge for environmental management. *J. Environ. Manag.* **2010**, *91*, 1766–1777. [CrossRef] [PubMed]

138. Christens, B.; Speer, P.W. Review essay: Tyranny/transformation: Power and paradox in participatory development. *Forum Qual. Soc. Res.* **2006**, *7*.

139. Cooke, B.; Kothari, U. *Participation: The New Tyranny?* Zed Books: London, UK, 2001; ISBN 1-85649-794-1.

140. Hickey, S.; Mohan, G. Towards participation as transformation: Critical themes and challenges. In *Participation: From Tyranny to Transformation*; Hickey, S., Mohan, G., Eds.; Zed Books: London, UK; New York, NY, USA, 2004; pp. 3–24. ISBN 1-84277-460-3.

141. Williams, G. Evaluating participatory development: Tyranny, power and (re)politicisation. *Third World Q.* **2004**, *25*, 557–578. [CrossRef]

142. Munoz-Erickson, T.A. Co-production of knowledge–action systems in urban sustainable governance: The KASA approach. *Environ. Sci. Policy* **2014**, *37*, 182–191. [CrossRef]

143. Jahn, T. *Science for sustainable development requires a critical orientation. ISOE Discussion Paper*; Institut fur sozial-ökologische Forschung: Frankfurt am Main, Germany, 2016; Volume 39.

144. Wiek, A.; Ness, B.; Schweizer-Ries, P.; Brand, F.S.; Farioli, F. From complex systems analysis to transformational change: A comparative appraisal of sustainability science projects. *Sustain. Sci.* **2012**, *7*, 5–24. [CrossRef]

145. Chilvers, J.; Longhurst, N. Participation in transition(s): Reconceiving public engagements in energy transitions as co-produced, emergent and diverse. *J. Environ. Policy Plan.* **2016**, *18*, 585–607. [CrossRef]

146. Scholz, R.W. The normative dimension in transdisciplinarity, transition management, and transformation sciences: New roles of science and universities in sustainable transitioning. *Sustainability* **2017**, *9*, 991. [CrossRef]

147. Cornwall, A. Unpacking 'Participation': Models, meanings and practices. *Community Dev. J.* **2008**, *43*, 269–283. [CrossRef]

148. Mobjörk, M. Consulting versus participatory transdisciplinarity: A refined classification of transdisciplinary research. *Futures* **2010**, *42*, 866–873. [CrossRef]

149. Allen, A. Rethinking power. *Hypatia* **1998**, *13*, 21–40. [CrossRef]

150. Massey, D. Politics and space/time. *New Left Rev.* **1992**, *196*, 65–84.

151. Bhabha, H.K.; Rutherford, J. Third space. *Multitudes* **2006**, *3*, 95–107. [CrossRef]

152. Haraway, D. *Simians, Cyborgs, and Women: The Reinvention of Nature*; Routledge: New York, NY, USA, 2013; ISBN 0-415-90387-4.

153. Hardy, M.; Jobbling, H. Beyond power/knowledge—Developing a framework for understanding knowledge 'flow' in international social work. *Eur. J. Soc. Work* **2015**, *18*, 525–542. [CrossRef]

2 Manuscript II

Bibliographic details:

Fritz, L. 2018. (De-)Constructing participation in transdisciplinary sustainability research: A critical review of key concepts. In: Engelschalt, J., Maibaum, A., Engels, F., Odenwald, J., (Eds.): *Schafft Wissen–Gemeinsames und Geteiltes Wissen in Wissenschaft und Technik*, Proceedings of the INSIST Conference, 7–8 October 2016. Munich: Social Science Open Access Repository, 106–125.

Contribution of the doctoral candidate:

Single author

(De-)Constructing Participation in Transdisciplinary Sustainability Research: A Critical Review of Key Concepts[1]

Livia Fritz

Keywords: participation, co-production, transdisciplinary research, sustainability science

1. Introduction

> «But now that global environmental change is threatening the Earth's carrying capacity, more scientists must take on a new role involving engagement with end-users of science. Scientists need to collaborate directly with people and business to ensure shared understanding of the new realities shaping our world, and help translate knowledge into action for sustainable development.»
> (Wilson, 2012 Executive Director of the International Council of Science)

Over the past four decades, debates have intensified questioning the capacity of 'traditional' disciplinary research to tackle the complex problems posed by societal developments. As exemplified by the introductory statement by Steven Wilson in the run-up to the Rio +20 summit, the re-conceptualisation of models of science-society relations is considered indispensable in order to respond to the «grand challenges» of our times: climate change, environmental degradation, rising inequalities within and across societies, to name but a few (European Commission, 2011). Particularly in the area of (un)sustainable development, the malfunctioning feedback between science and political action has become manifest. Along with this realisation came pledges for opening up the research process by including societal actors beyond the traditional scientific sphere, heralding the power of discursive, participatory processes in fostering innovation and societal learning. Observably, the call for rethinking contemporary cultures of knowledge production has moved high on the international policy agenda (e.g. Rio Agenda 21[2]) and partly has found its way into science funding policies, e.g. the "Science

---

1. This contribution is based on my PhD Proposal accepted at the Doctoral School of Architecture and the Sciences of the City, ETH Lausanne.
2. In particular Chapters 35.5. and 35.7. allude to the need for linking scientific and traditional, indigenous knowledge (http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=52&ArticleID=85&l=en).

with and for Society" programme of the Horizon 2020 of the European Commission, and international initiatives such as Future Earth. Throughout Europe, national research funding bodies have introduced funding schemes which call for the integration of different actor groups into research processes, e.g. FONA (DE), proVISION (AUT), Swiss priority programme Environment (CH, 1992-2000) and MISTRA Innovation (SE). These developments in science policy and practices have led some authors to speak of a 'participatory turn' (Bäckstrand, 2003; Chilvers and Kearnes, 2015, p. 13; Jasanoff, 2003) and 'participatory *re*turn', respectively (Wynne, 2007, p. 100).

Theoretically, these debates are captured in notions such as (i) 'post-normal science', arguing that when "facts are uncertain, values in dispute, stakes high and decisions urgent" extended forms of knowledge production are needed (Funtowicz and Ravetz, 1993); (ii) 'mode 2 knowledge production', which – in contrast to the classical 'mode 1' knowledge production – stresses that non-academic rationales are increasingly framing the production and validation of knowledge (Gibbons et al., 1994); and (iii) the 'triple-helix model', which assesses science-university-industry relations (Leydesdorff and Etzkowitz, 1998). Ideas on what this opening-up process looks like, and what it should look like, are diverse and range from citizen conferences to transdisciplinary research (TDR).

Within sustainability research, transdisciplinarity (TD), aiming at integrative forms of knowledge production, has emerged as a key notion. First used some 40 years ago by Erich Jantsch, a physicist and early complexity researcher, at an OECD conference, the notion has gained prominence in particular in the context of environmental and sustainability-related topics (Jahn, 2008). The rise in popularity, especially after the Rio summit (1992) and the official birth of sustainability science around the year 2000 (Kates et al., 2000), was accompanied by various conceptualisations of TD. Broadly speaking, two branches can be identified: sociological, actor-orientated approaches on the one hand, and philosophy of science approaches on the other (e.g Mittelstraß, 1989). In this article, actor-orientated approaches will be of primary interest. In these approaches, most authors (e.g. Hadorn et al., 2008; Scholz et al., 2006) agree on three minimum criteria according to which TDR: (1) departs from *lifeworld* problems and creates solution-orientated knowledge; (2) integrates different scientific disciplines, i.e. is interdisciplinary; and (3) includes non-scientific actors and their expertise in the production of societally relevant knowledge and steers a process of mutual learning. It is this third element of TD knowledge production, and the *participatory claim* attached to it, which is at the centre of interest of this article.

Despite the widespread call for and high expectations attached to opening up research processes by involving societal actors, fairly little is known about what constitutes different meanings and practices of participation in knowledge production. The literature on participation is widely dispersed, and more recent approaches to participation in TD sustainability research hardly rely on theoretical and practical reflections on participation developed in more established fields. In light of this discrepancy, this article follows Irwin's (2006, p. 310) proposition

107

to make the new "constellations the object of research itself": it asks how participation in knowledge production is constructed and problematised in different scholarly fields, and which understandings of participation underpin such forms of knowledge production. The aim of this article is to (i) bring into conversation three largely disparate scholarly debates on participation in research, (ii) critically examine widely held conceptualisations of participation and (iii) draw tentative contours of an empirical-analytical perspective on participation in TD sustainability research. This shall provide some ideas on how a shift in analytical perspectives on participation might address important gaps in the current understanding of participatory knowledge production.

The article is organised as follows: part 1 provides a review of participation in three different bodies of literature and identifies underpinning models of participation. Building on this state of research, the shortcomings of widely recited models and associated empirical perspectives on participation are critically discussed in part 2. Part 3 outlines the tentative contours of a multidimensional perspective on participatory knowledge production in TD sustainability research before concluding with a summary of general insights and suggestions for further research.

2. Tracing the meanings of participation: a review of key discourses

Questions of participation have been a matter of interest in various academic fields and public debates for decades. Broadly speaking, the literature on participation falls into two categories: literature on participation in decision-making and literature on participation in research and knowledge production. In the following depiction of the state of research, emphasis is put on this second strand of literature on participation – participation in knowledge production, research, and neighbouring fields. The focus is on TD literature as a core discourse on participation in knowledge production in sustainability research. Two related key discourses are addressed: firstly, participation in development research literature, because it enriches our understanding of the development and change component of TD sustainability research and provides valuable examples of critical reflections on participation. Secondly, participation in science and technology studies (STS), because this body of literature allows for a deeper understanding of the science and knowledge production components and provides useful insights into the entanglements of science and society and the conceptualisation of expertise. In the following, these three widely disparate scholarly debates on participation are briefly reviewed and brought into conversation.

2.1 Participation in TD sustainability research

Literature on TD is ample, but scattered over various thematic fields, spanning from medicine and public health (Choi and Pak, 2006) to architecture and urban planning (Tress et al., 2005). Hadorn et al. (2008: 27) describe TD as a 'fuzzy and contested field' which is formed by various lines of thinking and heterogeneous

conceptions of science and expertise. This heterogeneity is reflected in the co-existence of a variety of terminologies. While there is strong agreement on participation as a key element of TD sustainability research, a myriad of terms are used to designate those participating in knowledge production, including notions such as future users (Defila and Di Giulio, 2015), stakeholders (Polk and Knutsson, 2008), practice actors, lay people, and civil society actors. Attempts to assemble the heterogeneous writing can be found in comprehensive volumes by Hadorn et al. (2008) and (2012) and in Fam et al. (2016).

Within sustainability research, several interconnected strands of research on TD can be identified, each of which looks at participation from different angles. Firstly, a considerable body of literature elaborates on different ideal-types of TDR, i.e. it addresses the question of what TDR ought to be and how processes should be governed (Bergmann et al., 2012; Jahn, 2008; Scholz and Steiner, 2015). Lang et al. (2012), for instance, set up principles for guiding TDR from problem-framing to implementation. In their reading, an ideal-typical TD process consists of problem-framing, knowledge co-production and the re-integration of knowledge. Throughout these phases, participation appears as input from practice and science framing the problem to be researched, as a co-creation of knowledge by practice and scientific actors, and as a re-integration of knowledge into both societal and scientific practice (Lang et al., 2012, p. 28). Participation is hence ideal-typically thought of as a symmetrical process throughout all three research phases.

A second strand of literature reports on real-type TDR and associated participation practices. A vast number of articles focus on procedural aspects at the level of single projects or of a small set of case studies, i.e. they adopt a micro-level perspective (Steelman et al., 2015; Tötzer et al., 2011; Vilsmaier et al., 2015). Most of the case study analyses include a description of participation as one element of the process and capture the narrative of the researchers involved. A few authors (e.g. Binder et al., 2015; Di Giulio et al., 2016) explicitly include the reflections of non-scientific actors participating in TDR projects. In a quantitative review of this literature, Brandt et al. (2016) identify 'practitioners' engagement' as one of five key challenges in TD sustainability research. While practitioners were involved in most projects in their sample, only few projects gave decision-making authority to practitioners (Brandt et al., 2013, p. 6). Unlike in ideal-typical TDR, Wuelser and Pohl (2016) find that participation in the problem-framing phase is low in ten projects they studied. Following Di Giulio and Defila (2016, p. 201) this is not necessarily perceived as problematic and matches the preferences expressed by non-scientific participants interviewed, who welcome a traditional division of labour between scientific and non-scientific actors in this early project phase.

The third branch of literature is interested in setting up methods of evaluating TDR and its real-world impacts, and aims at the formation of quality criteria so as to enhance the legitimacy of participatory knowledge production in academic discourse and beyond. In these endeavours of assessing outputs and

109

impacts beyond academic impact metrics, participation in TD sustainability research is viewed as one element on the pathway to impact (Blackstock et al., 2007; Walter et al., 2007; Wiek et al., 2014; Wolf et al., 2013). TD, and with it the participation of heterogeneous actors in research, is seen as a means for achieving desired societal changes towards sustainability. In Walter et al.'s (2007) ex-post evaluation of the impact of TDR, for instance, participation appears as one potential influencing factor, albeit without further specification or operationalisation of the concept. A more elaborate conceptualisation of participation in impact-focused studies is Wiek et al.'s (2014, p. 124) differentiation between nature and quality of participation in TDR.

2.2 Participation in science and technology studies

Literature from the field of STS provides ample reflections on science-society boundaries, and the participation of heterogeneous actors in social spaces of science and technology has become a key concern (Abels, 2006). Scholarly interest ranges from participation in science-policy making and agenda-setting to participation in social appraisals of technology and risk assessments. Over the past four decades, industrialised societies have lived through numerous public controversies of emerging techno-scientific programmes, including nuclear power (Nowotny, 1976) and the nuclear catastrophes of Three Mile Island and Chernobyl, GMO techniques (Hansen, 2010), nanotechnology or shale gas extraction (Goldstein et al., 2016). Such controversies and political attempts to reduce public scepticism towards science and technology by allowing for 'public engagement' or 'public participation' in the governance of science and technology have attracted scholarly attention. STS contributions have shown that the opening-up of technology and risk assessment has been conceived, among other things, as a means to (re-)establish public trust in science or to foster acceptance for new technologies, and has widely echoed a 'deficit model', according to which the 'public' is imagined to have knowledge gaps that need to be filled by *better* science communication (Hansen 2010). Who belongs to those 'publics', which are included in social appraisals of technology and risks, and how they are constructed in relation to 'expertise' is subject of ongoing debate (Fineberg and Stern, 1996; Joss, 2002).

At a conceptual level, participation in technology assessment, just like TD approaches, challenges the well-established perception of a clear-cut boundary and division of labour between society and science as well as the idea that science holds a monopoly over the production of valid, trustworthy knowledge that should 'speak truth to power' (Hoppe, 1999). STS authors address participation as a form of boundary transgression and largely rely on Jasanoff's (2004) idiom of co-production. Along with that, public participation in science(-based policy making) triggered a series of debates on how to demarcate different forms of knowledge and expertise (Beck, 1992; Demeritt, 2015; Jasanoff, 2003). In a widely cited (though not uncontested) article, Collins and Evans (2002, p. 249) aim at dissolving the boundary between certified (scientific) and non-certified

110

(non-scientific) actors, and introduce the term 'experience-based experts' to designate those public actors who have special expertise in virtue of experience.

TDR and the participation of non-scientific actors in research projects has also attracted the attention of STS scholars, representing the most direct overlap with literature on TD sustainability research. Building on ideas of 'mode 2' (Gibbons et al., 1994), in an analysis of TDR projects Felt et al. (2016) challenge ideal-typical imaginaries of participation and ask to which extent participation constitutes a practice of boundary transgression. They assess (dis)entanglements between practice and scientific realms and find different models of how researchers and practice actors (re)define science-society relations. i) Linear translation model: scientific and societal arenas remain largely separated. Researchers are powerful actors in shaping what is to be regarded as a societal problem and knowledge is then translated to society. (ii) Delimited neutral arena model: temporal zones of encounters are established between the research and the problem-related area. Participating societal actors are regarded as gatekeepers who hold some specific, experimental knowledge or have access to data. (iii) Temporary shared epistemic arena model: the research arena is functionally delimited but partly overlaps with the problem-related arena with regard to producing, reflecting, and integrating knowledge. Participating societal actors appear as knowledgeable agents (Felt et al., 2016).

In *Remaking Participation,* Chilvers and Kearnes (2015) gather diverse facets of STS scholarship on participation and propose to rethink public engagements with science and environmental issues as diverse, emergent and in the making. The authors were motivated by "[…] the almost breathless celebration of the transformative potential of participation followed quickly by arguments for more participation" (Chilvers and Kearnes, 2015, p. 14). What they identify as missing in the dominant discourse – and this goes in line with the argument presented in this article - is a sustained attempt to not take participation for granted, but to understand how participation is constructed and in the making. Despite the fact that several of the here mentioned topics discussed in STS are relevant for thinking about participation in TDR, with a few notable exceptions cross-referencing between the two fields is rare.

2.3 Participation in development research

Within development studies – an interdisciplinary field interested, among other things, in societal changes in the Global South and closely associated with real-world actions – there has for decades been a tradition of participation in research and research-based development practices. Not least as a reaction to the sobering results of decades of development co-operation matched with the emergence of post-colonial thought (e.g. Said, 1978), the call for the inclusion of local/indigenous knowledge has entered development research long before it was labelled 'transdisciplinary'. Practices of Rapid Rural Appraisal (RRA) and, in particular, Participatory Rural Appraisal (PRA) emerged from the 1970s onwards. While the former developed tools for better grasping local knowledge (Chambers, 1994,

111

1974), the latter more radically aimed at reversing roles and shifting the perspectives from outsiders to insiders and stressed the importance of local actors as holders of valid contextualised knowledge (Brutschin and Wiesmann, 2003).

Influenced by the writings of Lewin (1946) and relying on the work of Freire's *Pedagogy of the Oppressed* (1970) and Boff's early liberation theory (1979), proponents of participatory methods and Participatory Action Research (PAR) questioned the dominant top-down practices that characterised much of development planning, research, and thinking. Participation has been seen as a means to ownership and empowerment of individuals and communities and, in turn, as a prerequisite for lasting change (Whyte, 1991). In the meantime, this initially radical critique of development practices and research has been mainstreamed in international development and incorporated into projects and programmes of governments and international organisations (Parfitt, 2004).

With this widespread adoption of participatory approaches in development practice, concerns grew that participation was not the panacea many claimed it to be (Christens and Speer, 2006). Critical perspectives on the concept and practice of participation and participatory development are provided, most prominently, by Kothari and Cooke (2001), Hickey and Mohan (2004) and Cornwall and Coelho (2007). Broadly speaking, different criticisms can be grouped into two branches: i) an internal critique of techniques and methods which aims at improving practices of participation; ii) a more fundamental critique which stresses power effects of participatory discourses (Williams, 2004, p. 559).

In addition to this rich experience with participation practices under different headings, development literature provides practical examples of and critical reflections on TDR (Habermann et al., 2013; Witjes et al., 2012). With the exception of few authors (e.g. Wiesmann et al., 2011), sustainability research scholars rarely refer to experience with participatory approaches in development research and vice versa. Yet, the goals, dynamics and normative aspirations might be comparable and could render an integration of these respective research bodies fruitful. Relying on experiences with participation within development research gives valuable input for improving our understanding of participation in knowledge production for societal change.

2.4 Of ladders and flows: deconstructing 'models' of participation across fields

The rough literature overview given above indicates the various discourses on participation in science and (societal) development and suggests that participation has been brought forward in reaction to different kinds of problems. Put simply, TD sustainability research identifies mismatches between what we know and what we do; development research, on the other hand, observes a lack of ownership and empowerment and, with regard to technology assessment, STS literature problematises a decreasing public trust in science and technology. The common answer to those and other problems is seen in the participation of various actors in the respective process.

112

Accordingly, participation is a polyvalent term, occurs in different shapes, is associated with multiple ends, and has come to mean different things to different people. Combined with a variety of nouns, the term 'participatory' has been loaded with diverse social, political and methodological meaning. Broadly speaking, the manifold ways of making sense of participation can be contextualised in two historically parallel developments: growing public engagement in environmental decision-making in the global North, and action-orientated approaches to community participation of marginalised groups in the Global South (Lawrence, 2006, p. 282). Yet, are there any common grounds when we speak of participation TD sustainability research, development studies, and STS?

Across the three fields, several authors take up and further develop a particular vision of participation which goes back to the *Ladder of Participation* by Arnstein (1969). Her ladder is probably the most popular typology upon which many of today's conceptualisations of participation in various fields are built (Huxley, 2013, p. 1533). Relying on her experiences as a community worker in the US of the 1960s, Arnstein (1969) categorises eight uses of the term participation and arranges them in a ladder pattern, with each rung corresponding to the extent of citizen power: manipulation and therapy (non-participation); informing, consultation, placation (tokenism); partnerships, delegated power, and citizen control (citizen power). While numerous scholars have renamed the rungs of the ladder for their purposes, Arnstein's model instilled a particular vision of participatory progress, whereby climbing up the ladder is accompanied by a redistribution of power from the power-holding bodies to the to-be-empowered citizens (Chilvers and Kearnes 2015: xvi). This implies a realist understanding of power as a commodity which can be held by actors and exerted by one actor over another (Hayward, 2000).

In the literature on TD sustainability research, the underpinning model of participation is hardly ever elucidated. Among those authors who make their understanding of participation explicit, different approaches exist. For instance, Stauffacher et al. (2008) conceive participation, in reference to Arnstein, as intensities of involvement of non-scientific actors throughout a project cycle. With the help of this functional-dynamic model, they analyse (and propose to design) the intensities of involvement in a TD case study along the axes of information, consultation, cooperation, collaboration, and empowerment. Conceptualisations of participation specifically for the context of knowledge production have been provided by Defila et al. (2006, p. 216) as well as by Boeckmann (2005). With slight variations, they describe participation as a continuum ranging from non-scientific actors being the object of research/being informed to being a partner on equal footing/actively shaping the process. Both establish an indirectly proportional link between the number of people involved and the intensity of their involvement. In a similar vein, adaptations of the Arnstein typology can be found in the field of development studies. These include Pretty's typology (1995, p. 1252), which speaks to the user of participatory approaches and conceptualises motivations as an important factor in shaping interventions, and White's (1996)

113

typology of interests, which aims at unfolding conflicting ideas about how participation is being used throughout a process. Burgess and Chilvers (2006, p. 719) show that in the literature on participation in governance of science and appraisal of technology, too, three to four-stage classifications of participatory processes based on Arnstein's ladder have become widely used.

Stirling (2008, p. 268) argues that one common feature of participation and its analysis lies in the importance of intentionality attached to it. Analytical attention has been focused on the motivation underlying participation practices. Most prominently, Fiorino distinguishes between three imperatives underwriting participatory practices: normative (participation as an end in and of itself), substantial (participation aimed at achieving better ends), and instrumental (participation aimed at securing particular interests/ends) (Fiorino, 1989), each of which result in different forms of participation. While the first is process-orientated, the latter two focus on outcomes (Stirling, 2008, p. 269).

Alternatively to models based on degrees of involvement, Rowe and Fewer (2005) focus on the *nature of involvement*. They identify three forms of public engagement according to the flow of information: public communication (one-way communication), public consultation (one-way communication in the opposite direction), and public participation (two-way communication). In the field of STS, further suggestions on how to capture participation reflecting the 'acceptability' or 'trust' problem in the public include: Nelkin and Pollak's (1979) distinction between participation as advisory, as public consultation, and as information; or Chilvers' (2007) division into non-interactive, interactive, and active forms of participation.

Field / *Axes of comparison*	Sustainability research	STS	Development research
Important literature sub-fields on participation	actor-orientated branches of TDR	participatory technology and risk assessment, public engagement	participatory rural appraisal, participatory action research
Main "problem" to be addressed by participation	complexity of *lifeworld* problems; gap between knowing about unsustainable practices and acting accordingly	lack of trust in science and new technologies	lack of ownership and marginalisation
Actors / "invited publics"	'practice actors' (often institutionalised actors such as municipalities, companies, NGOs)	the 'public'	concerned individuals, communities
Exemplary typologies of participation referred to	functional-dynamic model by Stauffacher et al. (2008); continuum of participation by Defila et al. (2006) and Boeckmann (2005)	participation as flow of information by Rowe and Fewer (2005)	Pretty's typology (1995); White's (1996) typology of interests
Exemplary contribution to other fields	guidance in process design and choice of methods for involvement of non-scientific actors	reflexivity, 'construction' of expertise	critical analyses of power in and through participation processes

Table: Schematic comparison based on scoping literature review.

114

3. Critical reflections

In the previous part, the current state of research on participation in TD sustainability research were briefly discussed and key works in the bordering fields of development studies and STS were taken into account. Upon that basis, I described common notions and typologies of participation. In the following, I engage in a critical discussion of these conceptualisations of participation and their implications for empirical analyses of participation, particularly in TD sustainability research.

3.1 The predominance of ideal-typical imaginaries of participation

In the field of TD sustainability research, ideal-typical imaginaries of participation in knowledge production prevail while a critical perspective is widely lacking. The term participation has become a buzzword, or, as Renn labels it, a 'dazzling term' (Renn 2005 quoted in Scholz, 2011, p. 388), which is mainly positively connoted, associated with democratic values, empowerment, public trust, and a higher probability of inducing societal change. Linked to this, many approaches to participation implicitly adopt normative models that assume a 'correspondence theory' of an external 'public', which is imagined to be in a natural state and waiting to be mobilised by participatory methods (Chilvers and Kearnes 2015). The notion of participation per se, however, does not say much about *who* is entitled to participate in which ventures, and in which ways. Participation in knowledge production as such neither tackles questions of representation, nor does it ensure the quality of the findings (or even superior quality, as compared to non-participatory processes). Weingart (1997, p. 611) speaks of a "[…] romanticized appeal of the higher rationality of lay knowledge". Many accounts of participation echo Habermasian ideals of discursive democracy (Cornwall and Coelho, 2007, p. 79) and are normatively guided by principles of ideal speech situations as laid down in Habermas' *Theory of Communicative Action* (1981). In this regard, analytical approaches privilege consensus-orientated over conflict-sensitive perspectives on participation. Yet, participatory sustainability research is embedded in wider societal struggles for defining what sustainability is, and how it can be achieved. While sustainable development is considered a 'vision shared by all' and participation in TDR is expected to contribute to fleshing out this vision, transformation is not merely a question of the right management principles, but as such a deeply political endeavour that might be contested (Brand 2016). Which changes are perceived as desirable and feasible is the result of negotiation processes that reflect societal power relations as much as perceptions of society-nature relations. When it comes to concrete ways of framing and solving sustainability problems, different societal actors express varying and sometimes even incommensurable values and perspectives (Polk and Knutsson, 2008; Popa et al., 2015). Here it is assumed that this plurality of values and perspectives is traceable in sustainability-orientated research, and that it has an impact on the participation process. This entails moving beyond conceiving participation in TD sustainability research as a mere managerial-organisational challenge and

towards conceptualising it as an intrinsically political act (Cornwall, 2008, p. 281). While critical perspectives, for instance, on power within and through participation have gained considerable attention in development studies (Cooke and Kothari, 2001), they have only recently begun to emerge in fields more closely associated with public involvement in science and environmental risk, including sustainability research and STS (Chilvers and Kearnes, 2015). As of now, within the body of literature more narrowly focused on TD sustainability research, critical approaches are marginal, illustrating the potential benefits of bringing these different research fields into conversation.

3.2 Output-orientated (self-)reflections prevail over process-orientated empirical analyses

In reaction to the rather poor empirical basis upon which the high expectations towards TD approaches for sustainable development are grounded (Felt et al., 2012), many current contributions focus on the outputs, impact, and outcomes of TD sustainability research, and tend to regard participation as an input. Participation is frequently portrayed as a means to achieve a certain end (societal change), rather than as a dynamic social process in its own right, with various interpretations and uncertainties. Literature on TD sustainability research hardly addresses the ways in which, for instance, worldviews of the respective actors, the availability of resources, or the perceptions of expertise shape participation. Accordingly, little is known about causes hampering participation and co-production of knowledge, and insights into how different contexts affect participation and, in turn, the societal impact of a project are rare. Methodologically, most of the empirical literature on TDR is based on an in-depth analysis of individual projects, while more aggregated and comparative analyses are scant (Zscheischler and Rogga, 2015). Most of these (self-)reflections are partial in the sense that they speak from the standpoints of the scientific actors, while the perspectives of non-academic participants are seldom adopted.

3.3 Linearity and one-dimensionality

Several of the models of participation reviewed originate in the field of (urban, community) planning and were primarily designed with an interest in processes of decision-making and governance, quests for empowerment, or the planning of interventions. They are not based on experiences with participation in knowledge production and the inclusion of different epistemes in research processes. The short, non-exhaustive, review of typologies of participation referred to in the three bodies of literature suggests that linear, one-dimensional models and typologies of participation dominate. Their linearity is manifest in the implicit 'the more participation, the better' logic emblematically illustrated by the metaphor of ladders. They are one-dimensional in the sense that participation appears as a function of the degree of transfer of power which is intentionally handed over by the power-holding actors. In so doing, they rely on a classical understanding of power as 'power over', e.g. the 'powerful' transferring (or not) some of their power

116

to the initially 'powerless'; more relational and discursive forms of power are widely neglected. A post-structuralist approach would, for instance, suggest to understand power as various effects stemming from both intentional and unintentional practices and discourses of participation (Cook et al., 2013).

The ways in which participation is conceptualised arguably has repercussions on the empirical perspective applied to understanding participation practices. While the predominant typologies described provide a valuable starting point for thinking about types and degrees of participation in research and knowledge production, they fall short in explaining why participation plays out differently in different contexts. By and large, descriptive accounts are privileged which focus on the 'what' of participation, while the 'how' and 'why' of different forms of participation are under-researched. Beyond motivations and intentions, there is little systematic knowledge of the factors that form participation processes in TD sustainability research.

4. Contours of an alternative perspective: constructing spaces of participation

In this article, the ways in which participation is addressed in three scholarly fields were reviewed, and widely held conceptualisations of participation were critically reflected with regard to their repercussions on empirical approaches to participation practices. The comparative discussion of the fragmented literature on participation in TD sustainability research, development studies, and STS has shown that the notion of participation is loaded with various meanings and is mostly normatively connoted. While attempts of categorising and assessing participation along ladder patterns are abundant, the question of why different intensities occur largely remains unanswered. Different forms of participation appear as a result of the intentions and goals of those setting up the process; empirical perspectives are predominantly focused on the outputs rather than the processes of participation, and are guided by ideals of deliberative democracy. I therefore want to conclude this article with some thoughts on how the 'what' of participation (expressed in intensities) could be complemented with research on why these different shapes of participation materialise. Shifting perspectives away from the imaginaries of ladders might bring to the fore different kinds of questions for empirical enquiries into participation practices.

In the following, a tentative analytical perspective is outlined which is sensitive to the role of various factors shaping participation in TD sustainability research. Moving beyond linear, one-dimensional representations of participation, I here propose to conceive of participation as a *relational space* characterised by the duality of agency and structure (Löw, 2013). Following this idea, in participation processes the actors involved enter a social space which they actively create, but which is also co-constituted by the surrounding social structures and norms. Literature in the three fields reviewed here provides some spatial analogies, not directly focused on participation, but on related aspects of science-society

117

relations. With their concept of 'mode 2', Nowotny et al. (2001), for instance, suggest that the epistemological boundaries between the fields of science and society at least partially dissolve. At the intersection of the realms of science and other societal fields, a new common space emerges which they call the *agora*. In reference to the Greek "political arena and the market place", they describe the interface as "a public space in which 'science meets the public', and in which 'the public speaks back to science'" (Nowotny et al., 2001, p. 247). Other scholars rely on symbolisms of space as an analytical perspective on social processes. For instance, Felt et al.'s (2009) *epistemic living spaces* and Cornwall's (2004) *spaces for transformation* provide ideas on how to conceptualise participatory practices as a space.

Transferring elements of those concepts to the case of participation suggests that such spaces are shaped by miscellaneous factors, related both to their embeddedness in the respective societal fields as well as to the actors involved. Conceiving participation as a relational space allows us to understand different shapes and intensities not merely as a function of the intentions of the 'architects of participation' (Felt et al., 2012, p. 6). It also draws attention to the forces of the wider scientific and practice fields within which individual engagement situations are embedded, and hence urges us to take into account the power relations inscribed, the ascription of roles, expertise, and identities amongst those who participate. An analytical approach focusing on spaces of participation might guide an empirical analysis of the dimensions that constitute practices of participation and shape their fabrication. The resulting multidimensional approach directs analytical attention to factors on different scales, from institutional and structural ones to factors at the level of individual actors or collectives, and suggests that we look at their inter-relations. In so doing, it complements existing perspectives on both the 'what' of participation and on the outputs of participation, and helps us to move beyond the sole focus on the engagement situation by taking into account its embeddedness in the wider political economy of knowledge production.

While the literature in the three fields introduced above suggests that several elements are involved in the making of participation, these need to be systematically brought together. In addition, empirical research is needed to elucidate the way in which the actors involved conceive of participation, and what they perceive as participation-related factors. Future research should aim at widening the empirical basis on the factors constituting spaces of participation, move beyond single case study approaches and self-reflections, and take into account the perspectives and standpoints of both scientific and non-scientific actors in the making of collaborative knowledge production projects in the field of sustainability.

References

Abels, G., 2006. Forms and functions of participatory technology assessment–Or: Why should we be more sceptical about public participation? Presented at the Participatory Approaches in Science & Technology Conference 4th–7th June, Edinburgh.

Arnstein, S.R., 1969. A ladder of citizen participation. J. Am. Inst. Plann. 35, 216–224.

Bäckstrand, K., 2003. Civic science for sustainability: reframing the role of experts, policy-makers and citizens in environmental governance. Glob. Environ. Polit. 3, 24–41.

Beck, U., 1992. Risk society: Towards a new modernity. London and New York: Sage.

Bergmann, M., Jahn, T., Knobloch, T., Krohn, W., Pohl, C., Schramm, E., Faust, R.C., 2012. Methoden transdisziplinärer Forschung. Frankfurt am Main and New York: Campus Verlag.

Binder, C.R., Absenger-Helmli, I., Schilling, T., 2015. The reality of transdisciplinarity: a framework-based self-reflection from science and practice leaders. Sustain. Sci. 10, 1–18.

Blackstock, K.L., Kelly, G.J., Horsey, B.L., 2007. Developing and applying a framework to evaluate participatory research for sustainability. Ecol. Econ. 60, 726–742.

Boeckmann, T., Dorsch, P., Hoffmann, F., Ohlhorst, D., Schumacher, U., Wulff, J., 2005. Zwischen Theorie und Praxis. Anregungen zur Gestaltung von Wissenschafts-Praxis-Kooperationen in der Nachhaltigkeitsforschung. Discussion paper 17, Zentrum für Technik und Gesellschaft.

Boff, L., 1979. Liberating grace. New York: Orbis Books.

Brandt, P., Ernst, A., Gralla, F., Luederitz, C., Lang, D.J., Newig, J., Reinert, F., Abson, D.J., von Wehrden, H., 2013. A review of transdisciplinary research in sustainability science. Ecol. Econ. 92, 1–15.

Brutschin, J., Wiesmann, U., 2003. Transdisciplinary research in development cooperation: origins and paradigms. Unity Knowl. Transdiscipl. Res. Sustain. Encycl. Life Support Syst. EOLSS.

Burgess, J., Chilvers, J., 2006. Upping the ante: a conceptual framework for designing and evaluating participatory technology assessments. Sci. Public Policy 33, 713–728.

Chambers, R., 1994. Participatory rural appraisal (PRA): analysis of experience. World Dev. 22, 1253–1268.

Chambers, R., 1974. Managing rural development ideas and experience from East Africa. Uppsala: Scandinavian Institute of African Studies.

119

Chilvers, J., 2007. Deliberating competence: Theoretical and practitioner perspectives on effective participatory appraisal practice. Sci. Technol. Hum. Values 33.

Chilvers, J., Kearnes, M., 2015. Remaking Participation: Science, Environment and Emergent Publics. London and New York: Routledge.

Choi, B.C., Pak, A.W., 2006. Multidisciplinarity, interdisciplinarity and trans-disciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness. Clin. Invest. Med. 29, 351.

Christens, B., Speer, P.W., 2006. Review essay: tyranny/transformation: power and paradox in participatory development. Forum Qualitative Sozialforschung 7/Forum: Qualitative Social Research 7.

Collins, H.M., Evans, R., 2002. The third wave of science studies studies of expertise and experience. Soc. Stud. Sci. 32, 235–296.

Cook, B.R., Kesby, M., Fazey, I., Spray, C., 2013. The persistence of "normal"catchment management despite the participatory turn: Exploring the power effects of competing frames of reference. Soc. Stud. Sci. 43, 754–779.

Cooke, B., Kothari, U., 2001. Participation: The new tyranny? London: Zed Books.

Cornwall, A., 2008. Unpacking "Participation": models, meanings and practices. Community Dev. J. 43, 269–283.

Cornwall, A., 2004. Spaces for transformation? Reflections on issues of power and difference in participation in development. In: Participation: from tyranny to transformation. London and New York: Zed Books, 75–91.

Cornwall, A., Coelho, V.S., 2007. Spaces for change? The politics of citizen participation in new democratic arenas. London: Zed Books.

Defila, R., Di Giulio, A., 2015. Integrating knowledge: Challenges raised by the "Inventory of Synthesis." Futures 65, 123-135.

Defila, R., Di Giulio, A., Scheuermann, M., 2006. Forschungsverbundmanagement: Handbuch für die Gestaltung inter- und transdisziplinärer Projekte. Zürich: vdf Hochschulverlag AG.

Demeritt, D., 2015. The Promises of Participation in Science and Political Ecology, in: Perreault, T.B., Gavin; McCarthy, James (Ed.), Handbook of Political Ecology. London and New York: Routledge.

Di Giulio, A., Defila, R., Brückmann, T., 2016. "Das ist halt das eine … Praxis, das andere ist Theorie" - Prinzipien transdisziplinärer Zusammenarbeit im Forschungsalltag, in: Defila, R., Di Giulio, A. (Eds.), Transdisziplinär Forschen - Zwischen Ideal und gelebter Praxis: Hotspots, Geschichten, Wirkungen. Frankfurt am Main: Campus Verlag.

120

European Commission, 2011. Horizon 2020—The Framework Programme for Research and Innovation.

Fam, D., Palmer, J., Riedy, C., Mitchell, C., 2016. Transdisciplinary research and practice for sustainability outcomes. New York: Routledge.

Felt, U., 2009. Knowing and living in academic research: convergences and heterogeneity in research cultures in the European context. Institute of Sociology of the Academy of Sciences of the Czech Republic, Prague.

Felt, U., Igelsböck, J., Schikowitz, A., Völker, T., 2016. Transdisciplinary Sustainability Research in Practice: Between Imaginaries of Collective Experimentation and Entrenched Academic Value Orders. Sci. Technol. Hum. Values 1, 30.

Felt, U., Igelsböck, J., Schikowitz, A., Völker, T., 2012. Challenging participation in sustainability research. J. Deliberative Mech. Sci. 1, 4-34.

Fineberg, H.V., Stern, P.C., 1996. Understanding Risk: Informing Decisions in a Democratic Society. Washington: National Academies Press.

Fiorino, D.J., 1989. Environmental risk and democratic process: a critical review. Colum J Envtl L 14, 501.

Freire, P., 1970. Pedagogy of the Oppressed. New York: Herder and Herder.

Funtowicz, S.O., Ravetz, J.R., 1993. The emergence of post-normal science, in: Science, Politics and Morality. Dordrecht: Springer, pp. 85–123.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M., 1994. The new production of knowledge: The dynamics of science and research in contemporary societies. Los Angeles (a.o.): Sage.

Goldstein, B.D., Renn, O., Jovanovic, A.S., 2016. Public Health, Risk Perception, and Risk Communication: Unconventional Shale Gas in the United States and the European Union, in: Rose, T. (Ed.), Environmental and Health Issues in Unconventional Oil and Gas Development. Amsterdam (a.o.): Elsevier, pp. 107–127.

Habermann, B., Misganaw, B., Peloschek, F., Dessalegn, Y., 2013. Inter- and Transdisciplinary Research Methods in Rural Transformation: Case Studies in Northern Ethiopia. Vienna: Centre for Development Research (CDR).

Habermas, Jürgen, H., 1981. Theorie des kommunikativen Handelns. Frankfurt am Main: Suhrkamp.

Hadorn, G.H., Hoffmann-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., Wiesmann, U., Zemp, E., 2008. Handbook of trans-disciplinary research. Dordrecht: Springer.

Hansen, J., 2010. Biotechnology and public engagement in Europe. Houndsmill, Basingstoke: Palgrave Macmillan.

Hayward, C.R., 2000. De-facing power. New York (a.o.): Cambridge University Press.

121

Hickey, S., Mohan, G., 2004. Towards participation as transformation: critical themes and challenges. In: Participation: from tyranny to transformation. Zed Books, London and New York, 3–24.

Hoppe, R., 1999. Policy analysis, science and politics: from "speaking truth to power" to "making sense together." Sci. Public Policy 26, 201–210.

Huxley, M., 2013. Historicizing planning, problematizing participation. Int. J. Urban Reg. Res. 37, 1527–1541.

Irwin, A., 2006. The politics of talk: coming to terms with the "new"scientific governance. Soc. Stud. Sci. 36, 299–320.

Jahn, T., 2008. Transdisziplinarität in der Forschungspraxis. In: Bergmann, M., Schramm, E. (eds.): Transdisziplinäre Forschung. Integrative Forschungsprozesse verstehen und bewerten. Frankfurt am Main and New York: Campus Verlag, 21–37.

Jasanoff, S., 2004. States of knowledge: the co-production of science and the social order. London and New York: Routledge.

Jasanoff, S., 2003. Breaking the waves in science studies: comment on H.M. Collins and R. Evans, 'the third wave of science studies'. Soc. Stud. Sci. 389–400.

Joss, S., 2002. Toward the public sphere—Reflections on the development of participatory technology assessment. Bull. Sci. Technol. Soc. 22, 220–231.

Klein, J.T., Grossenbacher-Mansuy, W., Häberli, R., Bill, A., Scholz, R.W., Welti, M., 2012. Transdisciplinarity: joint problem solving among science, technology, and society: an effective way for managing complexity. Birkhäuser.

Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., Thomas, C.J., 2012. Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustain. Sci. 7, 25–43.

Lawrence, A., 2006. "No personal motive?"Volunteers, biodiversity, and the false dichotomies of participation. Ethics Place Environ. 9, 279–298.

Lewin, K., 1946. Action research and minority problems. J. Soc. Issues 2, 34–46.

Leydesdorff, L., Etzkowitz, H., 1998. The triple helix as a model for innovation studies. Sci. Public Policy 25, 195–203.

Löw, M., 2013. Raumsoziologie. Frankfurt am Main: Suhrkamp Verlag.

Mittelstraß, J., 1989. Wohin geht die Wissenschaft? Über Disziplinarität, Transdisziplinarität und das Wissen in einer Leibniz-Welt. Konstanz. Bl. Für Hochschulfragen 26, 97–115.

Nelkin, D., Pollak, M., 1979. Public Participation in technological decisions: reality or grand illusion. Technol. Rev. 81, 54–64.

Nowotny, H., 1976. Social aspects of the nuclear power controversy. IIASA Laxenburg.

122

Nowotny, H., Scott, P., Gibbons, M., 2001. Re-thinking science: Knowledge and the public in an age of uncertainty. SciELO Argentina.

Parfitt, T., 2004. The ambiguity of participation: a qualified defence of participatory development. Third World Q. 25, 537–555.

Polk, M., Knutsson, P., 2008. Participation, value rationality and mutual learning in transdisciplinary knowledge production for sustainable development. Environ. Educ. Res. 14, 643–653.

Popa, F., Guillermin, M., Dedeurwaerdere, T., 2015. A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science. Futures 65, 45–56.

Pretty, J.N., 1995. Participatory learning for sustainable agriculture. World Dev. 23, 1247–1263.

Rowe, G., Frewer, L.J., 2005. A typology of public engagement mechanisms. Sci. Technol. Hum. Values 30, 251–290.

Said, E., 1978. Orientalism: Western Conceptions of the Orient. London: Kegan Paul.

Scholz, R.W., 2011. Environmental Literacy in Science and Society: From Knowledge to Decisions. London and New York: Cambridge University Press.

Scholz, R.W., Lang, D.J., Wiek, A., Walter, A.I., Stauffacher, M., 2006. Trans-disciplinary case studies as a means of sustainability learning: Historical frame-work and theory. Int. J. Sustain. High. Educ. 7, 226–251.

Scholz, R.W., Steiner, G., 2015. Transdisciplinarity at the crossroads. Sustain Sci 10, 521–526.

Stauffacher, M., Flüeler, T., Krütli, P., Scholz, R.W., 2008. Analytic and dynamic approach to collaboration: a transdisciplinary case study on sustainable landscape development in a Swiss prealpine region. Syst. Pract. Action Res. 21, 409–422.

Steelman, T., Nichols, E.G., James, A., Bradford, L., Ebersöhn, L., Scherman, V., Omidire, F., Bunn, D.N., Twine, W., McHale, M.R., 2015. Practicing the science of sustainability: the challenges of transdisciplinarity in a developing world context. Sustain. Sci. 10, 581–599.

Stirling, A., 2008. "Opening up" and "closing down" power, participation, and pluralism in the social appraisal of technology. Sci. Technol. Hum. Values 33, 262–294.

Tötzer, T., Sedlacek, S., Knoflacher, M., 2011. Designing the future—A reflection of a transdisciplinary case study in Austria. Futures 43, 840–852.

Tress, B., Tress, G., Fry, G., 2005. Defining concepts and the process of knowledge production in integrative research. Heidelberg: Springer.

123

Vilsmaier, U., Engbers, M., Luthardt, P., Maas-Deipenbrock, R.M., Wunderlich, S., Scholz, R.W., 2015. Case-based mutual learning sessions: knowledge integration and transfer in transdisciplinary processes. Sustain. Sci. 10, 563–580.

Walter, A.I., Helgenberger, S., Wiek, A., Scholz, R.W., 2007. Measuring societal effects of transdisciplinary research projects: design and application of an evaluation method. Eval. Program Plann. 30, 325–338.

Weingart, P., 1997. From "Finalization" to "Mode 2": Old wine in new bottles? Soc. Sci. Inf. 36, 591–613.

White, S.C., 1996. Depoliticising development: the uses and abuses of participation. Dev. Pract. 6, 6–15.

Whyte, W.F.E., 1991. Participatory action research. Newbury Park: Sage Publications, Inc.

Wiek, A., Talwar, S., O'Shea, M., Robinson, J., 2014. Toward a methodological scheme for capturing societal effects of participatory sustainability research. Res. Eval. 23, 117–132.

Wiesmann, U., Hurni, H., Ott, C., Zingerli, C., 2011. Combining the concepts of transdisciplinarity and partnership in research for sustainable development. Perspect. Swiss Natl. Cent. Competence Res. NCCR North-South 6, 43–70.

Williams, G., 2004. Evaluating participatory development: tyranny, power and (re)politicisation. Third World Q. 25, 557–578.

Wilson, S., 2012. Science is key to our sustainable future. Al Jazeera. https://www.aljazeera.com/indepth/opinion/2012/06/20126211211472368.html (accessed 08.05.2018).

Witjes, N., Novy, A., Schlögl, M., Obrecht, A.J., 2012. Wissensallianzen für Entwicklung, Strukturen, Akteure & Netzwerke der österreichischen Entwicklungsforschung. ed, Edition 18. OEFSE, Wien.

Wolf, B., Lindenthal, T., Szerencsits, M., Holbrook, J.B., Hess, J., 2013. Evaluating Research beyond Scientific Impact: How to Include Criteria for Productive Interactions and Impact on Practice and Society. GAIA-Ecol. Perspect. Sci. Soc. 22, 104–114.

Wuelser, G., Pohl, C., 2016. How researchers frame scientific contributions to sustainable development: a typology based on grounded theory. Sustain. Sci. 11, 789–800.

Wynne, B., 2007. Public participation in science and technology: performing and obscuring a political–conceptual category mistake. East Asian Sci. Technol. Soc. 1, 99–110.

Zscheischler, J., Rogga, S., 2015. Transdisciplinarity in land use science – A review of concepts, empirical findings and current practices. Futures, "Advances in transdisciplinarity 2004-2014" 65, 28–44.

124

3 Manuscript III

Bibliographic details:

Fritz, L.; Schilling, T.; Binder, C.R. 2019. Participation-effect pathways in transdisciplinary sustainability research: an empirical analysis of researchers' and practitioners' perceptions using a systems approach. *Environmental Science and Policy 2019*, 102, 65-77. DOI: 10.1016/j.envsci.2019.08.010

Contribution of the doctoral candidate:

The doctoral candidate had the main responsibility for the writing of the introduction, methods, discussion and conclusions sections of this article. The first two authors contributed equally to conceptualising the article and conducting the empirical research and co-wrote the results section. The third author provided conceptual inputs on the systems approach. The doctoral candidate took the lead for the revisions during the peer review processes and the finalisation of the article for publication.

Participation-effect pathways in transdisciplinary sustainability research: An empirical analysis of researchers' and practitioners' perceptions using a systems approach

Livia Fritz*, Thorsten Schilling, Claudia R. Binder

École Polytechnique Fédérale de Lausanne, Laboratory for Human-Environment Relations in Urban Systems, Station 2, 1015 Lausanne, Switzerland

A B S T R A C T

In sustainability research, transdisciplinary (TD) approaches that involve practitioners in the research process have emerged as promising tools for enhancing real-world knowledge and engendering societal change. However, empirical insights into how such participation can contribute to the societal effects of TD research are scant and largely rely on single case studies, neglecting practitioners' perceptions. In this article, we empirically investigate the perceptions of both researchers and practitioners on how practitioners' participation in TD research might instigate societal changes. We present the results of a qualitative meta-level study of participation processes in seven TD sustainability research projects from a large German research funding programme. Applying a systems approach, we (i) uncover direct, indirect and interlinked participation-effect pathways; and (ii) highlight feedback effects that shape a dynamically evolving participation process. By elucidating both researchers' and practitioners' perceptions of participation-effect pathways, this article contributes empirical insights to an emerging scholarship on theories of change in sustainability research and provides ideas on how to better include systems thinking into TD research and future studies of societal effects.

1. Introduction

Transdisciplinary (TD) approaches that involve diverse societal actors in sustainability research are gaining traction and political relevance in research policy and practice. In response to 'grand' societal challenges (European Commission, 2019), science policy and research funding programmes increasingly request researchers to co-create or co-produce knowledge with policy-makers, businesses, and civil society actors (Schneider et al., 2019a; Van der Hel, 2016), thus opening up knowledge production to actors beyond the scientific realm. Such proposals are generally rooted in the expectation that incorporating practitioners and their expertise into the research process produces 'robust' knowledge and engenders desired societal change (de Jong et al., 2016; Polk, 2014). With the increasing use and policy relevance of such approaches, the need to analyse and demonstrate the societal effects of research-practice interactions in TD sustainability research has intensified (Hansson and Polk, 2018; Van der Hel, 2016).

Existing approaches to identify and measure the societal effects of research commonly differentiate outputs, outcomes, and impacts (Morton, 2015; Shirk et al., 2012; Walter et al., 2007; Wiek et al.,

2014). Outputs are tangible or intangible products resulting from project activities and leading to first-order effects or outcomes, such as the enhancement of practitioners' capacities (Shirk et al., 2012; Wiek et al., 2014). Second-order effects or impacts refer to 'long-term and sustained changes' (Shirk et al., 2012) or 'structural changes and actions' (Wiek et al., 2014). In such conceptualisations, the participation of practitioners is commonly considered as an input factor whereas societal effects (outcomes and impacts) denote the desired endpoints ultimately reached through the creation of outputs (Shirk et al., 2012; Walter et al., 2007; Wiek et al., 2014).

Research in neighbouring fields to TD such as participatory action research has shown that participatory practices produce effects that are closely tied to the interactions and relations of the involved actors (Darby, 2017; Evans, 2016). Similarly, Spaapen and Van Drooge (2011) proposed to focus analytical efforts on processes by examining 'productive interactions' between researchers and stakeholders. Joining the call for process-oriented perspectives on the effects of collaborative research processes (Currie et al., 2005), formative evaluations conducted during the process have been identified as promising ways forward (Hellström, 2015; Wiek et al., 2014). Such varying facets of

---

emerging scholarship on the societal effects of TD research indicate the need for further empirical insights into the interrelations between effects and the dynamics of participation processes (Hansson and Polk, 2018). Considering the perceptions of diverse actors—including researchers and practitioners[1]—is pivotal for understanding the role of participation on the pathway to societal effects (de Jong et al., 2016; Hansson and Polk, 2018; Spaapen and Van Drooge, 2011).

TD scholars generally agree that societal effects often emerge from complex and non-linear processes (Kaufmann-Hayoz et al., 2016; Meagher et al., 2008; Molas-Gallart et al., 2000; Van Kerkhoff, 2014); however, only limited methodologies and conceptualisations are currently available for the analysis of these interactions (Belcher and Palenberg, 2018; van Drooge and Spaapen, 2017). Relying predominantly on the conceptual chain of outputs-outcomes-impacts for understanding societal effects results in insufficient consideration of the procedural and dynamic nature of TD approaches that deliberately break with linear research logics (Carew and Wickson, 2010; Klenk and Meehan, 2017). There is a need for methodologies and conceptualisations that acknowledge participation as a dynamic, non-linear, and adaptive process (Fritz and Binder, 2018) and grasp the complexity of pathways linking participation to societal effects in a systemic, interrelated manner. Increasingly, theories of change (ToCs), which have originally been developed as tools for evaluating social and development programmes (Weiss, 1997), are proposed for thinking also about change related to research projects (Douthwaite et al., 2003; Oberlack et al., 2019; Paina et al., 2017; van Drooge and Spaapen, 2017; Vogel, 2012). Empirical applications of how ToCs can be used to elucidate the theoretical assumptions, perceptions and mental models of actors engaging in TD sustainability research have been scarce.

In this article, inspired by scholarship on theories of change, we aim at illuminating the perceptions of diverse actors on how practitioners' participation in TD research might instigate societal changes. We position participation processes at the centre of an empirical analysis of perceived pathways to societal effects of TD research and ask:

- How do researchers and practitioners in TD sustainability research projects perceive participation-effect pathways?
- Which role do participation dynamics play in researchers' and practitioners' perceptions of participation-effect pathways?
- To which extent do the perceptions of researchers and practitioners on participation-effect pathways diverge?

Addressing these questions, we take up the criticism of ToCs of often being caught in linear logics (Oberlack et al., 2019; van Tulder and Keen, 2018) and rely on a systems approach which takes into account non-linear relations and feedbacks in participation-effect pathways, thus embracing that 'change processes are often non-linear, with multiple interactions and feedback loops' (Belcher et al., 2019). A systems approach (Binder et al., 2020) enables an examination of the perceived effects of participation, relations between them, and their potential feedbacks into dynamically evolving participation processes. By means of an empirical meta-analysis of researchers' and practitioners' perceptions in seven ongoing TD projects from a large German funding programme in the field of sustainability research, we identify (i) diverse participation-effect pathways, i.e. sequential dependencies between the perceived effects of participation which allegedly affect the involved practitioners and trigger changes in the wider context and (ii) feedback effects which impact the participation process itself.

Although widely used, definitions of 'outcome' and 'impact' remain inconsistent (e.g. compare Walter et al., 2007 and Shirk et al., 2012) and challenging to empirically disentangle (Binder et al., 2015). In this article, we rely on a simplified terminology that builds on the understanding of change being 'any event or variation in the state of affairs' (Belcher and Palenberg, 2018, p. 480). We consider the notion of 'societal effects' to refer both to changes affecting the involved practitioners and structural and processual shifts in the wider societal context of a project. Additionally, we consider 'effects' of participation in TD research to designate process-related changes in researcher-practitioner interactions and the overall research process that might or might not lead to societal effects.

By elucidating both researchers' and practitioners' perceptions of participation-effect pathways and related feedback effects, this article contributes empirical insights to an emerging scholarship on theories of change in TD sustainability research. An enhanced understanding of perceived participation-effect pathways also provides a basis for sharpening effect planning and monitoring as well as ex-post evaluation tools for participatory and TD research.

The remainder of this article is structured as follows: Section 2 provides a description of the methods and systems approach applied and the empirical materials used. Section 3 presents researchers' and practitioners' conceptions of participation-effect pathways and identifies feedbacks related to participation dynamics, before we critically discuss the conceptual and practical implications of these findings for practising and analysing TD research.

2. Material and methods

2.1. Funding programme and project sample

In this study, we conducted a meta-analysis of seven ongoing sustainability research projects that are part of a large German research funding programme. The funding programme is dedicated to fostering societally relevant research that contributes to sustainable development[2]. According to programme regulations, research projects are required to be interdisciplinary and involve societal actors in the research process. The selection of projects for an in-depth analysis was guided by the criterion of diversity regarding (i) scientific disciplines, institutions and funding volumes (project design); (ii) topics; (iii) intended societal effects; and (iv) types of participants. Consequently, the seven projects cover a broad range of sustainability-related topics and include researchers from various disciplines as well as practitioners with diverse professional backgrounds. The projects are part of two funding cohorts (Table 1).

2.2. Data collection

This study combines two bodies of materials. First, research proposals of the selected projects were collected and qualitatively analysed, considering the specific purpose (receiving funding) and audience (funding body and reviewers) for which they have been created (Wolff, 2004). Second, 21 interviews with researchers and 14 interviews with practitioners were conducted at different moments throughout the projects. Following a purposeful sampling approach (Lincoln and Guba, 1985), principle investigators (PI) were approached as gatekeepers and asked to establish contact with researchers who were closely involved in interactions with practice and with participating practitioners. At the time of data collection, all projects were ongoing and in different phases. The interviews were semi-structured and problem-centred (Witzel and Reiter, 2012), and aimed at gathering multiple perspectives on participation processes and their intended societal effects. An interview guide, which was used and adapted case-by-case, consisted of narrative questions about expectations regarding participation, perceptions of factors shaping research-practice

---

[1] We rely on the notion of 'practitioner' in a broad sense to designate any type of extra-scientific actor. Although these actors might have academic training, they do not conduct research as their main profession.

[2] The funding programme is scientifically accompanied by a research project of which this study is part.

L. Fritz, et al.

Table 1
Characteristics of projects according to project proposals.

CHARACTERISTIC/ PROJECT	A	B	C	D	E	F	G
Funding cohort	2015	2015	2015	2015	2014	2014	2014
Project duration	4 years	4 years	3 years	3 years	4 years	3 years	3 years and 3 months
Thematic cluster	health	regional development	food production	mobility	regional development	urban development	technology
Submitted budget (450 000 - 3 MM EUR)							
N° academic institutes	4	8	6	8	7	3	7
Type of practitioners involved	public service providers, associations	public sector actors	private sector actors, 'consumers'	public sector actors, private sector actors, service providers	NGOs, associations	NGOs, associations, public sector actors, 'citizens'	private sector actors, public sector actors, 'consumers'
Letter of intent of practitioners	yes	yes	yes	no	no	yes	no
Reference to notion of TD	Strong, mostly in the sense of interdisciplinary	strong	strong	strong	strong	strong	weak
Financing for practitioners budgeted	no	no	no	no	no	no	no

interactions, and factors influencing the realisation of intended societal effects. The interviews were conducted in January 2016, June-July 2017, Mai-June 2018 and lasted between 45 and 85 min. All interviews were recorded and transcribed verbatim. The transcripts and most documents are in German; we translated the excerpts included in this article into English (Table 2).

2.3. Data analysis

The empirical data were managed, coded, and analysed with the software 'MAXQDA'. The material was collectively analysed by the two first authors. Methods and data triangulation were ensured by including different data sources and the perspectives of multiple actors on the same processes (Patton, 1999). Furthermore, investigator triangulation relied on a 'negotiated agreement' approach to establish intercoder agreement (Campbell et al., 2013). Accordingly, disagreements between the authors regarding codes were discussed and resolved. In the few instances where coding differences could not be resolved, the disputed data were discarded.

The qualitative analysis of the empirical material relied on Clarke's 'situational analysis', which constitutes a methodological development of grounded theory. Therein, the researcher appears as knowledgeable about theory and a thorough literature review is an integral part of the analytical process (Clarke, 2005, p. 294). In our case, this meant that the data analysis was informed by our theoretical roots in system thinking, but provided room for both inductive coding of the data as well for considering deductive elements related to existing scholarship. We adopted a systems approach in order to explore effects and related interlinkages emerging from the interviews and defined a system as 'anything that is composed of system elements connected in a characteristic system structure' (Bossel, 1999, p. 20). We adapted the following key elements of a systems approach for our study purpose: (1) system elements, (2) system interrelations; (3) system boundaries; (4) system goals (Binder et al., 2020).

First, in line with our inductive approach, we coded perceived effects of participation as system elements. Thereby, we included expectations with regard to effects of participation as well as effects that were already observed by the interviewees during the ongoing project. The coding system was refined iteratively and emerging effect categories were grounded in literature - deducing them where available from established effect categories (Table 3).

Second, we condensed and aggregated interview statements across projects in the form of models representing participation-effect pathways. They illustrate different—albeit entangled—ways in which researchers and practitioners linked participation processes to societal effects. To inform the creation of pathway models, we specifically looked for dependencies in interview statements that indicated perceived relations between effects. The graphical display of our findings was inspired by Belcher et al.'s (2019) generic representation of ToCs, but adapted for the purpose of this study.

Third, we identified three types of system boundaries, which we conceptualised as arenas: (i) the arena of actor collaboration, where we analysed the effects of participation dynamics on the research and participation process itself; (ii) the arena of involved practitioners, where we examined effects on the practitioners involved in the project; and (iii) the arena of the wider practice context, which relates to changes in the wider context of the project.

Fourth, considering researchers' and practitioners' perspectives, we examined different actors' goals and expectations regarding participation-effect pathways and looked for commonalities and differences in their perceptions.

Table 2

Overview of interviews conducted with researchers and practitioners.

	A	B	C	D	E	F	G
RESEARCH	2 Prof, 2 PhD, 1 collaborator	1 Prof, 1 Postdoc, 1 PhD	2 Prof	2 Prof	1 Prof, 1 Postdoc	3 Prof, 1 collaborator	2 Prof, 1 collaborator
PRACTICE	1 NGO, 1 employee of public service provider	1 political representative, 2 public administration	1 company employee	1 public administration	1 public administration	2 NGO, 1 public administration	2 entrepreneurs, 1 company employee

Table 3

Inductive-deductive development of effect categories.

EFFECT CATEGORIES IN EMPIRICAL MATERIAL	DESCRIPTION	RELATED EFFECT CATEGORIES IN SELECTED LITERATURE*
CAPACITY BUILDING	Participation to create individual and collective learning effects that improve the knowledge base or capacities for decision-making	Bergmann et al., 2017; Binder et al., 2015; Currie et al., 2005; Hansson and Polk, 2018; Lang et al., 2012; Morton, 2015; Rau et al., 2018; Shirk et al., 2012; Walter et al., 2007
IMPLEMENTATION	Participation to facilitate using, implementing or applying the results and outputs of the projects, such as technologies, platforms, policy recommendations	Kaufmann-Hayoz et al., 2016; Mitchell et al., 2015
ADAPTING STRUCTURES AND PRACTICES	Participation to initiate changes in structures and practises that exist in the related practice context	Burkhardt-Holm and Zehnder, 2018; Morton, 2015; Shirk et al., 2012; Walter et al., 2007
TRANSFER	Participation to disseminate the project results to a wider context, i.e. to other practitioners not involved in the project	Kaufmann-Hayoz et al., 2016; Mitchell et al., 2015
CONVINCING	Participation to persuade actors of behaving differently, e.g. to consider sustainability values in the decision-making process	/
EMPOWERMENT	Participation to improve the status, visibility and legitimacy of participating practitioners in their practice context and to enhance their ability to act	Blackstock et al., 2007; Darby, 2017; Evans, 2016
NETWORK EFFECTS	Participation to extend or strengthen networks among practitioners and between researchers and practitioners	Binder et al., 2015; Hansson and Polk, 2018; Molas-Gallart et al., 2000; Spaapen and Van Drooge, 2011; Talwar et al., 2011; Walter et al., 2007; Wiek et al., 2014: Wolf et al., 2013
AWARENESS BUILDING	Participation to create awareness for sustainability-related issues	Binder et al., 2015; Meagher et al., 2008; Morton, 2015
SELF-CONCEPTION	Participation to fulfil intrinsic motivations on individual and/or organisational levels, e.g. convictions, values, or philosophies	/
INPUT FOR RESEARCH PROCESS	Participation to improve the research process in particular regarding its practical relevance, e.g. through better access to the field or input of practical knowledge	/
FEEDBACK EFFECTS ON PARTICIPATION PROCESS	Participation builds the foundation for collaborating, e.g. through developing a common language or building trust	/

* [not all focused on participation; not all based on empirical evidence].

3. Results

We present the results in two parts. First, we present the researchers' and practitioners' perceptions with regard to the diversity of pathways linking participation processes to societal effects. Thereby, we point to commonalities and differences in the researchers' and practitioners' perceptions. Second, we uncover feedback effects that stemmed from and influenced these processes. Throughout this section, we illustrate the results with interview excerpts. For reasons of comprehensibility, we refer only to extracts of the participation-effects pathway models in this section (Figs. 1–3) and include the complete models in the Appendices A–C of this article. The models contain effects associated with participation as system elements (boxes), their interrelations with each other and the participation process (arrows), and the system boundaries in the form of three arenas. Overall clusters of associated effects are displayed in italic writing.

3.1. Diverse participation-effect pathways

3.1.1. Direct and indirect pathways connecting participation and societal effects

Several interview statements reflect perceptions of a direct link between participatory processes and societal effects. Researchers and practitioners established direct participation-effect pathways mostly related to effects on the practitioners involved in the project, i.e. effects in the 'arena of involved practitioners'. For example, implementing project outputs was a primary societal effect anticipated by both groups. Researchers in several projects named the implementation of project outputs as a critical success criterion and considered the involvement of practitioners as the potential implementers to be an important success factor (AR3; CR1a). Thereby, implementing outputs refers to practitioners taking up and using results of the project in the form of products, including for example digital and analogue platforms, technologies, software, recommendations or visions. Similarly, practitioners mentioned that the outputs shaped by the participation process would be directly implemented (AP1; CP1; EP1; GP1). Two practitioners with corporate backgrounds specified that the implementation depends on the profitability of the output – in these cases a new technology and an alternative business model, respectively (CP1; GP1).

> We are of course open to new ideas and if there are any improvements […] this would of course be an advantage for us. And if this implies even an economic benefit, then it is highly interesting for our company to take it up. (CP1)

The 'empowerment' of practitioners through collaboration with researchers was another perceived direct participation-effect pathway. Several practitioners perceived their collaboration with universities to increase their visibility, legitimise their position and activities in the
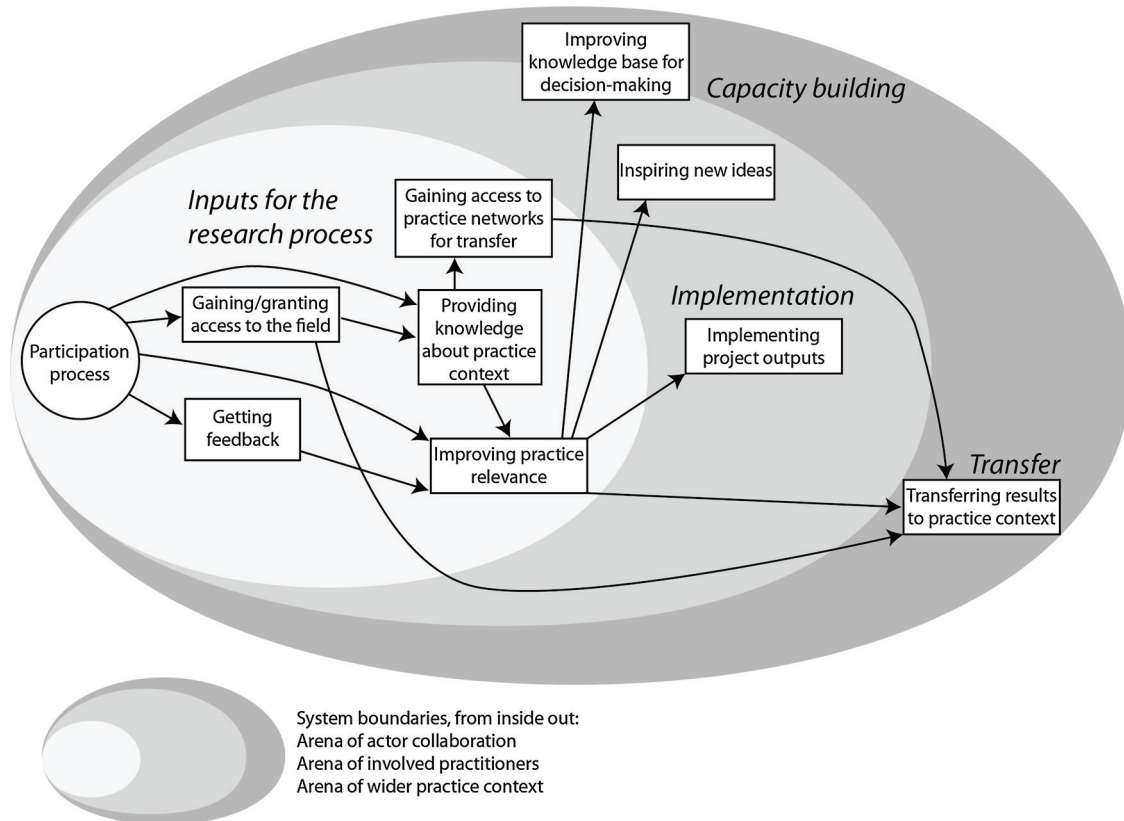
Fig. 1. Indirect participation-effect pathways: researchers' and practitioners' perceptions.

practice context (FP1; FP2; FP3), and improve fundraising opportunities for their organisation (FP2).

> When we as a small association are affiliated with established research institutions conducting cutting edge research, then, of course, this helps our fundraising activities. […] When we can say that we sit at the table with X and Y [researchers] and that we are connected with them, we get a whole different weight in the eyes of some institutions. (FP2)

Likewise, researchers narrated empowerment as a direct effect of practitioners' participation in their projects (FR1a). However, there are differences in considerations regarding empowerment across actor groups. First, the empowerment category is more central in practitioners' narrations than in researchers'; practitioners mentioned empowerment more often and with greater emphasis than researchers. Second, researchers described empowerment in relatively abstract terms, simply speaking of 'strengthening' and 'supporting' practitioners, whereas practitioners drew a more nuanced picture of how their involvement enhanced their ability to act.

Another type of societal effects directly linked to the participation process were network effects. Several interviewees mentioned that their interactions in participatory workshops resulted in new contacts among practitioners (GR1a; GR2; GP1; GP2; GP3). Researchers and practitioners tended to attach different weights to these network effects, as reflected in the statements below: a researcher described network effects as a side-effect of the collaboration process, while a practitioner – a self-employed consultant - referred to the same effects as the primary motivation to participate.

> It happens, even though it is not necessarily intended. But because they [the practitioners] get to know each other, some kind of networking happens and people exchange among each other. (GR1a)

This is a really positive element of such projects and also the reason for which I engage in them: having the possibility to extend your own network. (GP3)

Several practitioners and researchers also drew indirect links between participation and societal effects. Such indirect pathways include effects on the research process as a first step that subsequently contributes to achieving societal effects. In these pathways, participation was assumed to improve the practical relevance of the research and its outputs (AR1a; AR2; BR3; BP2; GR1a; GR2) in order to maximise opportunities for subsequent societal effects, such as the implementation and/or transfer of research outputs (Fig. 1).

Interviewees referred to different pathways of how this practical relevance could be increased. One such differentiation related to knowledge inputs: practitioners' participation in the research process ought to ensure the availability and input of sufficient system knowledge. This knowledge was supposed to enable researchers to grasp the most striking problems and consider contextual factors, such as regulations or norms, that support or hinder the realisation of societal effects (BP2; BR3; GR2). As one researcher in a project on sustainable technologies expressed his/her expectation regarding practitioners' participation:

> What do we expect? Well, definitely also to receive impulses: what are problems, what does not work, and why does it not work in practice. (GR2)

Pathways including the input of knowledge about the practice context were framed differently across the interviews. In some cases, the input of knowledge was framed as a direct outcome of the participation process – for example, via the contributions of practitioners in advisory board meetings (AR1a; AR2; AR3), workshops (BR2; BR3; GR2), or bilateral meetings (BR2; BR3). Others reflected an indirect logic whereby practitioners should primarily facilitate researchers' field

access, granting access to both data or people (AR2; AR3; BR2; BP1; CR1a; DP1; ER2). One researcher stressed access to a suitable audience to whom results could be regularly communicated as being critical for a successful transfer (CR1a). A policy-maker at the municipal level participating in a project on regional development described how they granted researchers access to the field and communicated remarks from local politicians to the researchers, thus acting as an intermediary between the project and the wider practice context:

> And we have informed political actors as well, local politicians. They are invited, if they have specific questions, to communicate them to us so that we can pass them on to the researchers. (BP1)

'Getting feedback' was another frequently mentioned intermediary step in an indirect pathway to societal effects, such as 'implementation' or 'transfer'. Researchers referred to receiving feedback from practitioners as a means of enhancing the practical relevance of the project results (AR1a; AR2; AR3; BR2; CR1a; CP1; DR1a). Such reasoning reflects an iterative research logic whereby practitioners are asked to test preliminary research outputs (e.g. the prototype of a platform) and provide feedback on how to adapt them on the basis of their experiences. As one researcher in the health sector expressed him-/herself with regard to the anticipated uptake of an interactive platform developed in the project:

> Well, this project is about developing something that will later be of use in practice. And in order to ensure this, it is certainly important to have practitioners on board, because we aim at providing an interactive platform which is sustainable and which we can already test in our practice institutions. (AR2)

Both researchers and practitioners referred to inputs for the research process as a first step towards achieving societal effects; however,

practitioners put significantly less weight than researchers on indirect participation-effect pathways via the research process.

3.1.2. Pathways of interlinked societal effects

Beyond direct and indirect pathways connecting participation and societal effects, our results indicate that interdependencies and sequential links exist between societal effects in the arenas 'of involved practitioners' and 'of the wider practice context'. The latter are perceived to be conditional on a series of intermediary steps. These pathways of interlinked societal effects typically contain a direct link between participation and a first societal effect, followed by subsequent societal effects. Which intermediary societal effects were supposed to contribute to other societal effects (e.g. transfer) differed across interviews. Accordingly, divergent strategies and approaches were planned to achieve the same societal effect. This is reflected in the interlinkages of 'capacity-building' with several other effects, including 'awareness building', 'convincing', 'empowerment' and 'transfer' (Fig. 2).

In one such pathway, 'capacity-building' serves as a precondition for 'transfer' (Fig. 2). Practitioners referred to learnings from the participation process to enrich their discussions with colleagues. They mentioned that the acquired competences and skills would strengthen their argumentation and enable them to transfer ideas about sustainability to the wider practice context (GP2; GP3). One practitioner from an association in the health sector expected to build capacities through first-hand access to research results. Emphasising their own role as an intermediary between research and the wider practice context, he/she perceived capacity-building as a precondition for transferring research results to other practitioners in the health sector (AP2). A researcher from the same project described how the practitioner would receive access to research results ('capacity-building'), which would subsequently allow them to adapt their practices (AR1a). Hence, the
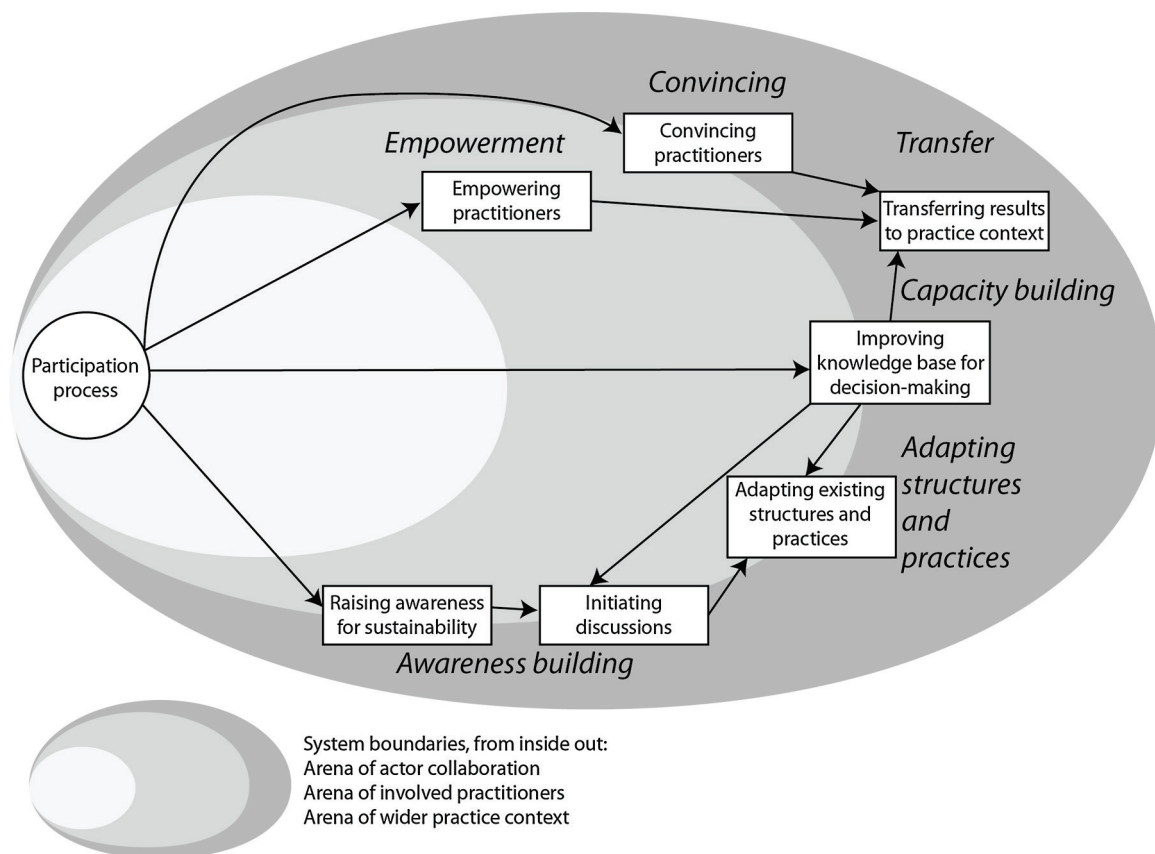

Fig. 2. Pathways of interlinked societal effects: researchers' and practitioners' perceptions.

researcher anticipated a societal effect that would affect the involved practitioner, whereas the practitioner saw himself/herself as an intermediary between research and a wider context.

In their narrations, researchers often tailored pathways to the type of practitioner. For practitioners to whom the above-mentioned researcher ascribed the roles of implementers and users of project outputs, he/she built a different pathway leading from 'raising awareness' to 'initiating discussions' and 'adapting existing structures and practices'. This reflects an interlinked logic whereby the direct effect was limited to practitioners' increased understanding of sustainability. The project leader framed the potential follow-up effects ('initiating discussions' and 'adapting existing structures and practices', referred to as 'cultural change' in the quote) as ideal outcomes of the practitioners' raised awareness of sustainability problems:

> We need to be cautious: to which extent we can really achieve a cultural change within the frame of the project? So, if we put it in a bit more humble way, we could say that we can achieve [...], or trigger a discussion, which at some point might lead to a cultural change. (AR1a)

The above examples illustrate how one researcher considered different pathways of interlinked societal effects to ultimately contribute to a change in structures and practices. These represent different strategies to achieve societal effects for different groups of participants.

Transferring results to a wider practice context, described above as a follow-up effect to 'capacity-building', was linked to further preceding societal effects (Fig. 2). One practitioner from a NGO highlighted the empowering effect of collaborating with researchers in a project on regional development, anticipating his/her influence in the practice context to be positively affected by the scientific authority of the researchers with whom he/she collaborated (EP1). Ultimately, this was assumed to enable him/her to transfer development measures, which were recommended by the project, to other villages and to contribute more effectively to the sustainable development of the region:

> Here in our region it is very difficult to found an association. And that's also why this partnership with the project [name of the project] is very important for us; that they [the researchers] help us better understand how we can have an impact on the people in our association; that we better understand which measures we can apply in different villages. And it makes the people in our association proud that university comes and asks them, what they need and what they want. This is why it is important for us to have these measures being analysed scientifically; then we are backed up to recommend it in other villages. (EP1)

Similarly, in a project on sustainable technologies a researcher referred to a pathway of interlinked societal effects leading to the transfer of research outputs via 'convincing practitioners' (CR1a). He/she stressed the importance of promoting the research output through adequate communication channels, which subsequently would enable them to convince practitioners who were not directly involved to also implement research outputs. Thereby, he/she highlighted the importance of convincing so-called 'multipliers'—actors who have outreach to and a high influence on other practitioners. In this interlinked participation-effect pathway, convinced practitioners are a precondition for the transfer of results to a wider context. A practitioner from the same project, conversely, emphasised his/her role as a 'technical pioneer', referring to a competitive advantage gained through the collaboration and the corresponding early access to the output developed. These two perspectives represent opposing views on the relation between the involved practitioners and the wider practice context. The researcher ascribes the role of 'multipliers' to the involved practitioners, while the practitioner sees the collaboration as an opportunity to set him-/herself apart from the competition in the wider practice context.

3.2. Feedback effects influencing the participation process

Examining the role of participation dynamics in narrations on participation-effect pathways uncovered another type of effects, namely feedback effects impacting the participation process. Feedback effects stem from and influence interactions between researchers and practitioners and unfold within the inner system boundary defining the 'arena of actor collaboration' (Fig. 3). These effects appeared as crucial success factors for the collaboration in interviewees' reflections about participation-effect pathways.

Several interviewees referred to changes in interpersonal relations over time that built a foundation for their collaboration with researchers and practitioners, respectively. Such reflections include trust-building and becoming acquainted with the other actors (FR1a; CR1a; ER2). In an urban development project involving mostly NGOs and associations, the PI concluded towards the end of the project:

> And then there are persons with whom we built a trustful relationship so that we can now [towards the end of the project] say: 'now we could start to really collaborate with them'. That's the way it is. These short-term projects are in fact way too short. (FR1a)

Other interviewees described learning effects from participation as having shaped interactions between researchers and practitioners (BR3; EP1; GR1a; GR2; GP1; GP3). For example, one practitioner from a NGO explained that he/she understood how to translate scientific knowledge into practice only after several years of participation and specified the need for a common language to enable effective collaboration. Confronted with communication problems, the project team in this regional development project engaged an intermediary actor with the task of facilitating exchanges between research and practice. A researcher from the same project shared her/his perception of this process and described how several years of field collaboration were necessary to build trust with practitioners (ER2). The practitioner explained:

> Because in the first project I sometimes had the impression, well, that we did not really understand the academic language [laughs]. And now, with X [person] as a link between us [the practitioners and researchers], I think it works really well. And I think because we are having a person at the interface, both sides benefit more from the project because we understand each other better and we better know how to go about it. (EP1)

Another feedback effect relates to changes in attitudes towards participation and their influence on practitioners' and researchers' commitment toward engaging in the process. In explaining how positive experiences early on in the collaboration process increased motivation to further engage in projects, several interviewees described how their attitudes or those of others shifted from scepticism towards participation to being optimistic and enthused (BP1; ER2; GR2; GP2). A policy-maker involved in a research project on regional development shared her/his assessment of such a change in attitudes:

> Meanwhile, there is a positive attitude towards this [collaborating with researchers], [...] through this collaboration, a process took place that has truly been accompanied by a change in awareness here. (BP1)

In some cases, these feedback effects related to past collaborations in other project contexts. Several interviewees recalled previous collaborations as critical success factors for a fruitful participation process (AR1a; CP1; ER2, BP1, EP1), thus indicating that limiting examination only to the present project entity might obscure other participation-related effects. Researchers and practitioners tended to focus on similar aspects when reflecting on participation-related effects, such as developing trust, a common language and aligning expectations. The importance of feedback effects from previous collaborations furthermore points to the need for considering effects related to the participation process as a central category when evaluating effects of TD research.
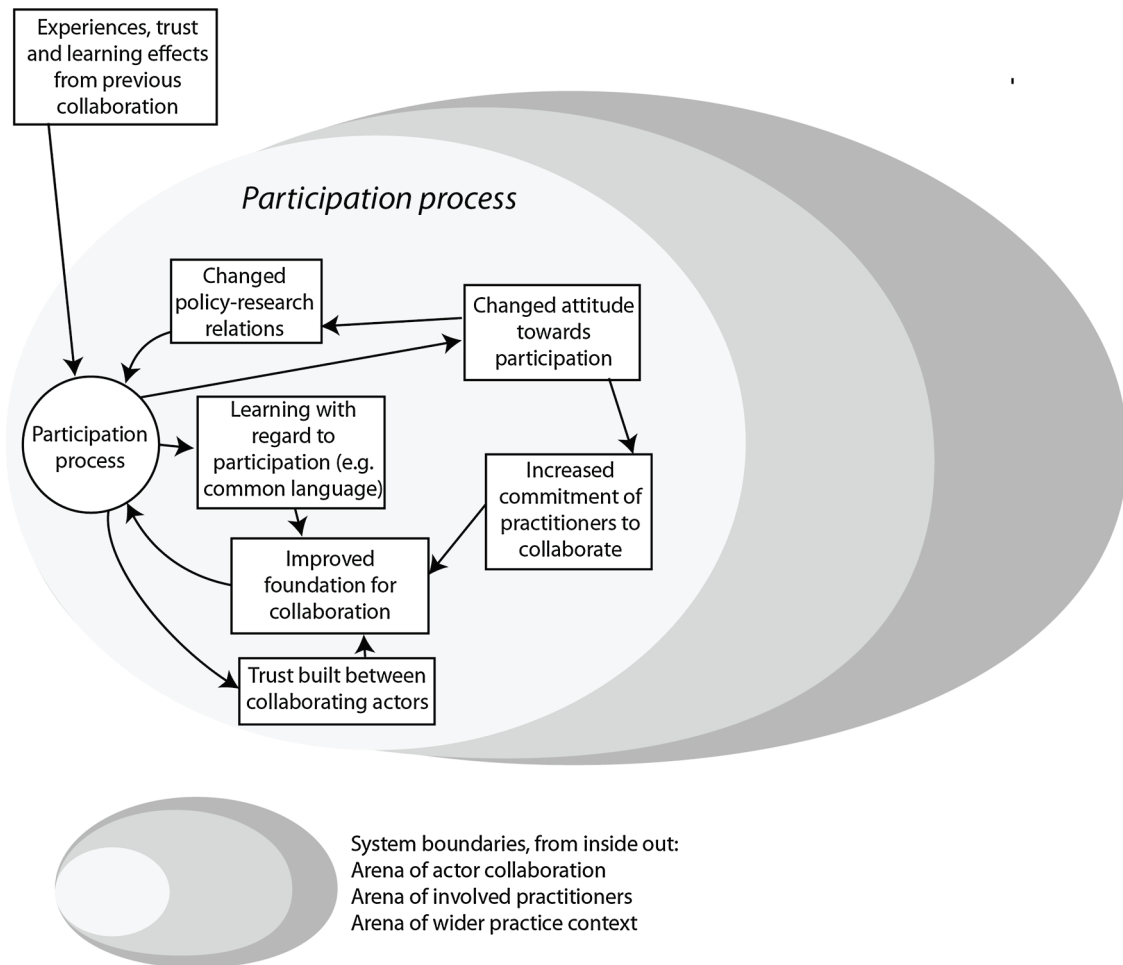
Fig. 3. Feedback effects influencing the participation process: researchers' and practitioners' perceptions.

4. Discussion

In this section, we discuss the contribution of our findings to the conceptual understanding of participation-effect pathways as well as their practical implications for impact-oriented TD research. We also critically reflect on the study's limitations and identify future research avenues.

4.1. Participation dynamics and interrelations of effects: a contribution to the conceptual understanding of participation-effect pathways

Firstly, our findings fleshed out effect categories for impact studies more narrowly focused on participation in TD research and contribute to process-oriented perspectives on the effects of participation (Currie et al., 2005; Darby, 2017; Hellström, 2015). In particular, we showed that feedback effects in the 'arena of actor collaboration' constitute a crucial type of effects that requires due consideration when studying or evaluating participation. Feedback effects, such as developing a common language or building trust, dynamically shape researcher-practitioner interactions across projects and appear as critical for achieving a fruitful and presumably effective collaboration process. These effects emerge directly from actors' interactions and influence the evolution of the process. They are both process-driven (Darby, 2017) and drive the process. Such emerging effects in the 'arena of actor collaboration' corroborate some of the factors shaping participation processes that have been discussed in the wider participation literature (Ernst, 2019; Fritz and Binder, 2018). Conceiving of these factors as feedback effects sharpens our perspective on how they impact the

collaboration process as it evolves and the potential for societal effects in the arenas 'of involved practitioners' and 'of the wider practice context'. The dynamics of the collaboration process also point to the importance of the temporal context (Klenk and Meehan, 2017). Prior collaborations and personal participation histories affect subsequent collaborations and their potential for unfolding effects; our analysis identified trust built, mutual understanding developed, and lessons learned about working with actors from diverse backgrounds as elements that overarched project entities.

Secondly, our findings contribute empirical insights to the scholarship on theories of change of researchers and practitioners in TD sustainability research (Belcher et al., 2019; Oberlack et al., 2019) and participatory research more generally (Douthwaite et al., 2003). We could confirm existing conceptualisations of a direct link between participation and the emergence of societal effects (e.g. Walter et al., 2007; Wiek et al., 2014; Shirk et al., 2012). Unlike in either-or conceptualisations of impacts and outcomes (e.g. Morton, 2015; Shirk et al., 2012; Walter et al., 2007), we found, however, that the same type of effect can occur at different positions in pathways of interlinked societal effects (e.g. raising awareness for a sustainability problem of the involved practitioners vs. practitioners as intermediaries to raise awareness in the wider context). This indicates that either-or categorisations of societal effects as impacts or outcomes might insufficiently represent the complexity of effect pathways. This complexity manifested in the perceived interlinkedness of societal effects. Societal effects of participation are oftentimes perceived to be embedded in sequential dependencies with other societal effects. Hence, conceptualising societal effects as parts of larger participation-effect

pathways instead of an isolated view on single effects, facilitates a comprehensive and holistic approach to analysing, evaluating, or planning societal effects of TD research. In addition to interlinked societal effects, our findings illuminate indirect links between participation and societal effects. In these pathways, participation creates effects on the research and participation process as a first step towards subsequent societal effects. Our findings thus reinforce previous calls for considering complex and non-linear relations in studying impacts and setting up ToCs (Oberlack et al., 2019; Van Kerkhoff, 2014; van Tulder and Keen, 2018).

Thirdly, our results contribute more detail to TD and participation scholarship stressing the need for paying attention to diverse actors' goals, values and roles (de Jong et al., 2016; Di Giulio et al., 2016; Enengel et al., 2012; Pohl et al., 2010; Zscheischler et al., 2018). Our results demonstrate the diverging perspectives of researchers and practitioners regarding participation-effect pathways and the weights given to specific effects. Some elements that researchers perceived as side-effects (e.g. network effects), constituted a core expectation and indeed motivation for practitioners to participate and vice versa. For example, researchers tended to conceive of participation as an input into the research process that increases the practical relevance of outputs and eventually leads to effects, whereas providing inputs for the research process was less important for practitioners, who focussed on societal effects. The assumptions about participation-effect pathways were accompanied by roles ascribed to oneself and to others. Thus, whereas some researchers conceived of practitioners as the key actors in the realisation of societal effects ('the implementers'), practitioners perceived their own roles as 'intermediaries' between research and a wider context. These findings lead us to concur with Schneider et al. (2019b) and Mitchell et al. (2015) that researchers and practitioners need to reflect on their epistemic values and their assumption about the appropriate division of roles between research and practice. The participating practitioners in the projects studied included actors with multifaceted professional backgrounds and reference systems as well as holding diverse convictions (de Jong et al., 2016). Our empirical insights substantiate previous assertions that participants do not act as isolated individuals, but rather are entangled in socio-material collectives (Chilvers and Kearnes, 2015) and different structural and organisational contexts (Fritz and Binder, 2018). They illustrate how practitioners' perceptions of societal effects relate to the overall goals of their home organisation, their function in that organisation, and/or their political or societal commitments. Hence, intended societal effects must be negotiated in relation to existing norms and belief systems. This confirms previous research highlighting the inherent normativity of sustainability-related TD research (Schneider et al., 2019b). Judging whether or not an effect is 'desired' and represents a contribution to sustainability is a fundamentally normative decision and largely depends on the sustainability values of the involved actors (Meinherz et al., 2020; Weiss et al., 2011).

4.2. Practical implications for TD research

The diversity of pathways and interrelated effects has important implications for the design of impact-oriented TD research. Different collaboration processes and strategies are likely to be effective depending on which types of participation-effect pathways actors seek to pursue. Hence, a common understanding of targeted pathways is pivotal to bundling their efforts for achieving them.

A systems approach can make such tacit assumptions about interrelations between participation effects transparent, assessable, and negotiable. The development of pathway models can be a useful tool to elicit researchers' and practitioners' perceptions of the pathways to effects and communicate their ToCs (van Drooge and Spaapen, 2017). Particularly, the divergences of perspectives and perceived roles and responsibilities found in this study reveal the necessity of illuminating researchers' and practitioners' perceptions in both planning and assessing societal effects. Researchers and practitioners involved in TD research should communicate their expectations, goals, and normative positions to ensure an effective collaboration.

Since differentiating outputs-outcomes-impacts can be overwhelming particularly when working with diverse actors not familiar with impact assessment (Binder et al., 2015), the reduced 'effect' terminology suggested in this article can be useful for eliciting researchers' and practitioners' ToCs. It allows to simply ask for changes which are supposed to emerge in different actor and system contexts. In so doing, a tripartite categorisation according to system contexts can serve as a way of disentangling the effects that primarily impact the involved practitioners from those that represent changes in the wider context and of grasping smaller-scale effects on the collaboration process. Mapping effects within different system boundaries can inform researchers and practitioners about their own capacity to contribute to the realisation of effects, and thus constitutes a first step towards assessing their influence over it, as suggested in ToC scholarship (Belcher et al., 2019; Earl et al., 2001; Vogel, 2012). Effects closer to the participation process (inner system boundary) tend to be susceptible to the influence of the involved actors, whereas those in the wider practice context (outer system boundary) are hardly steerable.

For funding bodies and academic institutions, the results suggest to reflect on the right degree of flexibility and adaptability of their assessment and evaluation schemes and to account for small-scale effects of participatory and TD research. Findings for the 'arena of actor collaboration' illustrated that effects also emerge in unintentional and serendipitous ways (Darby, 2017; Evans, 2016), which necessitates funding structures that provide flexibility for spaces of experimentation to develop (Rau et al., 2018) as well as for adaptive learning and reflexivity of those involved (Oberlack et al., 2019).

4.3. Limitations and future research

One limitation of this study relates to the ongoing nature of the projects during the data collection and analysis periods. Hence, the study relied on expectations and perceived effects and could not provide an ex-post assessment of how pathways to societal effects actually unfold over the long term. Second, the meta perspective and level of aggregation chosen to display findings across projects limited the extent to which the situatedness and structural and organisational context specificities of each project were considered. Accordingly, our analysis did not include factors inside (e.g. formats and degrees of actor interactions) and outside of the participation process (e.g. socio-political factors, power relations) that impede or drive the realisation of effects.

Further research is needed on how the system context shapes the potential of societal effects to unfold. Our results illustrate the importance of critically examining system boundaries when analysing societal effects. Focusing primarily on research projects risks neglecting processes and structures in their respective practice contexts. Influence factors that exist independently of the project (e.g. resistances against change) can significantly affect how participation-effect pathways unfold. Hence, there is a need to take into consideration project-related as well as contextual factors to understand when and under which conditions societal effects of participation emerge. Future research should focus on further developing the systems approach used in this study in order to also include such factors. Furthermore, building on the diversity of perceptions revealed in this article, future research should inquire into how varying perceptions of participation-effect pathways relate to the epistemic and ethical values of actors in TD sustainability research.

5. Conclusion

In this article, we provided empirical insights into the perceptions of both researchers and practitioners regarding the effects of their collaboration in TD sustainability research. Using a systems approach,

perceived effects of participation were found to be interwoven in complex and sequential pathways that either directly linked the participation process to societal effects or included effects on the research and participation process as intermediary steps. Differentiating the perceived effects of participation according to the system contexts in which they unfolded, we proposed a tripartite categorisation of effects in the context of TD research, namely in the 'arena of actor collaboration' (e.g. trust built); the 'arena of involved practitioners' (e.g. networks formed), and the 'arena of the wider practice context' (e.g. raised awareness of sustainability). Furthermore, different links among effects and feedbacks across the three arenas are conceivable. This shows how recognising feedbacks and multidirectional links allows to grasp the bigger picture of participation-effect pathways that typically go beyond linear relations between participation and single societal effects. The process-related effects that we identified as feeding back into participation processes furthermore suggest the need for grounding studies of the societal effects of TD research in a procedural and dynamic understanding of participation, including personal and collective participation histories.

The systems approach followed in this article enabled the mapping of effects as well as their interrelations and provides a first step for grasping the complex entanglements between participation and diverse effects. The pathway models developed showed that although similar effects appeared across interviews, perceptions of pathways to societal effects varied depending on the actor's standpoint and the project context. A systems approach can support those engaged in TD research in better designing their research process by eliciting and negotiating tacit assumptions on how participation contributes to societal effects and in communicating the distribution of roles and responsibilities among actors. This enables a consideration of multiple perceptions in both planning and studying societal effects. Notwithstanding the need for further refinement, adopting a systems approach is essential for a better understanding of the complex ways in which the inclusion of heterogeneous actors and knowledges leverages the transformative potential of sustainability research.

Declaration of Competing Interest

None.

Acknowledgements

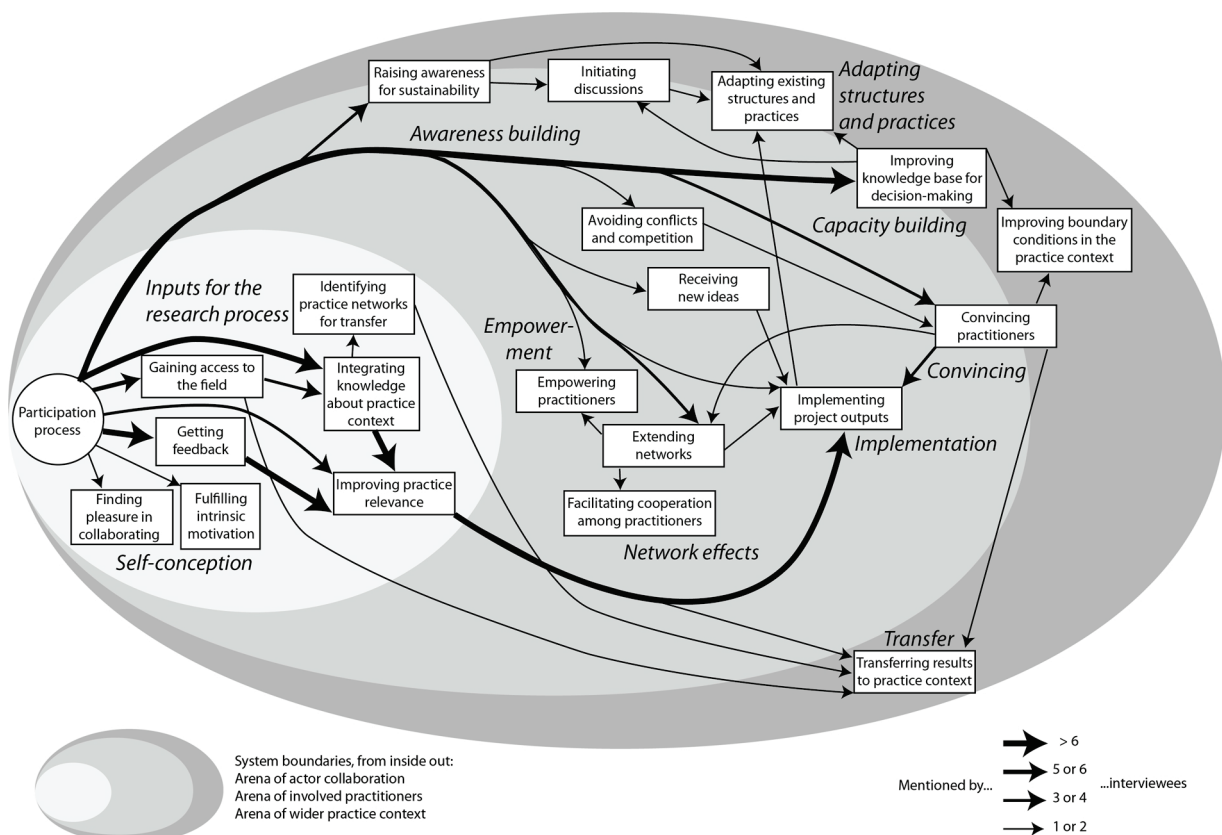**Appendix A**

Fig. A1

Fig. A1. Full model of researchers' expectations regarding the effects of participation in TD research.

74

Appendix B
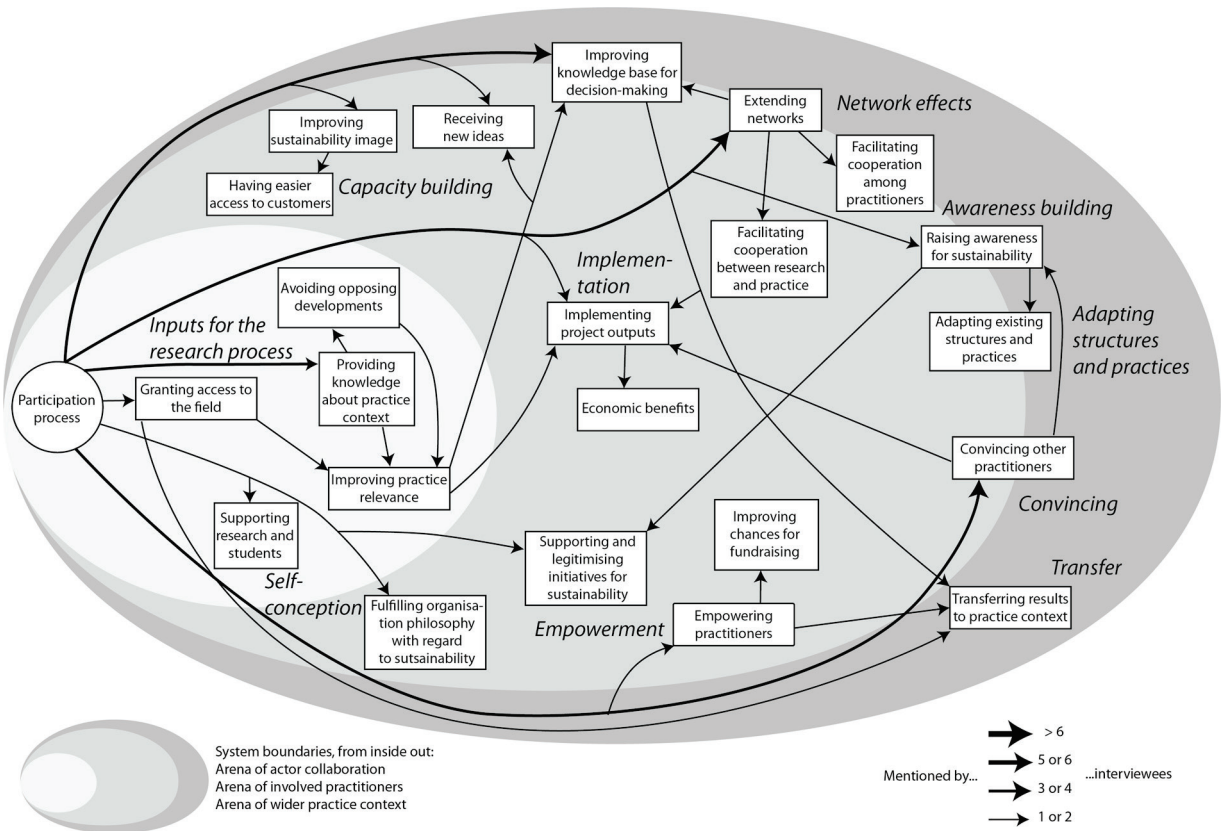
Fig. B1

Fig. B1. Full model of practitioners' expectations regarding the effects of participation in TD research.
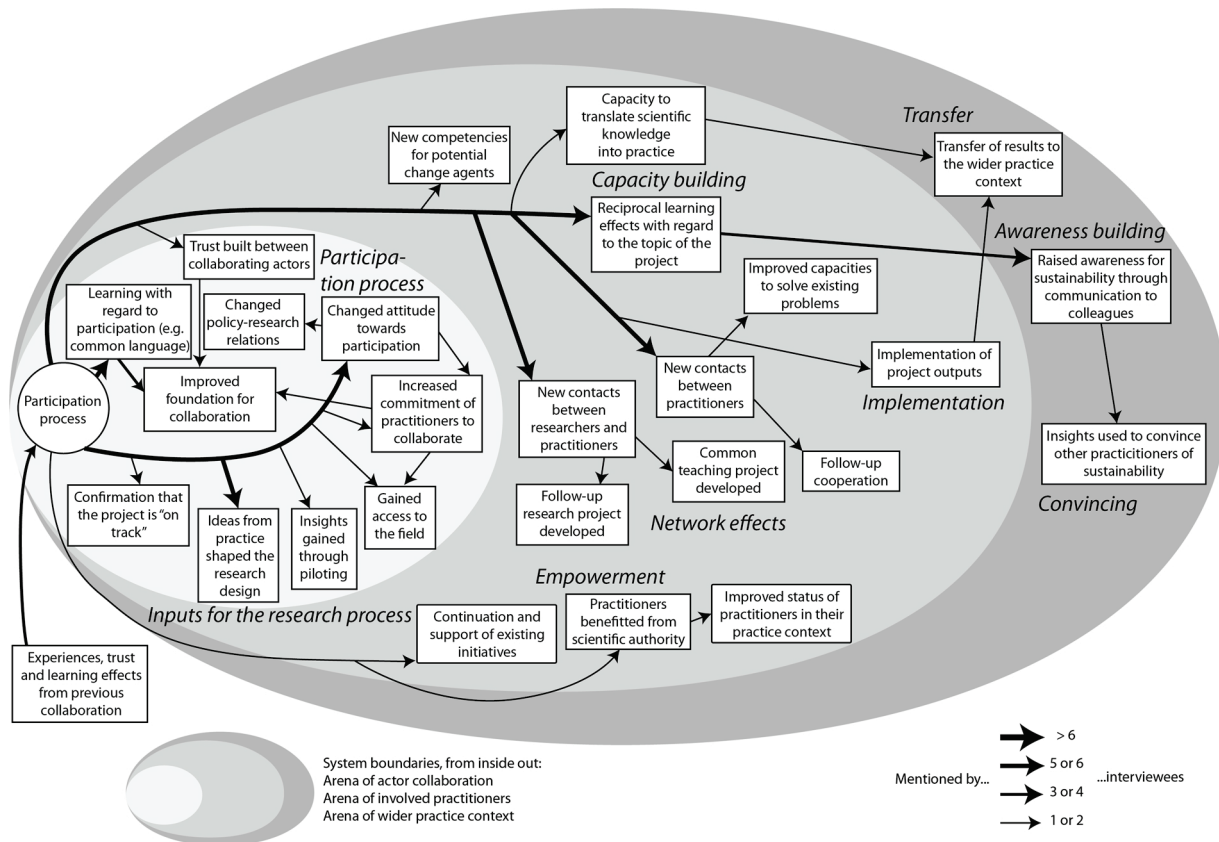
75

Appendix C

Fig. C1

Fig. C1. Full model of observed effects during the participation process: researchers' and practitioners' perspectives.

References

Belcher, B., Claus, R., Davel, R., n.d. Theory of change | Methods and tools for co-pro-ducing knowledge. https://naturalsciences.ch/topics/co-producing_knowledge/methods/td-net_toolbox/theory_of_change (accessed 11.07.19).

Belcher, B., Palenberg, M., 2018. Outcomes and impacts of development interventions: toward conceptual clarity. Am. J. Eval. 39, 478–495. https://doi.org/10.1177/1098214018765698.

Bergmann, M., Schäfer, M., Jahn, T., 2017. Wirkungen verstehen und feststellen. Working paper of the TransImpact Project, Frankfurt/Berlin. https://td-academy.org/sites/default/files/transimpact_arbeitspapier_2017.pdf (accessed 25.09.2019).

Binder, C.R., Absenger-Helmli, I., Schilling, T., 2015. The reality of transdisciplinarity: a framework-based self-reflection from science and practice leaders. Sustain. Sci. 10, 545–562. https://doi.org/10.1007/s11625-015-0328-2.

Binder, C.R., Hutter, M., Pang, M., Webb, R., 2020. Systems science and sustainability assessment. In: Binder, C.R., Massaro, E., Wyss, R. (Eds.), Sustainability Assessment of Urban Systems. Cambridge University Press in press.

Blackstock, K.L., Kelly, G.J., Horsey, B.L., 2007. Developing and applying a framework to evaluate participatory research for sustainability. Ecol. Econ. 60, 726–742.

Bossel, H., 1999. Indicators for Sustainable Development: Theory, Method, Applications. A Report to the Balaton Group. IISD.

Burkhardt-Holm, P., Zehnder, A.J.B., 2018. Fischnetz: assessing outcomes and impacts of a project at the interface of science and public policy. Environ. Sci. Policy 82, 52–59. https://doi.org/10.1016/j.envsci.2018.01.010.

Campbell, J.L., Quincy, C., Osserman, J., Pedersen, O.K., 2013. Coding in-depth semi-structured interviews: problems of unitization and intercoder reliability and agree-ment. Sociol. Methods Res. 42, 294–320.

Carew, A.L., Wickson, F., 2010. The TD Wheel: a heuristic to shape, support and evaluate transdisciplinary research. Futures 42, 1146–1155. https://doi.org/10.1016/j.futures.2010.04.025.

Chilvers, J., Kearnes, M., 2015. Remaking Participation: Science, Environment and Emergent Publics. Routledge, London and New York.

Clarke, A., 2005. Situational Analysis: Grounded Theory After the Postmodern Turn. Sage, Thousand Oaks, a.o.. .

Currie, M., King, G., Rosenbaum, P., Law, M., Kertoy, M., Specht, J., 2005. A model of impacts of research partnerships in health and social services. Eval. Program Plann.

28, 400–412. https://doi.org/10.1016/j.evalprogplan.2005.07.004.

Darby, S., 2017. Making space for co-produced research 'impact': learning from a parti-cipatory action research case study. Area 49, 230–237.

de Jong, S.P., Wardenaar, T., Horlings, E., 2016. Exploring the promises of transdisci-plinary research: a quantitative study of two climate research programmes. Res. Policy 45, 1397–1409.

Di Giulio, A., Defila, R., Brückmann, T., 2016. 'Das ist halt das eine … Praxis, das andere ist Theorie'-Prinzipien transdisziplinärer Zusammenarbeit im Forschungsalltag. In: Defila, R., Di Giulio, A. (Eds.), Transdisziplinär Forschen-Zwischen Ideal Und Gelebter Praxis: Hotspots. Campus Verlag, Geschichten, Wirkungen.

Douthwaite, B., Kuby, T., van de Fliert, E., Schulz, S., 2003. Impact pathway evaluation: an approach for achieving and attributing impact in complex systems. Agric. Syst. 78, 243–265.

Earl, S., Carden, F., Smutylo, T., 2001. Outcome Mapping: Building Learning and Reflection Into Development Programs. IDRC, Ottawa, ON, CA.

Enengel, B., Muhar, A., Penker, M., Freyer, B., Drlik, S., Ritter, F., 2012. Co-production of knowledge in transdisciplinary doctoral theses on landscape development—an ana-lysis of actor roles and knowledge types in different research phases. Landsc. Urban Plan. 105, 106–117.

Ernst, A., 2019. How participation influences the perception of fairness, efficiency and effectiveness in environmental governance: an empirical analysis. J. Environ. Manage. 238, 368–381. https://doi.org/10.1016/j.jenvman.2019.03.020.

European Commission, 2019. Horizon 2020 - Work Programme 2018-2020. Science With and for Society. Decision C(2019)1849 of 18 March 2019. http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-swfs_en.pdf.

Evans, R., 2016. Achieving and evidencing research 'impact'? Tensions and dilemmas from an ethic of care perspective. Area 48, 213–221. https://doi.org/10.1111/area.12256.

Fritz, L., Binder, C.R., 2018. Participation as relational space: a critical approach to analysing participation in sustainability research. Sustainability 10, 2853. https://doi.org/10.3390/su10082853.

Hansson, S., Polk, M., 2018. Assessing the impact of transdisciplinary research: the use-fulness of relevance, credibility, and legitimacy for understanding the link between process and impact. Res. Eval. 27, 132–144.

Hellström, T., 2015. Formative evaluation at a transdisciplinary research center. In: Polk, M. (Ed.), Co-Producing Knowledge for Sustainable Cities. Routledge, London and

New York, pp. 162–181.

Kaufmann-Hayoz, R., Defila, R., Di Giulio, A., Winkelmann, M., 2016. Was man sich er-hoffen darf–Zur gesellschaftlichen Wirkung transdisziplinärer Forschung. Transdisziplinär Forschen – Zwischen Ideal Und Gelebter Praxis. Hotspots, Geschichten, Wirkungen. Campus Verlag, Frankfurt 289–232.

Klenk, N.L., Meehan, K., 2017. Transdisciplinary sustainability research beyond engagement models: toward adventures in relevance. Environ. Sci. Policy 78, 27–35. https://doi.org/10.1016/j.envsci.2017.09.006.

Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., Thomas, C.J., 2012. Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustain. Sci. 7, 25–43. https://doi.org/10.1007/s11625-011-0149-x.

Lincoln, Y.S., Guba, E.G., 1985. Naturalistic Inquiry. SAGE.

Meagher, L., Lyall, C., Nutley, S., 2008. Flows of knowledge, expertise and influence: a method for assessing policy and practice impacts from social science research. Res. Eval. 17, 163–173.

Meinherz, F., Fritz, L., Schneider, F., 2020. How values play into sustainability assessments: challenges and a possible way forward. In: Binder, C.R., Massaro, E., Wyss, R. (Eds.), Sustainability Assessment in Urban Systems. Cambridge University Press.

Mitchell, C., Cordell, D., Fam, D., 2015. Beginning at the end: the outcome spaces framework to guide purposive transdisciplinary research. Futures 65, 86–96.

Molas-Gallart, J., Tang, P., Morrow, S., 2000. Assessing the non-academic impact of grant-funded socio-economic research: results from a pilot study. Res. Eval. 9, 171–182. https://doi.org/10.3152/147154400781777269.

Morton, S., 2015. Progressing research impact assessment: a 'contributions' approach. Res. Eval. 24, 405–419.

Oberlack, C., Breu, T., Giger, M., Harari, N., Herweg, K., Mathez-Stiefel, S.-L., Messerli, P., Moser, S., Ott, C., Providoli, I., 2019. Theories of change in sustainability science: understanding how change happens. GAIA-Ecol. Perspect. Sci. Soc. 28, 106–111.

Paina, L., Wilkinson, A., Tetui, M., Ekirapa-Kiracho, E., Barman, D., Ahmed, T., Mahmood, S.S., Bloom, G., Knezovich, J., George, A., 2017. Using Theories of Change to inform implementation of health systems research and innovation: experiences of Future Health Systems consortium partners in Bangladesh, India and Uganda. Health Res. Policy Syst. 15, 109.

Patton, M.Q., 1999. Enhancing the quality and credibility of qualitative analysis. Health Serv. Res. 34, 1189.

Pohl, C., Rist, S., Zimmermann, A., Fry, P., Gurung, G.S., Schneider, F., Speranza, C.I., Kiteme, B., Boillat, S., Serrano, E., 2010. Researchers' roles in knowledge co-production: experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. Sci. Public Policy 37, 267–281. https://doi.org/10.3152/030234210X496628.

Polk, M., 2014. Achieving the promise of transdisciplinarity: a critical exploration of the relationship between transdisciplinary research and societal problem solving. Sustain Sci 9, 439–451.

Rau, H., Goggins, G., Fahy, F., 2018. From invisibility to impact: recognising the scientific and societal relevance of interdisciplinary sustainability research. Res. Policy 47,

266–276. https://doi.org/10.1016/j.respol.2017.11.005.

Schneider, F., Buser, T., Keller, R., Tribaldos, T., Rist, S., 2019a. Research funding programmes aiming for societal transformations: ten key stages. Sci. Public Policy 46, 463–478. https://doi.org/10.1093/scipol/scy074.

Schneider, F., Kläy, A., Zimmermann, A.B., Buser, T., Ingalls, M., Messerli, P., 2019b. How can science support the 2030 Agenda for Sustainable Development? Four tasks to tackle the normative dimension of sustainability. Sustain. Sci. 1–12.

Shirk, J.L., Ballard, H.L., Wilderman, C.C., Phillips, T., Wiggins, A., Jordan, R., McCallie, E., Minarchek, M., Lewenstein, B.V., Krasny, M.E., 2012. Public participation in scientific research: a framework for deliberate design. Ecol. Soc. 17, 29.

Spaapen, J., Van Drooge, L., 2011. Introducing 'productive interactions' in social impact assessment. Res. Eval. 20, 211–218.

Talwar, S., Wiek, A., Robinson, J., 2011. User engagement in sustainability research. Sci. Public Policy 38, 379–390.

Van der Hel, S., 2016. New science for global sustainability? The institutionalisation of knowledge co-production in Future Earth. Environ. Sci. Policy 61, 165–175. https://doi.org/10.1016/j.envsci.2016.03.012.

van Drooge, L., Spaapen, J., 2017. Evaluation and monitoring of transdisciplinary collaborations. J. Technol. Transf. https://doi.org/10.1007/s10961-017-9607-7.

Van Kerkhoff, L., 2014. Developing integrative research for sustainability science through a complexity principles-based approach. Sustain. Sci. 9, 143–155.

van Tulder, R., Keen, N., 2018. Capturing collaborative challenges: designing complexity-sensitive theories of change for cross-sector partnerships. J. Bus. Ethics 150, 315–332. https://doi.org/10.1007/s10551-018-3857-7.

Vogel, I., 2012. ESPA Guide to Working With Theory of Change for Research Projects.

Walter, A.I., Helgenberger, S., Wiek, A., Scholz, R.W., 2007. Measuring societal effects of transdisciplinary research projects: design and application of an evaluation method. Eval. Program Plann. 30, 325–338.

Weiss, C.H., 1997. Theory-based evaluation: Past, present, and future. New Dir. Eval. https://doi.org/10.1002/ev.1086.

Weiss, G., Steiner, R., Eckmüllner, O., 2011. Assessing institutional frameworks of inter- and transdisciplinary research and education. J. High. Educ. Policy Manag. 24, 499–516. https://doi.org/10.1057/hep.2011.19.

Wiek, A., Talwar, S., O'Shea, M., Robinson, J., 2014. Toward a methodological scheme for capturing societal effects of participatory sustainability research. Res. Eval. 23, 117–132.

Witzel, A., Reiter, H., 2012. The Problem-centred Interview. Sage, Los Angeles a.o.

Wolf, B., Lindenthal, T., Szerencsits, M., Holbrook, J.B., Hess, J., 2013. Evaluating research beyond scientific impact: how to include criteria for productive interactions and impact on practice and society. GAIA-Ecol. Perspect. Sci. Soc. 22, 104–114.

Wolff, S., 2004. Analysis of documents and records. In: Flick, U., von Kardoff, E., Steinke, I. (Eds.), A companion to Qualitative Research. Sage, London a.o, pp. 284–289.

Zscheischler, J., Rogga, S., Lange, A., 2018. The success of transdisciplinary research for sustainable land use: individual perceptions and assessments. Sustain. Sci. 1–14. https://doi.org/10.1007/s11625-018-0556-3.

4 Manuscript IV

Bibliographic details:

Fritz, L.; Meinherz, F. 2020. The politics of participatory sustainability assessments: An analysis of power. In: Binder, C.R., Massaro, E., Wyss, R. (Eds.): *Sustainability Assessment of Urban Systems*. Cambridge: Cambridge University Press, 87-122.

This manuscript is reproduced with permission of Cambridge University Press through PLSclear.

Contribution of the doctoral candidate:

The doctoral candidate was the main responsible for conceptualising this research and writing the article. The co-author was involved in the overall conceptualisation of this article, the formulation of guiding questions, the visualisazions, and provided critical feedback on the manuscript.

4

The Politics of Participatory Sustainability Assessments: An Analysis of Power

Livia Fritz and Franziska Meinherz

> We should admit . . . that power produces knowledge (and not simply by
> encouraging it because it serves power or by applying it because it is
> useful); that power and knowledge directly imply one another; that there
> is no power relation without the correlative constitution of a field of
> knowledge, nor any knowledge that does not presuppose and constitute at
> the same time power relations.
>
> *(Foucault, 1977, p. 27)*

4.1 Introduction

Sustainability assessments are part of policy assessments – a family of techniques to assess the impact of a policy ex ante or to ensure that policy design is well informed and accounts for possible side effects. Since the 1990s, these instruments have rapidly spread across OECD member states and have become a mandatory part of policy planning in some countries (Adelle & Weiland, 2015; Sala et al., 2015). Together with other policy assessment tools, sustainability assessments are becoming normalized as part of the governance process. More generally, the act of assessing and auditing has come to be considered a key organizing principle of contemporary societies (Power, 1997).

Unlike in other policy fields, with regard to sustainability, the benchmark for the assessment is contested and surrounded by fundamental uncertainties (Holmes & Scoones, 2000). As Meinherz et al. have illustrated (see Chapter 3) with regard to sustainability, an "objective" and purely scientific assessment procedure is challenged by diverse normative claims attached to the notion of sustainability, the need to make trade-offs between different targets, and the need to take decisions in the face of uncertainty. To respond to these challenges, the involvement of societal actors has been advanced as gold standard of sustainability assessment procedures (Frame & Brown, 2008; Gibson et al., 2013; Santos et al., 2006; Sharifi & Murayama, 2013; Videira et al., 2012). The call for rethinking ways of researching and governing sustainability problems has become a priority on the international policy agenda (e.g., the United Nations' Agenda 21 or the Aarhus Convention). With regard to these developments in the field of policymaking for sustainability, and also similar trends in science policy and practice, some scholars speak of a "participatory turn" (Bäckstrand, 2003; Jasanoff, 2003), a "participatory return" (Wynne,

87

2007) and a "deliberative turn" (Dryzek, 2000). Concomitantly, new approaches to knowledge production have emerged, such as "post-normal science," which posits that when "facts are uncertain, values in dispute, stakes high and decisions urgent," expanded forms of knowledge production are needed (Funtowicz & Ravetz, 1993, p. 744). Similarly, "Mode 2 knowledge production" states that non-academic rationales are increasingly framing the production and validation of knowledge (Gibbons et al., 1994).

In the case of sustainability assessments, this means that designated experts in the field of sustainability assessments – or in the scientific disciplines that are relevant for the sustainability issue at hand – are joined by other societal actors. These actors can be those concerned, those having access to practical and contextual knowledge, and/or those having a stake (Frame & Brown, 2008; Santos et al., 2006; Videira et al., 2012). While forms and methods of involvement vary, many authors attach high expectations to participation in sustainability assessments and herald the power of discursive, participatory processes in facilitating societal learning, holding that these foster participants' trust in the results and their commitment to the derived policies. Indeed, participatory approaches are seen as key for achieving transformative change and innovation (Glass et al., 2013). However, some authors have noted that a participatory process per se does not guarantee these positive outcomes (Kropp, 2013). The way in which the process is laid out and the context within which it is embedded affect how participants relate to the process, and which stakes, values, and expertise are taken into account in it (Beierle, 1999; Muro & Jeffrey, 2008; Videira et al., 2006).

In the vast literature on participatory approaches to sustainability assessment, critical reflections on the layout of the participatory process in the respective contexts and its implications for the assessment process have been called for (Cashmore & Richardson, 2013). Particularly the importance of power in shaping processes of participation is acknowledged (Kristiansen & Bloch-Poulsen, 2013; Lawrence, 2013; Muro & Jeffrey, 2008; Raik et al., 2008; Sinclair et al., 2015), pointing toward the need for comprehensive enquiries into the multiple dimensions of power that pervade such processes. Participatory processes are deeply embedded in wider societal relations and inherently political (Cornwall, 2008), and an analysis of diverse forms of power is inevitable when addressing questions of societal transformations (Avelino, 2017; Brand, 2016). Considering that assessments, audits, and measurements of projects, programs, and policies have emerged as powerful elements of policymaking and are expected to provide an evidence base for informed decisions (Power, 1997), addressing questions of power in the construction of participatory assessment processes seems all the more essential. Yet, there are numerous challenges for grounding the practice of and research on sustainability assessments in social and political theories of power. The conceptualization of power that underlies considerations of participatory processes is often unidimensional (Cook et al., 2013) and poorly equipped to take into account the complex entanglements of knowledge, power, and politics in participatory sustainability assessments.[1]

4.1.1 Goals and Structure of the Chapter

In this chapter, we put the spotlight on the politics of participatory sustainability assessments and argue that an analysis of power in and stemming from participatory sustainability assessments contributes to leveraging the transformative capacities of these tools. Guided by social theories of power, we explore how power relations shape participatory sustainability assessments and how such assessments act on power relations. In doing so, we take into account the potentially repressive side of power (domination, manipulation) as much as its productive side (making do, empowerment). We develop a framework for analyzing different forms of power at different points in the process of assessing sustainability: (i) in defining and framing the problem to be assessed, (ii) in the knowledge-production and assessment process, and (iii) in the learning and governance processes in which the results of the assessment are acted upon. A multidimensional conceptualization of power allows us to prepare the ground for discussions on fundamental questions, such as which form of power leads to which kind of change, or which form of power prevents change. Such questions illustrate that an analysis of power is not only of theoretical interest, but also of practical relevance. Overall, we aim to launch a broader debate on the phenomenon of power in sustainability assessments.

The following questions guide our reflections:

- What does participation in sustainability assessments mean and how can we conceive of it?
- How can we analytically and empirically grasp the dimensions of power that exist in and shape participatory sustainability assessments?
- What can a multidimensional analysis of power teach us in regard to enhancing the transformative power of participatory sustainability assessments for sustainability transitions?

In Section 4.2, we look at conceptualizations of participation and illustrate that participation is a contested concept that goes beyond methodological questions. To equip ourselves for a discussion of the politics of participatory sustainability assessments, in Section 4.3, we propose a multidimensional conceptualization of power, based on theories from the social and political sciences. This allows us to move beyond one-dimensional accounts of power and to look, in Section 4.4, for diverse traces of power throughout the assessment process. We conclude that those in charge of a participatory sustainability assessment have to be aware of the constructed nature of and the power dynamics at play in participatory processes, as well as of their own crucial role as (co-)designers and facilitators. (Self-)Reflexivity is an essential process within collaborative approaches to sustainability assessment (Dryzek & Pickering, 2017; Popa et al., 2015; Stirling, 2008).

4.2 Meanings of Participation in Sustainability Assessments

The choice of methods for selecting and involving diverse actors in a sustainability assessment is tied to the underlying conceptualization of participation. Participation is

a polyvalent term, occurs in different forms, and is associated with multiple ends, without one universally accepted definition. In this section, we elaborate on different meanings and conceptualizations of participation. We discuss conceptualizations of participation according to the underlying motivations and goals, as well as typologies based on the degree of involvement, thus illustrating how understandings of participation implicitly or explicitly influence forms and intensities of involvement.

4.2.1 Conceptualizations of Participation According to Motivation

Conceptualizations of participation according to motivation revolve around the question of whether participation is/should be implemented primarily for functional reasons (i.e., to help make better decisions, to produce better knowledge) or because the democratization of all societal fields is critical for sustainable development (van den Hove, 2006).

This question can also be found in Fiorino's (1989) conceptualization of three imperatives underwriting participatory practices: the normative imperative, in which participation is an end in and of itself; the substantial imperative, in which participation has the goal of achieving better ends; and the instrumental imperative, in which participation is aimed at securing particular interests. While the first is process-oriented, the latter two focus on outcomes (Stirling, 2008). The goal of outcome-oriented approaches to participation can be to improve the decision-making quality by including diverse forms of knowledge; to include diverse values and priorities about what the future should look like; and to build trust, foster ownership, and encourage learning among participants (Whitmarsh et al., 2009). Another, similar, categorization is that of Blok (2007), who distinguishes three virtues of public deliberation: civic virtue (more informed and involved citizens), governance virtue (enhancing the legitimacy of decisions), and cognitive virtue (fostering learning). The latter, cognitive virtue, is critical in situations of uncertainty, as is the case for most sustainability issues (Whitmarsh et al., 2009). Van Asselt Marjolein and Rijkens-Klomp's (2002) typology of participation in impact assessments follows a similar logic. They map participatory methods on a spectrum of goals ranging from "process as a goal" to process as a means and on a spectrum of outputs ranging from "mapping out diversity" to "reaching consensus."

A fine-grained differentiation of approaches to participation on which scholars from sustainability science draw[2] is developed by Renn und Schweizer (2009) in the context of risk governance. They present six ideal–typical ways of structuring public input into policymaking: functionalist, neoliberal, deliberative, anthropological, emancipatory, and post-modern. Distinct worldviews and understandings of democracy underpin each of these categories. As with Fiorino's distinction, in this typology, forms of participation, and instruments used to structure the participation process, vary in accordance with deeper-rooted rationales (Renn & Schweizer, 2009). In the functionalist approach, participation appears as a necessity for addressing complex societal functions that require the input of knowledge and values from different constituencies. The aim is to improve the quality of

the decision output. Methods such as the Delphi method, workshops, hearings, or citizen advisory committees are particularly suited to fulfill these expectations toward participation. In the neoliberal approach, participation is aimed at representing values and preferences proportionally to their share in the affected population, in order to arrive at informed consent and win-win solutions. In this rationale, referenda, focus groups, or digital participation are appropriate instruments. The deliberative approach strives for the inclusion of all relevant arguments in order to achieve consensus through debate. In this approach, discourse-oriented models, consensus conferences, and citizen juries are frequently used. In contrast, participation in the post-modern approach aims to demonstrate plurality as well as the legitimacy of dissent. It is rooted in the acknowledgment of plural rationalities and considers mutually acceptable arrangements, and not necessarily consensus, as a successful result. Instruments such as open forums or open-space conferences are well suited to organizing participation for this purpose (Renn & Schweizer, 2009, pp. 177–180).

4.2.2 Conceptualizations of Participation According to Degree of Involvement

Linked to these categorizations according to motivations and goals, participation is furthermore described with regard to the degree of involvement of societal actors (Fritz, 2018). Ideals regarding the appropriate and desirable degree of involvement are tied to the motivations underlying a participation process. Representing what we have described above as a normative rationale, in the field of sustainability research participation is frequently conceptualized in reference to the "Ladder of Participation" by Arnstein (1969). She categorizes eight uses of the term "participation" and arranges them in a ladder pattern according to the degree to which societal actors are involved. Adaptions of the ladder for the context of sustainability research are numerous (e.g., Schneider & Buser, 2018; Stauffacher et al., 2008).

Arnstein's conceptualization of participation assumes a logic of "the more participation, the better." Climbing up the ladder goes hand in hand with the redistribution of power from the power-holding actors to the to-be-empowered citizens (Chilvers & Kearnes, 2015). In this sense, participation claims to challenge the power relations that stabilize the societal status quo (Gaventa & Cornwall, 2001). In Arnstein's conceptualization, power is seen as a commodity that is held by some actors and wielded over others (Hayward, 2000). Although in such conceptualizations participation is inherently linked to power and is seen as a means to redistribute power, many advocates of participation echo ideals of deliberative democracy (Cornwall & Coelho, 2007), based on Habermas' (1981) principles of ideal speech. Such ideal deliberative procedures involve "free debate and dispute in which the only legitimate force is a good argument" (Dryzek, 1993, p. 229). This communicative rationality results from interactions that are "competent and free from delusion, deception, power and strategy" (Holmes & Scoones, 2000, p. 9). Accordingly, participatory processes within sustainability assessments are thought to counterbalance and manage power relations, but are not analyzed as being formed by power relations themselves

(Hartz-Karp et al., 2015). Following these theoretical premises, analyses that build on communicative rationality tend to focus on consensus and pay little attention to the negotiation processes or the potential conflicts among participants (Leeuwis, 2000; van den Hove, 2006). In the face of fundamental differences in perspectives and values, as in the case of sustainability issues, the pertinence of consensus as a meaningful goal has been called into question (Spash, 2007).

Conceptualizations of participation according to degree of involvement have their origin in the field of planning and participatory governance. They are not based on experiences with participation in knowledge production or the inclusion of different epistemic cultures in research processes (Fritz & Binder, 2018). This needs to be considered when addressing participatory sustainability assessments that at least to some degree involve joint knowledge production by diverse actors. Epistemologically, participatory approaches to knowledge production and assessments blur the boundaries and division of labor between research and policymaking (Jasanoff, 2004). Drawing on knowledge of diverse provenances in a participatory sustainability assessment requires understanding the underlying premises of different knowledge systems, as well as paying attention to the different degrees of credibility, trustworthiness, and authority ascribed to them.

4.2.3 Toward Critical Participation Studies

Increasingly, scholars have called for paying attention to the ways in which participation is constructed and co-produced with societal order. Critical perspectives on the participation of heterogeneous actors in knowledge production and research processes have gained ground (Chilvers & Kearnes, 2015; Hegger & Dieperink, 2015; Klenk et al., 2013). Concomitantly, interest in the interrelations of power, participation, and knowledge in sustainability research has grown. Following this emerging scholarship, in this chapter we conceptualize participation as a space in between research and policy. Inspired by metaphors of space, such as "epistemic living spaces" (Felt, 2009), "spaces for transformation" (Cornwall, 2004), and "closed, invited and claimed space" (Gaventa, 2006), we look at participation as a relational space embedded in wider science–society relations. This perspective implies that participation is not merely the result of the motivation and intention of those setting up the process, but shaped through an interplay of actions and structures (Fritz & Binder, 2018). Conceptualizing participation as a dynamic and complex process is a prerequisite for better understanding when it contributes to transformation and when it reproduces an unsustainable status quo (Kropp, 2013). Accordingly, we understand participation as being "in the making" and are interested in the diverse factors that constitute and continuously shape participation processes in sustainability assessment. These include the degree of coherence with the institutional and systemic contexts, the availability and distribution of resources, the worldviews or expectations of actors, and power relations (Fritz & Binder, 2018).

Conceiving of participation as a space compels us to ask a series of analytical questions with regard to how power, entangled with knowledge, shapes the forms and outcomes of

participation in sustainability assessments. It requires us to look at the individual actors and their ways of interacting as much as at the societal and material context within which participation takes place, including discursive elements such as negotiation and political cultures and the dominant models of expertise and sustainability discourses. In the remaining sections, we focus on power as a key crosscutting issue that is entangled with numerous other factors shaping participation in sustainability assessments. The transversal nature of the power concept allows us to shed light on critical aspects in the making of participation spaces throughout the sustainability assessment process.

4.3 Toward a Multidimensional Conceptualization of Power

With this plurality of meanings of participation in our mind, we turn to the second key notion of this chapter: power. Here we introduce different theoretical ways of grasping the notion of power before we embark on an illustration of how participation and power can be interwoven in sustainability assessment practices. Power is a highly contested concept with multiple meanings. Some theorists describe power as being held by actors, some of whom are powerful and others of whom are comparatively powerless. Power in this perception is a "zero sum game," in which the gain of power by some actors happens at the expense of others. Other theorists see power as embodied in complex relations and discourses and, while it affects everyone, it cannot be held by any single actor. Such approaches understand power as potentially accumulative. Here power is not a finite resource, but can be shared or created by actors and their networks in various ways. Means of social organization can increase the overall power of a group of people, so that the group's potential to take action increases, without any single member of the group losing power in this process. While some perceive power as a generally negative attribute that is exercised in order to control others, others attach positive attributes to it, such as the capacity to act (Gaventa, 2006).

Instead of opting for any one of these partly contrasting interpretations of power, we rely on a multidimensional understanding of power. As suggested by Partzsch (2015) in her work on power in sustainability research, we base our analytical grid on the conceptualization of power by Allen (1998). In the context of feminist studies, she offers a comprehensive conceptualization of power and merges theories of "power over," "power to," and "power with" in order to explain the complexity and diversity of women's experiences with power. Where needed, we complement her conceptualization with elements of particular relevance regarding participation in knowledge-production processes. This adaptation ensures that we can operationalize power in our study context (sustainability assessment).

4.3.1 Power Over (Coercion and Manipulation)

"Power over" addresses power that is exerted over actors, structures, and discourses. Weber (1972) established the understanding of power, widely known today, as the realization of

one's own will in asymmetrical relations. In the meantime, "power over" has been expanded and is often theorized along four dimensions or so-called faces of power (Partzsch, 2015, p. 51).

1st Face: Power as the Capacity of Powerful Actors to Directly Influence the Action of Less Powerful Actors

This refers to the classical understanding of power by Dahl (1957), who understands power as the ability of A to get B to do what B might not otherwise do. In this face, the capacity of actors to access and mobilize resources in order to influence a debate is crucial. Research and knowledge might be conceived as resources that are mobilized to influence debates. In this view, approaches to influence policy, knowledge, and action come down to countering expertise with other expertise (Gaventa & Cornwall, 2008, p. 173). This form of power is considered visible and observable in decision-making.

2nd Face: Power Means Being Able to Set the Agenda

With their work on "the two faces of power," Bachrach and Baratz (1962) redefine much of the debate over power in political science. They argue that Dahl's conceptualization of power reflected only one face of power relationships and stipulate that the scope of power is wider (Digeser, 1992). In their more expansive understanding, power encompasses more than conflicts over who wins and who loses. The powerful can prevent conflict from taking place in the first place by limiting the scope of decision-making to "safe issues" that do not threaten the status quo (Hayward, 2000, p. 15). Limiting power to the understanding contained in the first face would mean that the absence of certain voices from a debate is due to their own apathy or inefficacy. In the second face, this very mechanism becomes a process of exclusion from the political process, hence an exercise of power (Gaventa & Cornwall, 2001; Hayward, 2000). This form of power is referred to as hidden, in that certain groups of actors control who can come to the table and what is put on the agenda. These dynamics work through different mechanisms that delegitimize the concerns of other groups (Gaventa, 2006, p. 29). For example, established rules of the game can facilitate access to the process for some groups while hampering meaningful participation on the part of others. As a result, even when formally excluded actors are given access to the process, they may be required to mimic the language and knowledge of the powerful (Gaventa & Cornwall, 2008, p. 174).

3rd Face: Power Is Exerted through Influencing and Shaping the Formation of Ideas, Norms, and Intentions

Lukes (1974) adds a third, "radical" view on power that stipulates that power can also be exerted if B consciously wants to do what A desires. In this face, power is exercized through the manipulation of the very desires of B (Digeser, 1992, p. 979). The first two faces of

power describe how power can be used by A to overtly get B to do what A wants, even if it goes against B's own will. In this third face, power is invisible and subtle. It describes how power can covertly manipulate others to do something by altering what they think they want. "Invisible power" is exerted through norms and ideas, and shapes the "psychological and ideological boundaries" of participation (Gaventa, 2006, p. 29). Knowledge and the control of knowledge are seen as key elements for influencing people's consciousness. In that sense, power in this dimension resembles Gramscian notions of "hegemony" or Freirean ideas on a "culture of silence" that is produced via the internalization of knowledge by the oppressed (Gaventa & Cornwall, 2008, p. 174).

4th Face: Power Means that Subjectivity is Socially Constructed and Embedded in Historical Processes

Largely relying on Foucault's writing, interrelations between knowledge, power, and politics are understood as a fourth dimension of power (Digeser, 1992). While in the first three faces As and Bs are taken for granted, the fourth face goes one step further in that subjects are not expected to exist in a natural state. Power in this dimension means that subjectivity and individuality respectively are social constructs, the formation of which is historically contingent (Partzsch, 2015). Foucault uses the notion of power to describe parts of this construction process. According to him, power works through discourses, institutions, and practices that are productive of power effects, framing the boundaries of possible action (Digeser, 1992; Gaventa & Cornwall, 2008). To understand power, the roots and effects of norms and values need to be addressed. In this view, knowledge and power mutually constitute each other (Foucault, 1977). While in the three prior forms of power there is a possibility for relationships to not be mediated by power and to be "power-free," in this dimension power is omnipresent and cannot be erased.
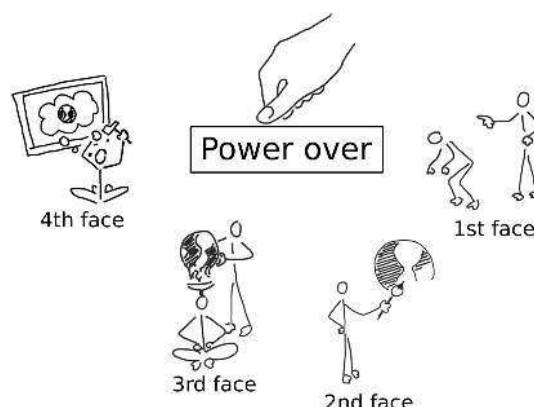
Figure 4.1 The four faces of "power over" (own illustration)

4.3.2 Power To (Resistance and Empowerment)

In this conceptualization, power is understood as the capacity of individual actors to form and shape processes despite resistance (Haugaard, 2002). The term "power to" is roughly synonymous with "empowerment" (Partzsch, 2015). Following Allen (1998, pp. 34–35) "power to" is "the ability of an individual actor to attain an end or series of ends." On the example of feminism, she argues that just as one can assert power to act "in response to a system of domination," one can also assert "power to act by dominating others, not simply by resisting." Thus, she concludes that resistance is one possible form of "power to," just as domination is one particular form of "power over" (Allen, 1998). Her example shows how different forms of power are not exclusive, but deeply entangled, and might be mutually reinforcing or weakening. The emphasis in this conceptualization lies on the agency of individuals and their individual capacity to act.
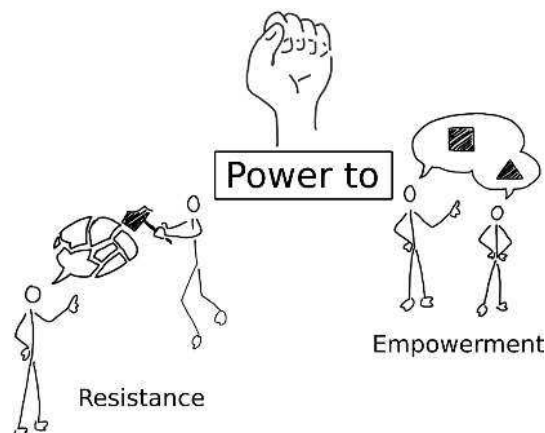
Figure 4.2 Resistance and empowerment as forms of "power to" (own illustration)

4.3.3 Power With (Cooperation and Learning)

In "power with," power refers to the capacity to collectively learn and act. The term has been coined to refer to "the building of a common ground between different interests" (Eyben et al., 2006, p. 8). Processes of finding commonalities and of developing collective strengths are placed at the center of analyses of "power with." In this regard, the notion refers to learning processes and to the development of a new consciousness on the part of a group or a community of individuals (Partzsch, 2015). "Power with" is often associated with Arendt's (1970, p. 44) view that power is "the human ability not just to act but to act in concert." Upon that basis, Allen (1998, p. 35) describes "power with" as "the ability of a collectivity to act together for the attainment of a common or shared end or a series of ends." "Power with" emphasizes the productive forces of power (Partzsch, 2015).

Box 4.1 **Power and the question of legitimacy**

Questions of power are closely linked to the normative question of whether the particular dynamics of power found in a specific situation are legitimate (Haugaard, 2003). We briefly illustrate this interrelatedness for the example of "power to." Hardy and Clegg (2006) link the discussion of power to the question of legitimacy, by stating that strategic agency ("power to", in the words of Allen) potentially challenges legitimized structures of domination. In a system in which the hierarchical organization of society is considered normal, such strategic agency is considered an illegitimate form of power, while the power embedded in the hierarchical structure (a form of "power over") is considered legitimate. This implies a differentiation between formally prescribed or normalized organizations of power and actual power relations (Hardy & Clegg, 2006). Whether "power to" is seen as empowerment or as resistance thus depends on the normalized or legitimized vision of how power is organized in a society. Hardy and Clegg (2006) emphasize that legitimizing forms of power or the outcomes of a mobilization of power (independent of the form of power that was used) are a means of avoiding opposition and achieving stability. Consequently, in the view of those mobilizing power, it is attractive to normalize their form of power. In so doing, they mobilize power not only to achieve physical outcomes, but also to legitimize these outcomes, or even the form of power that is being held.
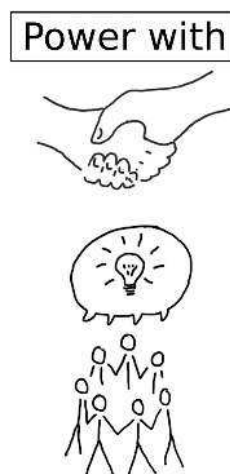
Figure 4.3 "Power with" as cooperation and learning (own illustration)

4.3.4 Studying "Power Over," "Power To," and "Power With" in Participatory Processes

The multifaceted conceptualization of power presented here, which we adapted from Allen (1998), differs from the definitions of those social and political theorists who understand power in just one of these dimensions (Haugaard, 2012). In the subsequent analysis, we illustrate that such a multidimensional approach, which explicitly highlights the

interrelatedness of "power over," "power to," and "power with," is crucial with regard to the complexity of participation in the context of sustainability assessments. The three dimensions allow for different analytical foci and call attention to different aspects and mechanisms of power. "Power over" urges us to pay attention to the ways in which actors, structures, or discourses exert power over others and hints toward the conflictual nature of power. "Power to" directs our analytical focus to the capacity of individual actors to act and achieve their respective goals. "Power with" suggests we look for moments in which collectives emerge that act jointly to achieve common goals. Here consensual facets of power are highlighted.

The different dimensions of power must be understood as analytical, rather than ontological, categories – they might occur simultaneously in any given situation (Allen, 1998, p. 37). They provide us with the necessary tools for analyzing the complexity of power relations in different phases of participatory sustainability assessments, as well as the diverse experiences with power. For instance, a multidimensional approach helps us to see that consensual forms of power or empowerment can be pervaded by "power over" mechanisms, which determine the capacities of individual actors to articulate their concerns and result in the marginalization of weak groups within a community. Or the other way round, a multidimensional approach pushes us to ask how "power with" leads to changes in discourses or structures that reproduce "power over" (Partzsch, 2015). Thus, a multidimensional approach allows us to take into account the productive aspects of power without losing sight of potentially unproductive and negative facets in our analysis.

Based on this theoretical framework, in Table 4.1. we present analytical questions that can be used to systematically explore the role of power throughout participatory sustainability assessments.

Table 4.1 *Dimensions of power and guiding questions derived for analyzing power in participatory sustainability assessments*

Dimension	Definition	Guiding questions for analyzing participation in sustainability assessments
Power over	Power that is exerted over actors, structures, and discourses, including: (1) power as the capacity of powerful actors to directly influence the action of less powerful actors (2) power as the capacity to set the agenda (3) power as the capacity to influence and shape the formation of ideas, norms, and intentions (4) power as the social constructedness and embeddedness of subjectivity in social and historical processes	• Which actors are able/entitled to define the problem to be assessed, the concept of sustainability to be adopted, or the options to be assessed in the participatory sustainability assessment? • Which actors decide who is (not) invited to the table and set the terms of how participants in the sustainability assessment interact? • How are the resources required to take part in the sustainability assessment distributed among actors? • In which ways does the process setup influence the capacity of actors to articulate their concerns and expertise?

Table 4.1 (*cont.*)

Dimension	Definition	Guiding questions for analyzing participation in sustainability assessments
		• In which ways do norms regarding what defines valid knowledge set the boundaries of participation in the sustainability assessment?
		• Whose knowledge and whose values enter and shape the participatory sustainability assessment?
		• How far does the participatory sustainability assessment challenge established institutions and practices?
		• On which forms of social and material organization is the participatory sustainability assessment contingent?
Power to	Power as the individual capacity to act; empowerment and resistance	• Which individual actors involved in the participatory sustainability assessment achieve their goals?
		• Which individual actors face resistance, and which of them nonetheless have the capacity to shape the participatory sustainability assessment?
		• In which ways does the participatory process increase the capacities of actors to achieve their goals?
Power with	Power as the capacity to collectively learn and act	• How do actors cooperate in and learn from the participatory sustainability assessment?
		• To what extent do new goals, understandings, and/or collectives emerge in the course of the participatory sustainability assessment?
		• Are bridges built between different interests in the participatory sustainability assessment?

4.4 Dimensions of Power in Participatory Sustainability Assessments: An Illustrative Analysis

With this theoretical backing, we now turn to spaces of participation in sustainability assessments and apply the multifaceted framework to an illustrative analysis of power in (1) defining and framing the problem to be assessed, (2) the knowledge-production and assessment process, and (3) governance processes in which results of the assessment are acted upon. We assume a generic sustainability assessment process in which participatory elements can occur at all stages of the assessment (see Figure 4.4).
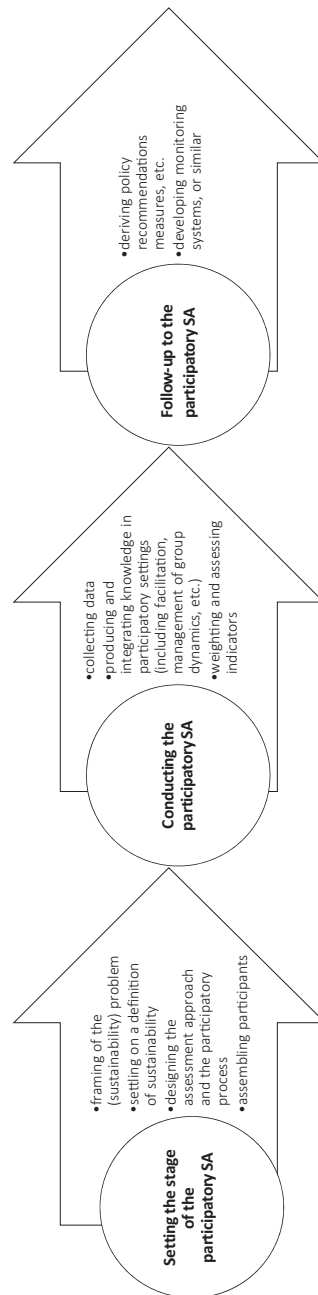
Figure 4.4 Selected elements of a generic participatory sustainability assessment. Source: own illustration; based on process elements mentioned in Binder et al. (2010); Morrison-Saunders et al. (2014); Sala et al. (2015)

Guided by the questions formulated in Table 4.1, we illustrate how, depending on the context and on the ways in which the participatory sustainability assessment is laid out, different forms of power can be present at these different stages (for an overview see Table 4.2). We acknowledge that in the reality of sustainability assessment practice this linearity is oversimplifying and the process might equally be an iterative one.

4.4.1 Setting the Stage for the Participatory Sustainability Assessment

Setting the stage for a sustainability assessment involves defining the problem that is to be assessed. This implies finding a definition of sustainability that serves as the reference in the assessment process (see Chapter 3 (Meinherz et al., 2020)) as well as framing the problem and the system of interest (see Chapter 8 (Binder et al., 2020b)). Setting the stage further includes deciding which approach is to be used, who is participating in the process at which stage and in which role, and how the outcomes of the process will play into governance processes. These decisions influence the remainder of the sustainability assessment.

4.4.1.1 Framing the Problem and the System of Interest

As Bloomfield et al. (1998, p. 11) argue "power lies substantially with those who decide where the boundaries are drawn." The drawing of boundaries with regard to the system of interest is of particular importance when conducting an assessment based on multifaceted and fuzzy concepts such as sustainability. If the problem at the core of the sustainability assessment is decided upon by one person or organization irrespective of the will of other people or organizations, we are typically in an instance of "power over." Some authors show that if the objectives are predefined and cannot be adapted by participants, this negatively impacts on the process and ultimately lowers the chances of reaching these objectives (Kallis et al., 2006, p. 231). Button and Mattson (1999, p. 623) describe this in the case of a deliberative inclusionary process (DIP) where "the perspective of land as something to be cherished and not as something to be used was clearly marginalized within the context of this highly technocratic discussion of 'resource management'." In reaction, a representative of a Native American group "expressed anger at being excluded from the planning of the event where there would have been a chance to move the forum away from a purely technical discourse." Similarly, Tewdwr-Jones and Thomas (1998) argue that the participation process in their case study was critically constrained by the fact that key elements of the policy discourse – e.g., the status of a national park and the question of what a local development plan should (not) include – were non-negotiable. These issues were outside the boundaries set by the responsible agency. This starting assumption and the political context shaped the process and its results (Stirling & Mayer, 1999). Both cases exemplify that those framing the problem and setting the system boundaries (intentionally or not) exert significant "power over" the participatory process.

Such observations point to tensions and dilemmas inherent to participation in the field of sustainability: aiming at an inclusive framing of the problem and the reference system on the one hand, and institutionally framed objectives that impose a pre-existing framing not necessarily shared by all participants on the other (Kallis et al., 2009, p. 985). Participatory methods rest on the idea that those involved are entitled to shape the process and set its goals and outputs (Kallis et al., 2006, p. 231). Reflecting on a deliberative visioning process, Kallis et al. (2009) show that the institutionally defined emphasis on ecological objectives did not receive support from the participants, who feared an externally imposed environmental agenda. The researchers took the decision to put the goals of the process up for debate. This entailed a focus in the problem framing on "quantitative" water management issues, of which the participants were aware. In this case, the aim of ensuring the internal coherence of the participatory approach implied that various combinations of economic, social, and environmental goals led to a watering down of legislation-set ecological objectives (Kallis et al., 2006, p. 261). If people or groups claim space in the sense that they get their stances to be represented in the problem definition, as exemplified with the water management case mentioned, we are in a context of "power to." In such an instance, actors who are not by default in charge develop the capacity to act in their interest.

If, however, in the course of the process, goals, knowledge, and understandings are newly developed and come to shape the problem definition and system understanding, this stage of the assessment process is characterized by "power with." In the water-management case study, this would have required that instead of a process in which the institutional ecological norms and the quantitative water-management norms of the participants remained intact and mutually exclusive, a process would have taken place in which new norms emerged – a new shared understanding of the problem. "Power with" can also take place if the problem is defined collectively by a group of people on the basis of a long-term collaboration process.

4.4.1.2 Settling on a Definition of Sustainability

Similar reflections apply to the definition of sustainability that underpins the assessment. Settling on a conceptualization of sustainability implies a decision regarding the world-views and values that are considered in the assessment, and is accompanied by an exclusion of alternative conceptualizations (Kemp & Martens, 2007; Robinson, 2004). Operationalizing sustainability in a given context can hence be interpreted as a form of social or political control, implying power relations (Frame & Brown, 2008). If an established definition of sustainability is taken as the benchmark, or if one organization or person decides upon a definition of sustainability regardless of other stances, we are in a context of "power over." Discursive forms of "power over" (fourth face) manifest if the underpinning nature–society conceptualizations or definitions of "development" and "well-being" are unquestioned while others are discredited as utopian (see Chapter 3 (Meinherz et al., 2020)). Pointing toward "power over," science and technology studies scholars address the authority of scientific expertise when it comes to defining sustainability

problems and show that in participatory settings experts often dominate by framing environmental issues as primarily technological issues (Berg & Lidskog, 2018). Seemingly paradoxically, societal actors tend to attribute the key role in describing the "true" nature of the issue at stake to science. This way, those participating "take a technical framing for granted, which limits their capacity to discover, understand and internalize challenges that arise outside a particular frame" (Berg & Lidskog, 2018, p. 12). Such participatory sustainability assessments echo and risk reproducing technocentric and anthropocentric worldviews.[3] Just like the problem framing, settling on a definition of sustainability can be marked by instances of "power to" or "power with."

4.4.1.3 Designing the Assessment Approach and the Participatory Process

In this step, the cornerstones of participation spaces are set. This step is most commonly shaped by instances of "power over." In most cases, the assessment is initiated by one party, who lays out the process, i.e., defines which method is to be applied, which steps are to be conducted in which way, and where and in which form participation comes in (Kallis et al., 2006). In research-oriented processes, it is mostly researchers who initiate the sustainability assessment and its participatory elements (Rosendahl et al., 2015). With regard to policy-oriented processes, Cook et al. (2013) note that participation is often initiated by the traditional decision-makers to either empower specific publics, or to legitimize their own decisions.[4]

Although rare, it is conceivable that the design of the participatory sustainability assessment is embedded in a context of "power with," such as when grassroots movements culminate in a formal assessment of a specific sustainability problem. The initiation of a sustainability assessment also takes place in a context of "power with" when it emerges from prior collaborative processes, e.g., when actors jointly launch a follow-up project.

4.4.1.4 Assembling Participants

The question of who enters spaces of participation, and in which role, reflects power relations. It is linked to decisions regarding which worldviews and forms of knowledge are considered valuable and valid in the context of the assessment, and/or who is considered a legitimate representative of a claim, as well as who feels entitled to participate. The question of who is to represent the claims of large groups that are not necessarily organized or clearly defined, such as consumers or residents, or the claims of non-human species, earth processes, or future generations is particularly challenging (Latour, 2005; Lövbrand & Stripple, 2013; Spash, 2007).

The decision of who is to participate can be marked by instances of "power over," "power to," or "power with." A spontaneously self-organized movement, of which anybody can be part, can be seen as an example of "claimed spaces" (Gaventa, 2006) and an emergence of participation in a context of "power with." Such spaces also emerge when actors make their way into different stages of a sustainability assessment, because they mobilize forms of "power to," either in the form of resistance or empowerment. In sustainability assessments applied by administrative bodies, we most likely find "invited spaces" (Gaventa, 2006). If

---

Box 4.2 **"When": The timing of participation**

The point in time at which one or several participatory methods are applied in a sustainability assessment varies and participatory elements can alternate with more scientific expert-based assessment steps. Moreover, the degree to which the outcomes of participatory elements influence the consequent steps in the assessment process varies. In the context of "neighbourhood sustainability assessment" tools, Sharifi et al. (2013) identify three moments where participatory elements can feed into the process: (i) when defining sustainability, targets, and indicators; (ii) when weighting criteria and indicators; and (iii) when developing an intervention based on the assessment. The "sustainability solution space" approach proposes an iterative and transdisciplinary process to elicit the normative sustainability goals of all participants and to contribute to the development and weighting of indicators (Wiek & Binder, 2005). Likewise, the "sustainability wheel approach" combines a comprehensive system analysis with the consideration of normative aspects as represented in stakeholders' experiences and perspectives. Both expert and stakeholder knowledge are gathered. The involvement of the latter is here particularly central in visioning processes as well as in the development of principles and indicators for the local context in which the assessment is embedded (see Chapter 8 (Binder et al., 2020b)); Chapter 6 (Schneider, 2020); Schneider et al., 2015). The moment at which participation is best built into a sustainability assessment also depends on the larger process within which the assessment is embedded. Whether it is part of a research- or policy-oriented process (e.g., decision-making at the end of the participatory sustainability assessment) marks an important difference. The wider process which the participatory sustainability assessment feeds into implicates different power dynamics (Kallis et al., 2006).

---

the administrative body decides who to invite to participate in the process, we observe an instance of "power over." This is also the case if specific actors are convoked in the process, either because this enhances the legitimacy of the process or because they hold a specific kind of knowledge. Situations of "power over" can thus be marked by different motivations: participants can be involved in the process either to render it more inclusive and to pursue social justice, or for utilitarian reasons that serve the interest of those designing the process (Reed et al., 2009). In the case of "invited spaces," those asked to take part have the possibility of refusing to participate or of dropping out of an ongoing process. Ensuring lasting commitment on the part of participants is described as a major challenge in participatory sustainability research (Siew et al., 2016) – pointing toward the complexity of power relations and mutual dependencies between actors.

Power dynamics also underpin actor understandings. Frequently, participants in sustainability assessments are conceptualized as "stakeholders." The term "stakeholder involvement" implies that the issues "at stake" are already agreed upon (Wynne & Felt, 2007). Seeing and labelling participants as stakeholders ascribes them specific roles. Relying on stakeholder involvement as opposed to wider conceptualizations of citizenship is likely to be marked by "power over" (second face) as it closes an open debate by starting from an already set problem definition (Reed et al., 2009). By inviting actors whose positions are

---

Box 4.3 **"Who": Selection of participants**

Regardless of the approach to and timing of participation, those initiating the participatory process need to decide who to involve. The criteria that inform this choice are tied to the purpose of the participatory process. Participants can be selected based on their (perceived) political influence, their expertise, the envisaged plurality of perspectives to be present in the process, the degree to which participants are affected by or can affect the outcome of the assessment process, the perceived legitimacy of their claims regarding the issue at hand, or their integrity or enthusiasm (Hage et al., 2010; Reed et al., 2009). Although frequently used, the approach of seeing participants through the filter of stakeholders is one approach among others, ascribes a specific role to participants, and impacts on power dynamics. An unsolved conundrum in stakeholder approaches is whether a clear delineation of the problem indicates those who have a "stake," or whether the definition of the problem should be guided by the concerns of heterogeneous actors in the first place (Reed et al., 2009). Ultimately, the decision of who is involved and who is omitted in an assessment determines "whose reality counts" (Chambers, 1997) and shapes the evolution and results of the participatory process.

---

known, those in charge of the sustainability assessment can select stakeholders with "fitting" positions and prevent controversy and conflict from the outset (Schikowitz, 2016).

4.4.2 *Conducting the Participatory Sustainability Assessment*

After having illustrated how different dimensions of power can shape the stage of defining the problem, the assessment process, and the notion of sustainability, we look at instances of power at the stage of conducting the actual assessment. This stage typically involves producing and/or integrating different forms of knowledge in a larger process of establishing and measuring indicators, as well assessing them against some sustainability criteria.

4.4.2.1 *Knowledge Production and Integration*

Participatory processes aimed at bringing together different forms of knowledge for a sustainability assessment do not per se cancel out existing knowledge hierarchies. Interpreted in the context of "power over" (second face), knowledge and its production, "contribute very strongly to the mobilization of bias" (Gaventa & Cornwall, 2001, p. 75). Scientific criteria and rules can be used (intentionally or not) to declare the knowledge of some groups more valid than others, e.g., of "certified experts" over "non-certified experts" (Collins & Evans, 2002). In participation spaces that are tailored to fit the most normalized forms of knowledge (e.g., scientific knowledge) less normalized forms of knowledge (e.g., local knowledge) struggle to have the same weight in the process (Klenk & Meehan, 2015).[5] Particularly when alternative framings of an issue lead to incommensurable visions, the dominance of some forms of knowledge over others becomes apparent (Holmes & Scoones, 2000).

Forms of knowledge that are difficult to integrate into the frames of reasoning of the more normalized forms of knowledge risk being excluded. Such mechanisms of "power over" have been discussed with regard to simulation and computer models that act as integration tools across epistemic boundaries. On the example of transdisciplinary sustainability research, it has been demonstrated how models "include but also exclude certain kinds of knowledge . . . and how they (re)produce orders, roles, and identities within the relation between science and society" (Igelsböck, 2016, p. 133). Similarly to the example of models, indicators can act as boundary objects in sustainability assessments (Turnhout, 2009), giving comparatively more power to those forms of knowledge which transfer well into measurable indicators.

Forms of "power over" (third and fourth faces) also pervade participatory events aimed at joint knowledge production. With regard to environmental policymaking, Holmes and Scoones (2000) illustrate that the authority of actors in participatory processes is tied to having privileged access to "objective factual knowledge" (Sanderson, 1999). In an analysis of seven DIPs, citizens were found to be locked into a referential and passive role. Their exchanges with scientific experts who relied on technical language reflected pre-existing power relations and hampered a deliberative process (Button & Mattson, 1999). In another case study, participants demanded more scientific data and quantified knowledge was particularly used in order to tackle the uncertainty and complexity of water governance. Simultaneously, privileging scientific knowledge undermined the collaborative spirit of the group and some participants perceived the scientific assessment as concealing a political program (Kallis et al., 2009).

Inscribed in "power over" (fourth face), knowledge can reflect established institutional dynamics, or alternatively, perpetuate dominant structures and ideas. Knowledge and social order appear as co-produced (Jasanoff, 2004). This embeddedness of knowledge production can inhibit innovation and societal change by preventing new ideas and creative solutions from gaining traction in the sustainability assessment process. This interdependency of knowledge and social order means that different contexts (e.g., democratic cultures) influence how actors perceive their capacity to participate, as well as the meaningfulness of their participation (Cook et al., 2013). The latter implicates that participants' motivation is predicated on trust that the process will be effective and improve a given situation. If the process proves to be protracted or participants do not see discernible results from the participation process, they are unlikely to stay committed (Holmes & Scoones, 2000; Kallis et al., 2009).

In addition to discursive power in knowledge production, "power over" in its first face forms the participation of diverse actors. Asymmetries in the distribution of financial resources among participants determine their respective capacities to invest time in and shape knowledge production processes (Fritz & Binder, 2018).

4.4.2.2 Managing Spaces of Participation: Facilitation and Group Dynamics

Some scholars ascribe considerable "power over" to facilitators and moderators in shaping the evolution of a participatory event, be it a group discussion, a participatory scenario workshop, or a group modeling workshop (see Box 4.4.). While they might not have a stake

in the sustainability issue under debate, they might have an interest in promoting specific methods or hold particular values with regard to collaboration, participation, or the need for democratizing sustainability science. In reflecting on their own roles as facilitators of participatory workshops, scholars share concerns that they might have pushed too much for a compromise in cases in which one might not have emerged spontaneously. In dealing with power relations, facilitators face the dilemma of remaining neutral while at the same time encouraging those who are reluctant to speak: "Intervention raises the question who to privilege and why, i.e. according to what criteria should the levelling be done? . . . From a different perspective, non-intervention is still an indirect act in favour of the status quo" (Kallis et al., 2009, p. 985). Additionally, macro-societal structures, such as gender relations, imply power relations. This is observed in participatory rural appraisal projects where women were not at ease sharing their experience in workshop settings (Holmes, 2001). Linked to the reproduction of macro-societal power relations, group dynamics embody another manifestation of power in participatory processes (Bell et al., 2012). Hidden power dynamics take place when, for example, self-censoring occurs or participants act tactically so as to extract benefits in other settings. With regard to who dominates in workshop settings, differences of personality as well as the capacity to articulate arguments and convince others are decisive (Kallis et al., 2009).[6] Findings from a community-based food-security planning process show how the viewpoints of less influential participants were gradually aligned with those of more powerful actors (McCullum et al., 2004). The results mirrored the "power over" dynamics within the group, even though the "result was deemed a consensus and the process itself considered fair, energizing and satisfying by the internal participants and external observers" (Muro & Jeffrey, 2008, p. 337).

4.4.2.3 Weighting and Assessing Indicators: Trade-offs and Incommensurability of Values

An important challenge at this stage of the sustainability assessment concerns the weighting of indicators and deciding which value or range represents the threshold of what is (un) sustainable (see Chapter 8 (Binder et al., 2020b)). Here, power struggles surrounding trade-offs between different indicators and dimensions of sustainability start to manifest. An example is the decision of how much environmental degradation we consider bearable in exchange for increased production capacities, employment rates, and economic growth.[7] Inevitably, these decisions are normative and mirror the worldviews of those participating, not all of which might be equally heard, i.e., if some have "power over" others.

Those conducting the assessment are confronted with tensions between valuing diversity and plurality of perspectives on the one hand, and the quest for consensus built into many participatory endeavors on the other. Perspectives might not only be contradictory but incommensurable (Martinez-Alier et al., 1998; Pellizzoni, 2003). In this case, the absence of a shared language or common reference system renders any attempt to compare different options impossible. Such a situation is diametrically opposed to the Habermasian ideal-speech situation held up in various conceptualizations of participation, most notably those

inspired by Arnstein's (1969) ladder of participation. Pellizzoni (2003, p. 12) argues that equalizing resources might maintain incommensurability by "translating discordant knowledge, concepts and expressions into dominant ones." Rather than acknowledging differences, they are camouflaged ("power over"). Participatory or social multi-criteria assessments are considered particularly apt for tackling situations in which perspectives starkly diverge (Martinez-Alier et al., 1998; Spash, 2007) and the roots of conflicts need to be disclosed (Kallis et al., 2006).[8] Conversely, an assessment relying on cost-benefit analysis encourages participants to focus on monetizing an environmental entity and puts aside incommensurable values (Spash & Vatn, 2006). This look at methods illustrates the power of the value-articulating institutions that are referred to in a process (Vatn, 2005).[9]

Even when values are commensurable, the quest for consensus tends to silence the voices of marginalized groups through hidden mechanisms of "power over." This is particularly pronounced when the values of some actors are subordinated to those of more articulate or persuasive actors in the participatory process. Often win-win outcomes are prevented by historically embedded institutions, reflected in power relations (Spash, 2007). In such a context, striving for consensus "does not provide the most just system for handling differences of opinion, but produces an outcome that does not rise above a low common denominator" (Holmes & Scoones, 2000, p. 33). Failure to address particular interests leaves room for the strategic and hidden manipulation of participatory processes. Such forms of "power over" occur when actors pretend to seek consensus, while covertly pursuing an individual agenda (Pellow, 1999; van den Hove, 2006).[10] Negotiation does inevitably take place in participatory processes. It is, hence, critical to ensure that "negotiation is framed in as fair as possible procedures in order to avoid the perverse effect of reinforcing the power of the strongest actor" (van den Hove, 2006, p. 13). Some scholars suggest that participatory processes need to be designed such that conflict becomes a driving force in the development of solutions and learning processes rather than a hindrance (Mouffe, 2000; Spash, 2007; van den Hove, 2006).[11]

The role of "power over" in dealing with the plurality of values and trade-offs in participatory sustainability assessments points to the importance of early phases of the assessment in which the cornerstones of a common ground are set. Manipulative forces can manifest if participants in the knowledge-production process end up contributing to the achievement of a goal that is not their own. Such a situation can occur if the actors involved in outlining the problem or the working definition of sustainability are not the same as those involved in the knowledge-production process. That there is a sense of purpose to sustainability, a form of vision (Hirsch Hadorn et al., 2006), means that to some extent the knowledge-production process of a sustainability assessment subscribes to this purpose or vision (Farrell, 2011). If we think of a multi-criteria assessment, "power over" occurs when development options or assessment criteria have been defined prior to the consultation. By predefining which options are up for debate, those in charge exert the power to keep other options off the table and restrict the space of what is "negotiable." In the context of technology appraisal, Stirling (2008) observes that incumbent interests tend to instrumentally frame an appraisal so as to limit the range of commitments that it might entail.

Box 4.4 **"How": Participatory methods**

Diverse methods exist to involve societal actors in sustainability assessments. For participation in research addressing complex problems, the following methods are frequently used: focus groups, participatory scenario analysis, participatory or mediated modeling, citizen juries, consensus conferences, participatory planning, and science–stakeholder workshops. The following publications provide comprehensive overviews of participatory methods used in the field of sustainability: Hartz-Karp et al. (2015), Kasemir (2003), Rauschmeyer et al. (2009), van Asselt Marjolein and Rijekens-Klomp (2002). The choice of methods to involve participants is not a merely technical one, but is tied to the underlying rationale and approach to participation (see Section 4.4.2.). For example, participatory multi-criteria assessment has been found useful for taking into account the high plurality of values regarding controversial sustainability issues and for dealing with their possible incommensurability (Martinez-Alier et al., 1998; Munda, 2006; Polatidis et al., 2006). Participatory modeling of complex sustainability issues has proven powerful in facilitating compromise and actionable conclusions (Stave, 2002; Videira et al., 2010). Depending on whether procedural goals (e.g., the development of policy recommendations) or social goals (e.g., social learning) are at the center, participation can be more appropriate at different stages of the modeling process (Videira et al., 2006). The entire modeling process can be participatory, e.g., in group model building (Vennix, 1996), or a model developed by a group of researchers can be used in a group discussion to facilitate dialogue about different perceptions regarding the system under discussion (Stave, 2002). Yet another method applied in sustainability assessments is that of participatory scenario and visioning processes. In participatory scenario analyses, the focus is on assessing available choices and on finding agreement on a desirable course of action in the face of trade-offs. In participatory visioning processes, the emphasis lies on developing a shared vision of a desirable future and only later on the pathways for its realization. Participatory visioning processes help identify common ideals and are particularly useful at early stages of a sustainability assessment process. Participatory scenario analyses are useful at later stages, when decisions need to be made based on the knowledge that was produced during the assessment (O'Brien & Meadows, 2001; Zurek & Henrichs, 2007). For participatory multi-criteria assessment and participatory visioning, see Chapter 6 (Schneider, 2020), Chapter 8 (Binder et al., 2020), and Chapter 9 (Merino-Saum, 2020).

4.4.3 Learning and Governance Processes as the Follow-Up to a Sustainability Assessment

Understanding the politics of participation requires us to extend our exploration to the stage at which the results of a sustainability assessment are eventually acted upon. Sustainability assessments are generally conducted with a specific action in mind, be it the implementation of a new policy, the construction of an industrial site, or the development of a company's corporate strategy (McCool & Stankey, 2004; Rametsteiner et al., 2011; Waas et al., 2014). Although the implementation phase is strictly speaking not part of the sustainability assessment (Morrison-Saunders et al., 2014), considering power dynamics at

this follow-up stage is important when thinking about the transformative power of these processes.

It is with regard to the follow-up that the powerful role of the wider context within which the assessment and its participatory elements are located becomes particularly tangible. The importance of methodological advances notwithstanding, a reflection on the example of a deliberative visioning process affirms that the contribution to society of such a process depends heavily on the context of its implementation and its integration with broader social or policy change (Kallis et al., 2006). An unfavorable institutional and environmental context, in which spontaneously emerging collectives are not valued, has been found to shut down the possibilities for follow-up actions based on a deliberative visioning process (Kallis et al., 2009).

At this stage, normative questions arise, such as who the process results benefit and whether they stabilize or disrupt power relations that perpetuate an unsustainable status quo (Kropp, 2013). Participatory processes can result in the promotion of incumbent actors' interests, unless due attention is paid to how their outputs are invoked in the policy process (Kothari & Cooke, 2001). For instance, a traditional decision-maker might be inclined toward participatory elements in a sustainability assessment in order to legitimize the resulting decisions, and to facilitate their implementation. This points to an intersection of a knowledge-production process characterized by "power with" with forms of "power over," in that the outcomes are instrumentalized with a goal in mind that was not jointly framed in the participatory process.

If the assessment is conducted in a way that novel or previously unheard bodies of knowledge emerge, it may mobilize forms of "power to" or "power with" in follow-up steps. By informing policies, expertise that is not traditionally part of the decision-making process comes to play a role in governance and claims that are not typically influential in the political arena are empowered.[12] In their landmark publication on sustainability science, Kates et al. (2001, p. 641) refer to such productive forms of power, stating that "[c]ombining different ways of knowing and learning will permit different social actors to work in concert, even with much uncertainty and limited information." By unfolding productive power, participatory knowledge-production processes can foster social learning, institutional trust, and cooperation in governing sustainability problems (Garmendia & Stagl, 2010; Hage et al., 2010; Reed et al., 2009; Santos et al., 2006; Videira et al., 2006). Following Hirsch-Hadorn et al. (2006), practice changes toward sustainability are most likely if the actors concerned are aware of the available bodies of knowledge, monitoring, and implementation strategies. Decision-making on complex problems in this reading becomes a process in which actors engage in continuous learning (Garmendia & Stagl, 2010), thus mobilizing "power with." Inscribing the implementation stage in a context of "power with" can contribute to the proactive and adaptive management of the issue at hand.[13]

Zooming out of an individual participatory process, sustainability assessments at large can be understood as a historically constructed social practice. This practice has gained importance to the point where it has become an integral part of how we conceive

of governance and knowledge production for governance. This institutionalization of sustainability assessments echoes "power over" (fourth face). By inscribing sustainability values in the governance process, the institutionalization of sustainability assessments in policy processes enforces sustainability as a guiding principle for action. These reflections illustrate that, since it is a form of policy assessment, a sustainability assessment is not neutral in terms of the power dynamics at play in society at large. Assessments and the actors implementing them become constitutive of an attempt to alter power relations by shaping the very values and practices of governance (Cashmore & Richardson, 2013).

Table 4.2 *Matrix of possible forms of power throughout participatory sustainability assessments*

Dimension phase	Setting the stage of the participatory SA	Conducting the participatory SA	Follow-up to the participatory SA
Power over	• One actor (group) has and makes use of the capacity to lay out the sustainability assessment and decide who is to be involved in the process (process design) • One actor (group) has and makes use of the capacity to set the priorities and values of the sustainability assessment (problem framing, sustainability definition, system boundaries)	• Knowledge production exists in the framework of one actor group and impedes the meaningful participation of other knowledge forms • Integration tools privilege the inclusion of some forms of knowledge over others • Facilitators shape group dynamics in participatory workshops • Downplaying plurality of values and perspectives to reach consensus • Uneven distribution of resources to engage in and influence the process	• Derived (policy) measures strongly favor one actor (group); instrumentalization of results by some actors • Inscribing sustainability values in governance processes • The institutionalization of sustainability assessments as a policy assessment tool enforces specific values as guiding principles of governance
Power to	• Different actor groups can make their views count in the definition of the problem • The proposition of an established authority is	• Diverse ways of knowing or producing knowledge enter the process either through invitation or by actors claiming space	• Results of the participatory assessment enable actors to achieve their policy aims by informing policies • Expertise that is not traditionally part of

Table 4.2 (*cont.*)

Dimension phase	Setting the stage of the participatory SA	Conducting the participatory SA	Follow-up to the participatory SA
	questioned and modified as a result of debate on the issue	• (Self-)empowerment	decision-making plays a role in governance • Values that are not typically influential in the political arena are empowered
Power with	• Emergence of a group that collectively initiates the assessment process, e.g., on an issue that was, at least in its final form, on none of the single actors' agendas • Collaborative design of the sustainability assessment as follow-up to previous collaboration and learning	• Social learning processes • Knowledge coproduction and collaborative development of new ideas, solutions	• Collective action on the basis of the sustainability assessment • Social learning process • Contribution to adaptive management

4.5 Concluding Discussion

Participation has been heralded as a key instrument in sustainability assessments. The involvement of diverse actors is thought essential to deal with the plurality of normative claims surrounding the definition of sustainability and the need to take decisions in a context of trade-offs and uncertainty. Despite the fact that participatory sustainability assessments are linked to ideas of action and societal change, critical reflections on the workings of power within, as well as resulting from, participatory assessments have been rare. We presented a conceptualization of power inspired by feminist studies that combines three forms of power: "power over," "power to," and "power with" (see Table 4.1). In a generic analysis we showed how, depending on the layout of the process and the configuration of the social context in which it takes place, different forms of power emerge (see Table 4.2). This suggests that in a participatory sustainability assessment, power works in multiple ways, and is as such neither good nor bad, but can be productive as well as undesirable. Judging the latter is intrinsically normative and depends on the context as well as the observer's standpoint. In this concluding section, we explore possible implications of power for the achievement of specific goals as regards participation and argue that, depending on the desired outcomes of the sustainability assessment, different power dynamics are productive when it comes to the goal of participation. Consequently, awareness of and reflexivity with regard to the power dynamics at play, and their conscious management, are crucial for participation to reach its goals.

4.5.1 From Spaces of Participation to Spaces of Transformation?

With regard to sustainability transformations, participation is often advocated based on the normative assumption that more participation is better – because participation is a goal per se, because participation is thought to foster civic learning and involvement and reinforce democratic processes, or because participation enhances the legitimacy of the process and commitment to its outcomes. As this analysis, guided by a multidimensional approach to power, has illustrated, mechanisms of "power over" or "power to" can restrict spaces of participation, undermine social learning, and limit the transformative potential of the process. More involvement does not necessarily overcome these challenges. If, for instance, the process fails to disrupt dominant discourses, remains subscribed to an established normative position, or in some other way gives over-proportional weight to one set of claims, "power over" and "power to" can also occur in processes characterized by a high intensity of involvement. In such cases, the participatory process runs the risk of concealing the reproduction of an unsustainable status quo. Such dynamics are aggravated if existing power relations and knowledge hierarchies in the social context of the assessment are neglected. For instance, in a context of rigid knowledge hierarchies and unbalanced power relations, new knowledge, civic learning, or social involvement might only unfold if marginalized claims or ways of knowing are deliberately empowered, or if the process is managed in a top-down fashion. This way it might be possible to steer and counterbalance the existing power relations. Such a process, however, compromises deliberative ideals that underlie the normative position that participation is an end in itself. Thus, depending on the context, trade-offs between different motivations for and goals of participation can be unavoidable.

Similarly, a participatory process that is embedded in a dominant discourse might have limited transformative potential, regardless of when and how participation takes place in the sustainability assessment. Examples of discourses that might be tacitly reproduced in a participation process include dominant economic paradigms or the weak conceptualization of sustainability on which technocratic discourses around solving sustainability issues rest (see Chapter 1 (Halla & Binder, 2020) and Chapter 3 (Meinherz et al., 2020)). The pervasiveness of these discourses and the long-standing authority on which they rely reduce the likelihood that actors whose worldviews differ substantially can make themselves heard. If a discourse is, however, only locally dominant, it might be possible to trigger a much greater transformative potential if "power over" is mobilized to introduce new discourses. Again, this interferes with the deliberative ideals ascribed to participation.

Even if the prevailing power dynamics complicate or render unlikely the emergence of truly novel conceptualizations of the problem domain, a participatory sustainability assessment has the potential to produce innovative solutions within a set problem domain or discourse. This is the case if the knowledge-production phase takes place in a context of inclusivity and dynamics of "power with." Similarly, approaches can be developed in which the implementation of the results of an assessment is shaped by instances of "power with." This might favor an adaptive management strategy and foster social learning processes. The chances of this potential being unleashed might be higher if the process embraces plurality

and differences in perspectives and ways of knowing, and confronts conflict instead of concealing it.

In a context in which some claims remain unheard because they do not resonate with the dominant discourse, or in which some forms of knowledge are marginalized because they do not integrate easily into the normalized knowledge system, it might be more productive to the goal of finding a promising governance strategy to consciously manage the process by mobilizing forms of "power over," and by empowering specific claims ("power to").

In contrast to these situations embedded in a context of "power over," the configuration of knowledge hierarchies and power relations can be such that throughout the assessment a participatory process characterized by "power with" is possible. In this a case, the transformative potential of the sustainability assessment might be greater if such power dynamics are fostered at the earlier phase of setting the stage. Processes of social learning and deliberation might point to problems or value claims that would not have emerged otherwise. Such an approach might also give more legitimacy to the process of defining the problem space and the reference definition of sustainability.

To conclude, regardless of the motivation behind making a sustainability assessment participatory, power dynamics pervade all stages of the process. While some might be minimized by careful design and the choice of the most appropriate method(s), others might be more elusive. All of them, however, need to be taken into account to ensure that the process results in the desired outcomes.

4.5.2 The Need for Reflexivity and Transparency

Our discussion suggests that more participation does not always lead to the outcomes commonly associated with it. Depending on the prevailing power dynamics, hierarchical processes might unleash a higher transformative potential than inclusive ones. Silver bullets do not exist and different contexts require different approaches. What is needed is reflexivity and critical reflection on existing knowledge hierarchies, discourses, and organizations of power, as well as on how the participatory sustainability assessment process interacts with them. On this basis, the process can be designed in such a way that it is most likely to reach its objectives. Our illustrative analysis has shown that trade-offs between the different goals associated with a participatory sustainability assessment might be necessary. The proposed conceptualization of power makes it possible to identify these trade-offs ex ante, and facilitates the taking of informed decisions on how to design the sustainability assessment process. Our analysis has demonstrated that the participation of diverse actors in an assessment exercise is both a question of methods and techniques and a deeply political endeavor. Hence, a participatory sustainability assessment cannot be looked at in isolation from its surrounding sociopolitical context. The various negotiation processes that form participation spaces throughout a sustainability assessment, the multiple purposes for which they can be mobilized, as well as their role in the wider governance landscape, show the need to pay greater attention to the politics of participatory sustainability assessments.

Despite their relevance in shaping results, detailed information on the participatory processes is lacking in many publications on participatory sustainability assessments and in sustainability research more generally. Further research is required to extend the generic analyses of the dimensions of power provided in this chapter through enquiries into real-world participatory sustainability assessments. More detailed and transparent accounts of participation processes would facilitate learning and the development of best practices. The analytical framework presented in this chapter can guide such critical reflections on power dynamics and how they are influenced by the sustainability assessment approach, as well as how they subsequently influence the outcomes of the latter. By stressing the diverse dimensions of power, we hope to encourage sustainability researchers to acknowledge and study both the productive and the restricting forms of power, as well as the unintended side effects they might produce in participatory processes.

Acknowledgments

Notes

1. Reflecting work on the "politics of knowledge" (Rubio & Baert, 2012), we use the notion of politics to refer to the deep entanglements of knowledge and values that are particularly visible in participatory knowledge-production processes, such as participatory sustainability assessments. In this view, and unlike in "liberal views" of knowledge (Merton, 1973), in participatory knowledge production, knowledge and societal order are not separate, but mutually constitute one another. Consequently, studying these relations, and the power struggles they entail, is crucial.
2. In the field of sustainability, Mielke et al. (2016) build on this approach to develop a typology of scientific perspectives on stakeholder involvement in sustainability science, including a technocratic type, a neoliberal-rational type, a functionalist type, and a democratic type.
3. See Chapter 3 (Meinherz et al., 2020) for a detailed account of the role of different worldviews and values with regard what sustainability is and should be. The authors also critically discuss the role of hegemonic discourses and their repercussions for pluralist approaches.
4. They further note that participation is often promoted by those who it empowers. This shows how a situation of "power over" – for instance, a traditional decision-maker considers that participation is opportune – can intersect with "power to" – a group is empowered to partake in participatory processes. However, it is possible that such a process, although empowering on paper, does not live up to the ambition because the traditional decision-makers fall back on their established modes of governing, regardless of the process (Cook et al., 2013) – or because strong dynamics related to the third and fourth face of "power over" are at play.
5. Those invited to take part may be required to imitate the language of those framing the process in order to be heard (Gaventa & Cornwall, 2008). If the knowledge-production practices of one group dominate, those familiar with these practices have a comparative advantage over those who are not.
6. In a case study on water governance, these characteristics however did not necessarily correlate with political or economic power outside the participatory space (Kallis et al., 2009).
7. For a case study example on trade-offs with regard to hydropower production in a Swiss Alpine region, see Chapter 6 (Schneider, 2020).

8. For a discussion of multi-criteria assessments, see Chapter 9 (Merino-Saum (2020)).
9. The concept of value-articulating institutions was initially proposed by Jacobs (1997) and developed further by Vatn (2005). The concept suggests that the kind of institutions that are "invoked in the process of expressing values, influences both the values that come forward and the conclusions that can be drawn on the basis of them" (Vatn, 2005, p. 210).
10. With regard to stakeholder involvement in strategies for corporate social responsibility, numerous examples are reported, for instance, for the tobacco industry (Burton & Rowell, 2002).
11. Thereby negotiation is understood as "a dynamic process in which preferences are endogenously constructed during the process itself, and where power relations are susceptible to change" (van den Hove, 2006).
12. In this sense, the participation of heterogeneous actors in knowledge production – in our case, in the sustainability assessment process – challenges the well-established role of science as the exclusive source of truth for political decision-making (Hoppe, 1999).
13. For suggestions on how sustainability assessments can incorporate the wider transition processes toward sustainability in which they are embedded, see Chapter 5 (Schilling et al., 2020). Furthermore, in Chapter 3, Meinherz, Fritz, and Schneider (2020) point to the need for experimental approaches.

References

Adelle, C., & Weiland, S. (2015). Sustainability assessment at the policy level. In *Handbook of Sustainability Assessment*. Cheltenham & Northhampton, MA: Edward Elgar Publishing, pp. 103–124.

Allen, A. (1998). Rethinking power. *Hypatia*, 13(1), 21–40. https://doi.org/10.1111/j.1527-2001.1998.tb01350.x.

Arendt, H. (1970). *On Violence*. San Diego, New York, London: Harcourt Brace jovanovich.

Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Institute of Planners*, 35(4), 216–224.

Avelino, F. (2017). Power in sustainability transitions: Analysing power and (dis)empowerment in transformative change towards sustainability. *Environmental Policy and Governance*, 27(6), 505–20. https://doi.org/10.1002/eet.1777.

Bachrach, P., & Baratz, M. (1962). Two faces of power. *American Political Science Review*, 56, 947–995.

Bäckstrand, K. (2003). Civic science for sustainability: Reframing the role of experts, policy-makers and citizens in environmental governance. *Global Environmental Politics*, 3(4), 24–41.

Beierle, T. C. (1999). Using social goals to evaluate public participation in environmental decisions. *Review of Policy Research*, 16(3–4), 75–103.

Bell, S., Morse, S., & Shah, R. A. (2012). Understanding stakeholder participation in research as part of sustainable development. *Journal of Environmental Management*, 101, 13–22. https://doi.org/10.1016/j.jenvman.2012.02.004.

Berg, M., & Lidskog, R. (2018). Deliberative democracy meets democratised science: A deliberative systems approach to global environmental governance. *Environmental Politics*, 27(1), 1–20. https://doi.org/10.1080/09644016.2017.1371919.

Binder, C. R., Baldi, M. G., Gex, B., & Massaro, E. (2020b). The sustainability solution space. In C. R. Binder, E. Massaro, & R. Wyss (eds.), *Sustainability Assessment in Urban Systems*. Cambridge University Press, (pp. 181–208).

Binder, C. R., Feola, G., & Steinberger, J. K. (2010). Considering the normative, systemic and procedural dimensions in indicator-based sustainability assessments in agriculture. *Environmental Impact Assessment Review*, 30(2), 71–81.

Blok, A. (2007). Experts on public trial: On democratizing expertise through a Danish consensus conference. *Public Understanding of Science*, 16(2), 163–182.

Bloomfield, D., Collins, K., Fry, C., & Munton, R. (1998). Deliberative and inclusionary processes: Their contributions to environmental governance. *ESRC DIPs in Environmental Decision-Making*, 17.

Brand, U. (2016). "Transformation" as a new critical orthodoxy: The strategic use of the term "transformation" does not prevent multiple crises. *GAIA-Ecological Perspectives for Science and Society*, 25(1), 23–27.

Burton, B., & Rowell, A. (2002). British American tobacco's socially responsible smoke screen. *PR Watch*, 9(4), 6–12.

Button, M., & Mattson, K. (1999). Deliberative democracy in practice: Challenges and prospects for civic deliberation. *Polity*, 31(4), 609–637.

Cashmore, M., & Richardson, T. (2013). Power and environmental assessment: Introduction to the special issue. *Environmental Impact Assessment Review*, 39, 1–4. https://doi.org/10.1016/j.eiar.2012.08.002.

Chambers, R. (1997). *Whose Reality Counts? Putting the First Last*. London: Intermediate Technology Publications Ltd (ITP).

Chilvers, J., & Kearnes, M. (2015). *Remaking Participation: Science, Environment and Emergent Publics*. Abington and New York: Routledge.

Claudel, M., Massaro, E., Santi, P., Murray, F., & Ratti, C. (2017). An exploration of collaborative scientific production at MIT through spatial organization and institutional affiliation. *PloS one*, 12(6), e0179334.

Collins, H. M., & Evans, R. (2002). The third wave of science studies: Studies of expertise and experience. *Social Studies of Science*, 32(2), 235–296. https://doi.org/10.1177/0306312702032002003.

Cook, B. R., Kesby, M., Fazey, I., & Spray, C. (2013). The persistence of "normal" catchment management despite the participatory turn: Exploring the power effects of competing frames of reference. *Social Studies of Science*, 43(5), 754–779. https://doi.org/10.1177/0306312713478670.

Cornwall, A. (2004). Spaces for transformation? Reflections on issues of power and difference in participation in development. In S. Hickey & G. Mohan (eds.), *Participation: From Tyranny to Transformation*. London and New York: Zed Books, pp. 75–91.

Cornwall, A. (2008). Unpacking 'participation': Models, meanings and practices. *Community Development Journal*, 43(3), 269–283. https://doi.org/10.1093/cdj/bsn010.

Cornwall, A., & Coelho, V. S. (2007). *Spaces for Change? The Politics of Citizen Participation in New Democratic Arenas*, vol. 4. Zed Books.

Dahl, R. A. (1957). The concept of power. *Systems Research and Behavioral Science*, 2(3), 201–215.

Digeser, P. (1992). The fourth face of power. *The Journal of Politics*, 54(4), 977–1007.

Dryzek, J. (1993). Policy analysis and planning: From science to argument. In F. Fischer & J. Forester (eds.), *The Argumentative Turn in Policy Analysis and Planning*. Durham, NC: Duke University Press.

Dryzek, J. (2000). *Deliberative Democracy and Beyond: Liberals, Critics, Contestations*. Oxford: Oxford University Press.

Dryzek, J., & Pickering, J. (2017). Deliberation as a catalyst for reflexive environmental governance. *Ecological Economics*, 131, 353–360.

Eyben, R., Harris, C., & Pettit, J. (2006). Introduction: exploring power for change. *IDS Bulletin*, 37(6), 1–10.

Farrell, K. N. (2011). Snow White and the wicked problems of the west: A look at the lines between empirical description and normative prescription. *Science, Technology, & Human Values*, 36(3), 334–361.

Felt, U. (2009). *Knowing and living in academic research: Convergences and heterogeneity in research cultures in the European context*. Prague: Institute of Sociology of the Academy of Sciences of the Czech Republic.

Fiorino, D. J. (1989). Environmental risk and democratic process: A critical review. *Columbia Journal of Environmental Law*, 14, 501.

Foucault, M. (1977). *Discipline and Punish: The Birth of the Prison*. New York: Vintage Books.

Frame, B., & Brown, J. (2008). Developing post-normal technologies for sustainability. *Ecological Economics*, 65(2), 225–241.

Fritz, L. (2018). (De-)constructing participation in transdisciplinary sustainability research: A critical review of key concepts. In J. Engelschalt, A. Maibaum, F. Engels, & J. Odenwald (eds.), *Schafft*

Wissen–Gemeinsames und geteiltes Wissen in Wissenschaft und Technik (SSOAR). München: SSOAR, pp. 106–124.

Fritz, L., & Binder, C. R. (2018). Participation as relational space: A critical approach to analysing participation in sustainability research. *Sustainability*, 10(8), 2853. https://doi.org/10.3390/su10082853.

Funtowicz, S. O., & Ravetz, J. R. (1993). The emergence of post-normal science. In R. Von Schomberg (ed.), *Science, Politics and Morality*. Dordrecht: Springer, pp. 85–123.

Garmendia, E., & Stagl, S. (2010). Public participation for sustainability and social learning: Concepts and lessons from three case studies in Europe. *Ecological Economics*, 69(8), 1712–1722. https://doi.org/10.1016/j.ecolecon.2010.03.027.

Gaventa, J. (2006). Finding the spaces for change: A power analysis. *IDS Bulletin*, 37(6), 23–33.

Gaventa, J., & Cornwall, A. (2001). Power and knowledge. In P. Reason & H. Bradbury (eds.), *Handbook of Action Research*, Concise Paperback Edition. London, Thousand Oaks, New Delhi: Sage, pp. 72–81.

Gaventa, J., & Cornwall, A. (2008). Power and knowledge. In P. Reason & H. Bradbury (eds.), *The Sage Handbook of Action Research: Participative Inquiry and Practice*, 2nd edition. London, Thousand Oaks, New Delhi: Sage, pp. 172–189.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994). *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. Los Angeles: Sage.

Gibson, B., Hassan, S., & Tansey, J. (2013*). Sustainability Assessment: Criteria and Processes*. London: Routledge.

Glass, J. H., Scott, A. J., & Price, M. F. (2013). The power of the process: Co-producing a sustainability assessment toolkit for upland estate management in Scotland. *Land Use Policy*, 30(1), 254–265. https://doi.org/10.1016/j.landusepol.2012.03.024.

Habermas, J. H. (1981). *Theorie des kommunikativen Handelns*. Frankfurt: Suhrkamp.

Hage, M., Leroy, P., & Petersen, A. C. (2010). Stakeholder participation in environmental knowledge production. *Futures*, 42(3), 254–264.

Halla, P. & Binder, C. R. (2020). Sustainability Assessment: Introduction and Framework. In C.R. Binder, E. Massaro, & R. Wyss (eds.), *Sustainability Assessment in Urban Systems*. Cambridge University Press, (pp. 7–29).

Hardy, C., & Clegg, S. R. (2006). Some dare call it power. In S. R. Clegg, C. Hardy, T. B. Lawrence & W. R. Nord (eds.), *The SAGE Handbook of Organization Studies*. London: Sage Publications, pp. 754–775.

Hartz-Karp, J., Pope, J., & Petrova, S. (2015). A deliberative collaborative governance approach to sustainability assessment. In A. Morrison-Saunders, J. Pope, & A. Bond (eds.), *Handbook of Sustainability Assessment*, Cheltenham and Northhampton, MA: Edward Elgar, pp. 375–402.

Haugaard, M. (2002). *Power: A Reader*. Manchester Manchester University Press.

Haugaard, M. (2003). Reflections on seven ways of creating power. *European Journal of Social Theory*, 6(1), 87–113.

Haugaard, M. (2012). Rethinking the four dimensions of power: Domination and empowerment. *Journal of Political Power*, 5(1), 33–54.

Hayward, C. R. (2000). *De-facing Power*. New York: Cambridge University Press.

Hegger, D., & Dieperink, C. (2015). Joint knowledge production for climate change adaptation: What is in it for science? *Ecology and Society*, 20(4). www.ecologyandsociety.org/vol20/iss4/art1/.

Hirsch Hadorn, G., Bradley, D., Pohl, C., Rist, S., & Wiesmann, U. (2006). Implications of transdisciplinarity for sustainability research. *Ecological Economics*, 60(1), 119–128. https://doi.org/10.1016/j.ecolecon.2005.12.002.

Holmes, T. (2001). A participatory approach in practice: Understanding fieldworkers' use of participatory rural appraisal in ActionAid The Gambia. *IDS Working Papers*, 123.

Holmes, T., & Scoones, I. (2000). Participatory environmental policy processes: Experiences from North and South. IDS Working Paper, Institute of Development Studies, University of Sussex. Brighton.

Hoppe, R. (1999). Policy analysis, science and politics: From "speaking truth to power" to "making sense together." *Science and Public Policy*, 26(3), 201–210. https://doi.org/10.3152/147154399781782482.

Igelsböck, J. (2016). Designing "integration machines." In B-J. Krings, H. Rodríguez, & A. Schleisiek (eds.), *Scientific Knowledge and the Transgression of Boundaries*. Wiesbaden: Springer, pp.133–160.

Jacobs, M. (1997). Environmental valuation, deliberative democracy and public decision-making institutions. *Valuing Nature*, 211–231.

Jasanoff, S. (2003). Technologies of humility: Citizen participation in governing science. *Minerva*, 41 (3), 223–244.

Jasanoff, S. (2004). *States of Knowledge: The Co-production of Science and the Social Order*. London and New York: Routledge.

Kallis, G., Hatzilacou, D., Mexa, A., Coccossis, H., & Svoronou, E. (2009). Beyond the manual: Practicing deliberative visioning in a Greek island. *Ecological Economics*, 68(4), 979–989.

Kallis, G., Videira, N., Antunes, P., et al. (2006). Participatory methods for water resources planning. *Environment and Planning C: Government and Policy*, 24(2), 215–234.

Kasemir, B. (2003). *Public Participation in Sustainability Science: A Handbook*. Cambridge University Press.

Kates, R. W., Clark, W. C., Corell, R., et al. (2001). Sustainability science. *Science*, 292(5517), 641–642.

Kemp, R., & Martens, P. (2007). Sustainable development: How to manage something that is subjective and never can be achieved? *Sustainability: Science, Practice and Policy*, 3(2), 5–14.

Klenk, N., & Meehan, K. (2015). Climate change and transdisciplinary science: Problematizing the integration imperative. *Environmental Science & Policy*, 54(Supplement C), 160–167. https://doi.org/10.1016/j.envsci.2015.05.017.

Klenk, N., Reed, M. G., Lidestav, G., & Carlsson, J. (2013). Models of representation and participation in model forests: Dilemmas and implications for networked forms of environmental governance involving indigenous people. *Environmental Policy and Governance*, 23(3), 161–176.

Kothari, U., & Cooke, B. (Eds.) (2001). Participatory development: Power, knowledge and social control. In *Participation: The New Tyranny?* London: Zed Books, pp. 139–152.

Kristiansen, M., & Bloch-Poulsen, J. (2013). Participatory knowledge production and power. In L. Phillips, M. Kristiansen, M. Vehviläinen, & E. Gunnarsson (eds.), *Knowledge and Power in Collaborative Research: A Reflexive Approach*. Taylor & Francis, pp. 193–212.

Kropp, C. (2013). Demokratische Planung der Klimaanpassung? Über die Fallstricke partizipativer Verfahren im expertokratischen Staat. In A. Knierim, S. Baasch, & M. Gottschick (eds.), *Partizipation und Klimawandel–Ansprüche, Konzepte und Umsetzung* München: Oekonom, pp. 55–74.

Latour, B. (2005). *Reassembling the Social: An Introduction to Actor-Network-Theory*, vol. 1. Oxford: Oxford University Press.

Lawrence, D. P. (2013). *Impact Assessment: Practical Solutions to Recurrent Problems and Contemporary Challenges*. Wiley Online Library. DOI 10.1002/9781118678381.

Leeuwis, C. (2000). Reconceptualizing participation for sustainable rural development: Towards a negotiation approach. *Development and Change*, 31(5), 931–959.

Lövbrand, E., & Stripple, J. (2013). Bringing governmentality to the study of global climate governance. In J. Stripple & H. Bulkeley (eds.), *Governing the Climate: New Approaches to Rationality, Power and Politics*. Cambridge University Press, pp. 27–41.

Lukes, S. (1974). Power: A *Radical View*. London and New York: Macmillan.

Martinez-Alier, J., Munda, G., & O'Neill, J. (1998). Weak comparability of values as a foundation for ecological economics. *Ecological Economics*, 26(3), 277–286.

McCool, S. F., & Stankey, G. H. (2004). Indicators of sustainability: Challenges and opportunities at the interface of science and policy. *Environmental Management*, 33(3), 294–305.

McCullum, C., Pelletier, D., Barr, D., Wilkins, J., & Habicht, J.-P. (2004). Mechanisms of power within a community-based food security planning process. *Health Education & Behavior*, 31(2), 206–222.

Meinherz, F., Fritz, L., & Schneider, F. (2020). How Values Play into Sustainability Assessments: Challenges and a Possible Way Forward. In C. R. Binder, E. Massaro, & R. Wyss (eds.), *Sustainability Assessment in Urban Systems*. Cambridge University Press, (pp. 65–86).

Merino-Saum, A. (2020). Assessing sustainability through participatory multi-criteria approaches (PMCAs): An updated comparative analysis. In C. R. Binder, E. Massaro, & R. Wyss (eds.), *Sustainability Assessment in Urban Systems*. Cambridge University Press, (pp. X–X).

Merton, R. K. (1973). *The Sociology of Science: Theoretical and Empirical Investigations*. University of Chicago Press.

Mielke, J., Vermassen, H., Ellenbeck, S., Milan, B. F., & Jaeger, C. (2016). Stakeholder involvement in sustainability science: A critical view. *Energy Research & Social Science*, 17, 71–81.

Morrison-Saunders, A., Pope, J., Bond, A., & Retief, F. (2014). Towards sustainability assessment follow-up. *Environmental Impact Assessment Review*, 45, 38–45.

Mouffe, C. (2000). *Deliberative Democracy or Agonistic Pluralism*. Vienna: Institute for Advanced Studies.

Munda, G. (2006). Social multi-criteria evaluation for urban sustainability policies. *Land Use Policy*, 23(1), 86–94. https://doi.org/10.1016/j.landusepol.2004.08.012.

Muro, M., & Jeffrey, P. (2008). A critical review of the theory and application of social learning in participatory natural resource management processes. *Journal of Environmental Planning and Management*, 51(3), 325–344.

O'Brien, F., & Meadows, M. (2001). How to develop visions: A literature review, and a revised CHOICES approach for an uncertain world. *Systemic Practice and Action Research*, 14(4), 495–515.

Partzsch, L. (2015). Kein Wandel ohne Macht: Nachhaltigkeitsforschung braucht ein mehrdimensionales Machtverständnis. *GAIA-Ecological Perspectives for Science and Society*, 24(1), 48–56.

Pellizzoni, L. (2003). Uncertainty and participatory democracy. *Environmental Values*, 12(2), 195–224. https://doi.org/0.3197/096327103129341298.

Pellow, D. N. (1999). Negotiation and confrontation: Environmental policymaking through consensus. *Society & Natural Resources*, 12(3), 189–203.

Polatidis, H., Haralambopoulos, D. A., Munda, G., & Vreeker, R. (2006). Selecting an appropriate multi-criteria decision analysis technique for renewable energy planning. *Energy Sources*, Part B, 1(2), 181–193.

Popa, F., Guillermin, M., & Dedeurwaerdere, T. (2015). A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science. *Futures*, 65, 45–56.

Power, M. (1997). *The Audit Society: Rituals of Verification*. Oxford, New York: Oxford University Press.

Raik, D. B., Wilson, A. L., & Decker, D. J. (2008). Power in natural resources management: An application of theory. *Society and Natural Resources*, 21(8), 729–739.

Rametsteiner, E., Pülzl, H., Alkan-Olsson, J., & Frederiksen, P. (2011). Sustainability indicator development: Science or political negotiation? *Ecological Indicators*, 11(1), 61–70.

Rauschmayer, F., van den Hove, S., & Koetz, T. (2009). Participation in EU biodiversity governance: How far beyond rhetoric? *Environment and Planning C: Government and Policy*, 27(1), 42–58.

Reed, M. S., Graves, A., Dandy, N., et al. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management*, 90(5), 1933–1949.

Renn, O., & Schweizer, P.-J. (2009). Inclusive risk governance: concepts and application to environmental policy making. *Environmental Policy and Governance*, 19(3), 174–185. https://doi.org/10.1002/eet.507.

Robinson, J. (2004). Squaring the circle? Some thoughts on the idea of sustainable development. *Ecological Economics*, 48(4), 369–384.

Rosendahl, J., Zanella, M. A., Rist, S., & Weigelt, J. (2015). Scientists' situated knowledge: Strong objectivity in transdisciplinarity. *Futures*, 65, 17–27. https://doi.org/10.1016/j.futures.2014.10.011.

Rubio, F. D., & Baert, P. (2012). The politics of knowledge: An introduction. In F.D. Rubio & P. Baert (eds.), *The Politics of Knowledge*. Oxon: Routledge, pp. 1–10.

Sala, S., Ciuffo, B., & Nijkamp, P. (2015). A systemic framework for sustainability assessment. *Ecological Economics*, 119, 314–325. https://doi.org/10.1016/j.ecolecon.2015.09.015.

Sanderson, I. (1999). Participation and democratic renewal: from 'instrumental' to 'communicative rationality'? *Policy & Politics*, 27(3), 325–341.

Santos, R., Antunes, P., Baptista, G., Mateus, P., & Madruga, L. (2006). Stakeholder participation in the design of environmental policy mixes. *Ecological Economics*, 60(1), 100–110.

Schikowitz, A. (2016). Choreographies of togetherness: Re-ordering collectivity and individuality in transdisciplinary sustainability research in Austria (Doctoral thesis). Wien.

Schilling, T., Mühlemeier, S., Wyss, R., & Binder, C.R. (2020). A Concept for Sustainability Transition Assessment (STA): A Dynamic Systems Perspective Informed by Resilience Thinking. In C. R. Binder, E. Massaro, & R. Wyss (eds.), *Sustainability Assessment in Urban Systems*. Cambridge University Press, pp. 123–138.

Schneider, F. (2020). A mixed-method, dialogue based approach to sustainability assessments: Fostering learning towards sustainable development. In C. R. Binder, E. Massaro, & R. Wyss (eds.), *Sustainability Assessment in Urban Systems*. Cambridge University Press, pp. 141–160.

Schneider, F., Bonriposi, M., Graefe, O., et al. (2015). Assessing the sustainability of water governance systems: The sustainability wheel. *Journal of Environmental Planning and Management*, 58(9), 1577–1600.

Schneider, F., & Buser, T. (2018). Promising degrees of stakeholder interaction in research for sustainable development. *Sustainability Science*, 13(1), 129–142. https://doi.org/10.1007/s11625-017-0507-4.

Sharifi, A., & Murayama, A. (2013). A critical review of seven selected neighborhood sustainability assessment tools. *Environmental Impact Assessment Review*, 38, 73–87.

Siew, T. F., Aenis, T., Spangenberg, J. H., et al. (2016). Transdisciplinary research in support of land and water management in China and Southeast Asia: Evaluation of four research projects. *Sustainability Science*, 813–829. https://doi.org/10.1007/s11625-016-0378-0.

Sinclair, A. J., Diduck, A. P., Vespa, M., Morrison-Saunders, A., Pope, J., & Bond, A. (2015). Public participation in sustainability assessment: Essential elements, practical challenges and emerging directions. In A. Morrison-Saunders, J. Pope, & A. Bond (eds.), *Handbook of Sustainability Assessment*. Camberley: Edward Elgar, pp. 349–375.

Spash, C. L. (2007). *Deliberative Monetary Valuation (DMV) in Theory.* CSIRO Sustainable Ecosystems Working Paper Series.

Spash, C. L., & Vatn, A. (2006). Transferring environmental value estimates: Issues and alternatives. *Ecological Economics*, 60(2), 379–388.

Stauffacher, M., Flüeler, T., Krütli, P., & Scholz, R. W. (2008). Analytic and dynamic approach to collaboration: A transdisciplinary case study on sustainable landscape development in a Swiss prealpine region. *Systemic Practice and Action Research*, 21(6), 409–422.

Stave, K. A. (2002). Using system dynamics to improve public participation in environmental decisions. *System Dynamics Review*, 18(2), 139–167.

Stirling, A. (2008). "Opening up" and "closing down" power, participation, and pluralism in the social appraisal of technology. *Science, Technology & Human Values*, 33(2), 262–294.

Stirling, A., & Mayer, S. (1999). *Rethinking Risk: A Pilot Multicriteria Mapping of a Genetically Modified Crop in Agricultural Systems in the UK*. Brighton: Science Policy Research Unit, University of Sussex.

Tewdwr-Jones, M., & Thomas, H. (1998). Collaborative action in local plan-making: Planners' perceptions of "planning through debate." *Environment and Planning B: Planning and Design*, 25(1), 127–144.

Turnhout, E. (2009). The effectiveness of boundary objects: The case of ecological indicators. *Science and Public Policy*, 36(5), 403–412.

van Asselt Marjolein, B. A., & Rijkens-Klomp, N. (2002). A look in the mirror: Reflection on participation in Integrated Assessment from a methodological perspective. *Global Environmental Change*, 12(3), 167–184.

van den Hove, S. (2006). Between consensus and compromise: Acknowledging the negotiation dimension in participatory approaches. *Land Use Policy*, 23(1), 10–17. https://doi.org/10.1016/j.landusepol.2004.09.001.

Vatn, A. (2005). Rationality, institutions and environmental policy. *Ecological Economics*, 55(2), 203–217.

Vennix, J. A. (1996). *Group Model Building: Facilitating Team Learning Using System Dynamics*. Chichester and New York: John Wiley and Sons.

Videira, N., Antunes, P., Santos, R., & Lobo, G. (2006). Public and stakeholder participation in European water policy: A critical review of project evaluation processes. *Environmental Policy and Governance*, 16(1), 19–31.

Videira, N., Antunes, P., Santos, R., & Lopes, R. (2010). A participatory modelling approach to support integrated sustainability assessment processes. *Systems Research and Behavioral Science*, 27(4), 446–460.

Videira, N., Lopes, R., Antunes, P., Santos, R., & Casanova, J. L. (2012). Mapping maritime sustainability issues with stakeholder groups. *Systems Research and Behavioral Science*, 29(6), 596–619.

Waas, T., Hugé, J., Block, T., Wright, T., Benitez-Capistros, F., & Verbruggen, A. (2014). Sustainability assessment and indicators: Tools in a decision-making strategy for sustainable development. *Sustainability*, 6(9), 5512–5534.

Weber, M. (1972). *Wirtschaft und Gesellschaft*. 5. rev. edition. Tübingen: Mohr.

Whitmarsh, L., Swartling, A. G., & Jäger, J. (2009). Participation of experts and non-experts in a sustainability assessment of mobility. *Environmental Policy and Governance*, 19(4), 232–250.

Wiek, A., & Binder, C. (2005). Solution spaces for decision-making: A sustainability assessment tool for city-regions. *Environmental Impact Assessment Review*, 25(6), 589–608.

Wynne, B. (2007). Public participation in science and technology: Performing and obscuring a political–conceptual category mistake. *East Asian Science, Technology and Society*, 1(1), 99–110.

Wynne, B., & Felt, U. (2007). *Taking European Knowledge Society Seriously: Report of the Expert Group on Science and Governance to the Science, Economy and Society Directorate, Directorate-General for Research, European Commission*. Luxembourg: Office for Official Publications of the European Communities.

Zurek, M. B., & Henrichs, T. (2007). Linking scenarios across geographical scales in international environmental assessments. *Technological Forecasting and Social Change*, 74(8), 1282–1295.

5 Manuscript V

Bibliographic details:

Fritz, L.; Binder, C.R. 2020. Whose knowledge, whose values? An empirical analysis of power in transdisciplinary sustainability research. *European Journal of Futures Research.* DOI: 10.1186/s40309-020-0161-4

Proof version of the article.

Contribution of the doctoral candidate:

The doctoral candidate principally designed and carried out the research as well as wrote the manuscript. The doctoral candidate developed the conceptual perspective, collected the empirical data and performed the analysis. The co-author supported the interpretation of findings and provided critical feedback on the manuscript.

RESEARCH ARTICLE

Open Access

Whose knowledge, whose values? An empirical analysis of power in transdisciplinary sustainability research

Livia Fritz[*] and Claudia R. Binder

Abstract

The participation of practitioners in transdisciplinary sustainability research has been heralded as a promising tool for producing 'robust' knowledge and engendering societal transformations. Although transdisciplinary approaches have been advanced as an effective avenue for generating knowledge positioned to question and transform an unsustainable status quo, the political and power dimensions inherent to such research have hardly been discussed. In this article, we scrutinise the constitution of participation in transdisciplinary research through a power lens. Guided by social theories of power and a relational understanding of participation, we analyse how diverse actors equipped with a variety of material and ideational sources wield power over the subjects, objects, and procedures of participation. We applied a qualitative meta-analysis of five transdisciplinary projects from a major German research funding programme in the field of sustainability to unveil the ways in which the funding body, researchers, and practitioners exercise instrumental, structural, and discursive power over (i) actor selection and (re-)positioning, (ii) agenda setting, and (iii) rule setting. We found that researchers primarily exert instrumental power over these three elements of participation, whereas practitioners as well as the funding body wield primarily structural and discursive power. By elucidating tacit and hidden power dynamics shaping participation in transdisciplinary research, this article provides a basis for improving process design and implementation as well as developing targeted funding instruments. The conclusions also provide insights into barriers of participatory agenda setting in research practice and governance.

Keywords: Participation, Power, Transdisciplinary research, Transformation, Discourses, Science policy and funding

Introduction

The United Nations' '2030 Agenda for Sustainable Development' is a prominent example of how a rethinking of our ways of researching and governing sustainability problems has become a priority on the international policy agenda [1]. In the face of complex and highly interconnected problems such as those embodied in the Sustainable Development Goals, calls for new, often participatory approaches to science and knowledge production have gained momentum [2]. Such proposals are generally rooted in the perspective that the monopoly of science over the production of trustworthy knowledge that should 'speak truth to power' is deficient in the face

of complex problems [3]. In response to these 'grand' societal challenges [4], science policy and research funding programmes under the umbrella of 'responsible research and innovation' increasingly ask researchers to co-create knowledge with policymakers, businesses, and civil society actors [5, 6], thus extending knowledge production to actors beyond the scientific realm.

In sustainability research, transdisciplinary (TD) approaches that incorporate practitioners and their expertise into the research process have emerged as promising tools for ensuring relevant research agendas,[1] producing

---

[1]A broad range of terms has been used to designate those participating, including extra-scientific actors, stakeholders, practice actors, non-academic partners, and non-certified experts. For simplicity, we rely on the notion of 'practitioner' in a broad sense to designate any type of extra-scientific actor. Although these actors might have academic training, they do not conduct research as their main profession.

* Correspondence: livia.fritz@epfl.ch
École Polytechnique Fédérale de Lausanne (EPFL), Laboratory for
Human-Environment Relations in Urban Systems (HERUS), Station 2, 1015
Lausanne, Switzerland

'robust' knowledge and engendering societal change towards desirable futures [7–9]. Societal goals commonly associated with TD research relate to the empowerment of certain ideas as well as the participating practitioners ('power to') [10, 11] or to the stimulation of societal learning ('power with') [12]. In order to unleash this potential, design principles of TD research allude to ideals of 'co-leadership' and interactions between researchers and practitioners on 'equal footing' [11–13], thus assuming a 'symmetry of enlightenment' between researchers and practitioners and implying balanced power relations between the heterogeneous participants [14]. Such ideals also manifest in popular conceptualisations of participation in TD scholarship in terms of practitioners' degree of influence on the collaboration [15], thereby taking up the quest for power redistribution to the 'powerless' as represented in Arnstein's much-cited ladder of participation [16].

However, living up to these ideals in the practice of TD sustainability research can be challenging. Desired sustainable futures and their associated pathways are hotly contested [17, 18], and recognising participation as relational processes [19, 20] that are co-produced with the socio-political context [21] demands the disclosure of the negotiations, conflicts, and power dynamics that shape these processes. As Nowotny et al. put it with regard to the space between research and practice, called the 'agora': 'The agora, therefore, is not an empty or an anarchic place; […] Of course, it would be naïve to claim the agora is devoid of power structures and power struggles. Power certainly matters' [22].

In line with this view of the significance of power at the research-practice interface, scholars have increasingly stressed the need to recognise the entanglements of power and participation in TD research [10, 23–25]. Previous studies have examined how power relations among researchers [26], between researchers and practitioners, and among practitioners influence processes and outcomes of participation in research [10, 27, 28]. Against the backdrop of funding contexts and the wider academic system [29], the unequal distribution of financial and time resources has been found to engender power asymmetries between researchers and practitioners in TD projects [24, 30, 31]. Moreover, in the context of wider macro-societal power relations, the dominance of individual participants has been reported as another manifestation of power occurring in both single participatory events [32] and over the course of longer-term TD processes [33]. Building on and combining diverse knowledge sources has also highlighted the varying degrees of reliability, trustworthiness, and authority which they are assigned [24, 34, 35]. Such reflections on power asymmetries between diverse participants have impacted the very conceptualisation of TD, as how strongly different practitioners influence the problem definition, the choice of knowledge production approach(es),

and related decisions have been advanced as definitive criteria in distinguishing 'participatory' vs. 'consulting' approaches [36].

Despite the growing recognition that 'power matters' and pervades TD processes [37], empirical explorations of its role are limited, and existing studies have rarely been grounded in explicitly articulated understandings of power [38]. Among the very few studies that have offered empirical insights into how power shapes researcher-practitioner interactions, most have relied on single case studies and the perceptions of researchers, thus neglecting the practitioners' experiences. In this article, we scrutinise the constitution of participation practices in TD research through a power lens in an effort to illuminate the often tacit and hidden power relations shaping them. Guided by social theories of power and a relational understanding of participation, we ask how and on what basis different actors wield power over the subjects, objects, and procedures of participation in TD research. By means of a qualitative meta-analysis of five TD projects from a major German funding programme in the field of sustainability research, we unveil the ways in which the funding body, researchers, and practitioners wield instrumental, structural, and discursive power over (i) the actors, their roles, and respective positioning; (ii) the setting of the research agenda and the definition of issues; and (iii) the setting of rules governing their interactions. Through an integrated consideration of the different actors' exercise of power, we elucidate power dynamics and moments of shifting power relations. In assessing the very practices of participation that lie at the core of various approaches to researching and governing sustainability problems, this article contributes to critical sustainability and future-orientated studies that are aware of power dynamics and critical of their own practices. A better understanding of the often-hidden workings of power in TD research can facilitate a conscious reflection on power dynamics and thus contribute to more reflexive process design and implementation as well as provide guidelines for targeted funding structures.

The remainder of this article is organised as follows: Section 2 lays the conceptual and theoretical foundations, introducing dimensions and sources of power and relating them to key elements of participation. Section 3 describes the methods and the empirical materials used in this research. Building on the proposed theoretical lens, Section 4 presents findings of how different actors exercise power over participation practices, and then, we critically discuss theoretical and practical implications for research practice and governance in Section 5.

Theoretical framework
Our theoretical framework rests on two pillars: (i) relational theories of power and (ii) conceptual elements of participation.

Conceptualising power

Power is a contested concept that is filled with a profusion of meanings. In this article, we rely on relational theories of power and follow approaches that integrate both structures and actors in the analysis of power. Following Fuchs and Glaab [39] and Partzsch and Fuchs [40], we consider three dimensions of power, namely instrumental, structural, and discursive power.[2] Adopting this multidimensional framework enables us to study both the exercise of power by actors and the power embodied in established institutions and norms [43]. The exercise of power rests on different sources of power or varying combinations of sources. When needed, we complement conceptions developed for political decision-making processes with literature concerning power in participatory development research and emphasise particularly pertinent aspects regarding participation in knowledge production processes [42].

Dimensions and sources of power over

Power over refers to power that is wielded over actors, structures, and discourses. Weber [44] established a widely used definition of power as the realisation of one's own will in asymmetrical relations. Power over is often distinguished along three dimensions [40]:

Instrumental power refers to the classic understanding proposed by Dahl [45], who emphasised the direct influence of an actor over another actor and described power as the ability of actor A to get actor B to do something that B might not otherwise do. The capacity of actors to mobilise material sources in order to influence a decision or process is at the core of this dimension [46]. Instrumental power is visible in decision-making processes and formal rules [47], as well as in the influence of actors on formal political decision-makers, such as via lobbying [39].

Structural power builds on the work of Bachrach and Baratz [48] and focuses on the material and structural conditions influencing actors' decisions. In this broader notion of power, structural-material power predetermines processes of decision making and non-decision making by shaping both the options and behaviour of actors. This concept focuses on the material and ideational structures that shape actors' decision options and allocate indirect and direct influence [40]. While from the perspective of instrumental power, the absence of certain actors from a process or debate appears to be due to these actors' own inaction, considering structural power allows us to understand the same observation as the result of a mechanism of exclusion and hence an exercise of power. For instance, structural

power is exercised by restricting participation in decision-making to issues that align with the status quo [49]. This form of power is exercised through excluding or discrediting the concerns of others [47]. Structural power is also observed when the rules of the game allow some actors a smooth access to the process while hampering others' meaningful participation. In order to be heard, initially excluded actors who are granted access to a process may need to learn and adopt the language, behaviour, or knowledge of the powerful and incumbent actors in this process [46].

Discursive power is derived from Lukes' [50] 'radical view' of power that can also be exerted if actor B consciously wants to do what actor A desires. Discursive power is exercised through influencing the desires and beliefs of B [51]. This dimension refers to invisible and subtle forms of power [47], which rest primarily on ideational sources, such as values, norms, and ideas, when trying to influence an agenda or a process [39]. Knowledge and the control of it are key sources for the exercise of discursive power [46]. Relying on Foucault's [52] understanding of power, also the construction of subjectivity and individuality constitute an exercise of discursive power. Work on discursive power has highlighted that power not only pursues and serves interests but also generates them in the first place. This dimension stresses the role of accepted truths and knowledge about desirable developments, thereby uncovering the interrelations between discursive power, legitimacy, and authority [40].

As briefly indicated in the above descriptions, each of the three dimensions of instrumental, structural, and discursive power draws on the conditions and resources necessary to exercise power. While the literature on power offers a myriad of categorisations of these so-called sources of power, scholars mostly concur in broadly differentiating between material and ideational sources of power [43].

Material sources of power can be of actor-specific or structural nature and include the financial means that actors hold as well as their access to natural and technological assets such as communication infrastructures [43]. Material sources provide actors not only with direct decision-making power and agenda-setting power, but also the structural contexts that equip them with direct rule-setting or regulatory power. Agenda-setting power and rule-setting power overlap if agendas are about rules [39].

Ideational sources of power derive from social constructs such as ideas, values, and norms [43]. In the context of this study, sustainability and sustainable development figure as such constructs. Similarly, perceptions of actors as legitimate, knowledgeable, or trustworthy can provide such sources of power. Like material sources, ideational sources of power are relative. For instance, the power of an idea—e.g., stakeholder participation in science—exists only in relation to other ideas—e.g., objective

---

[2]We acknowledge that the multidimensional nature of power includes not only diverse facets of power over, but also power to and power with [41]. However, in this article, we focus exclusively on different facets of power over, partly based on [42], and do not address intersections with power with and power to. For further elaboration, please see [42].

science. *Authority, legitimacy, and knowledge* constitute crucial sources of ideational power allowing an actor's power to increase in relation to others. Importantly, these sources of ideational power are interrelated. For example, knowledge becomes more powerful when it is linked to legitimacy, and actors tend to be perceived as more legitimate when they invoke certain kinds of knowledge [39]. *Authority* can be described as the socially acknowledged right to make judgments, take decisions, or conduct actions [53], and it is formed by the relative status or position within the wider institutional context of the participating actors [54]. *Legitimacy* refers to an actor's ability to publicly represent a group of actors or speak on behalf of an issue. An actor can rely on legitimacy by invoking norms and values that are widely recognised or considered attractive. Hence, an actor with legitimacy draws their power from the status of the values they represent [54]. Likewise, the legitimacy of particular processes and measures is linked to their fit with dominant societal norms and may be enhanced through the framing of policy options or decisions in terms of such norms. The activation of attractive norms provides an important source of power to actors in pursuit of their interests [39]. *Knowledge* in the sense of the processing of information constitutes another ideational source of power [39]. Being attentive to the situatedness of knowledge [55] requires the acknowledgement that the different actors' status as credible and 'certified' experts affects what is considered trustworthy knowledge, fact, or even truth [56, 57].

Conceptualising participation

Our perspective on participation encompasses the involvement of practitioners and the inclusion of their expertise in TD research. For the development of a power lens on participation in TD, we build on conceptual elements that have been developed in participation studies, particularly in constructivist science and technology studies.

Following the 'ecologies of participation' approach [21], participation practices comprise three main elements: subjects (who), objects (what), and models of participation (how) (Fig. 1). 'Subjects' denotes the actors who take part in and enact a participation practice. 'Objects' refers to the issues at stake and the concerns that are debated and formed in the participation practice. 'Models of participation' refers to the procedural formats of the participation practice.

These three elements of participation—subjects (who), objects (what), and procedures (how)—are co-produced with the wider societal contexts as well as the knowledge and political cultures in which they are embedded [21, 58]. Conceiving of them as co-produced allows us to be attentive to power in the making of participation in TD research. Norms, discourses, and structures in the respective academic and practice contexts in which a TD project is set can shape power relations within that project in important ways. At the same time, a project and some of the participating actors implicitly or explicitly aim at altering or maintaining the surrounding structures, discourses, and norms or do so in unintended ways [59] (Fig. 1).

We assume that each of the constituent elements (subject, object, procedures) of participation practices in TD research provides opportunities for the exercise of power. Regarding 'subjects', power is wielded to include or exclude actors in a process and to convey status and roles among participants. Regarding the 'objects', setting the scope of investigated issues provides opportunities to
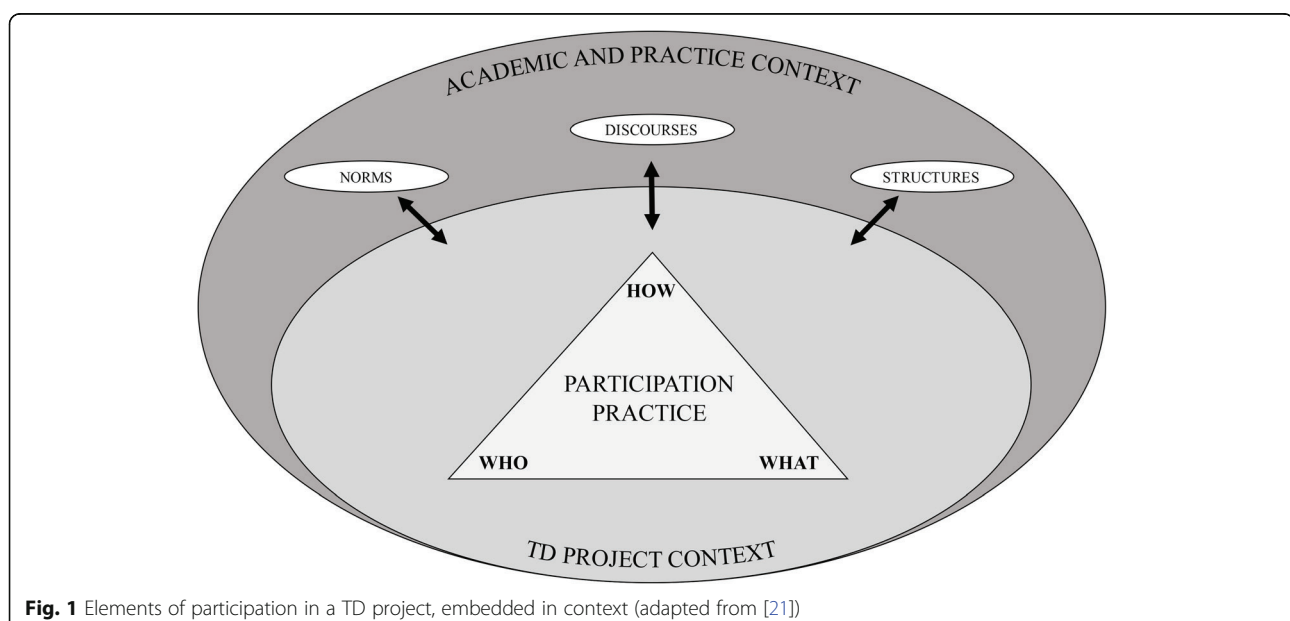

Fig. 1 Elements of participation in a TD project, embedded in context (adapted from [21])

Table 1 Forms of power in relation to elements of participation (authors' elaboration)

Element of participation/ dimension of power	Who (subjects) Refers to the actors interacting	What (objects) Refers to the agenda of interactions	How (procedures) Refers to the rules of interactions
Instrumental	Who decides who participates and who directly influences this decision?	Who sets the agenda of the process?	Who sets the rules of the process and controls their enactment?
Structural	In what ways do structural conditions predetermine the selection and participation of actors?	In what ways do structural conditions circumscribe the issues which enter the agenda?	In what ways do structural conditions predetermine the formats of participation?
Discursive	In reference to which norms and ideas are actors selected and positioned in the process?	How do ideas and norms shape the framing of issues and agendas?	To what norms, ideas, or standards do the formats of participation allude?
Sources	Ideational and material		
Actors	Funding body, researchers, practitioners		

wield power. Regarding the 'procedures' of how participation takes place, setting the rules of interaction and deciding on methods and locations constitute arenas for power exercise that determine who can meaningfully engage in the process. While analytically separate, knock-on effects and path dependencies of power dynamics are conceivable across the elements constituting participation. For instance, the kind of power that different actors exercise regarding the 'procedures' might circumscribe some actors' options to shape the 'objects' of participation. Guided by this framework, we analyse how and on what basis different actors in TD projects exercise instrumental, structural, and discursive power over each of these elements of participation (Table 1). In the analysis, we distinguish three types of actors potentially exercising power—researchers, practitioners, and the funding body—and enquire into shifts in power relations between these actors in the constitution of participation.

Materials and methods
Programme context and project selection
This article is based on a meta-analysis of five on-going sustainability research projects that are part of a German research funding programme. The programme aims to foster societally relevant research that contributes to sustainable development. In order be eligible for funding, research projects must be interdisciplinary and include societal actors in the research process. Thus, the programme provides an empirical site for studying TD and participatory practices in the field of sustainability research. The funding programme was scientifically accompanied by a research project of which this study was part and which was conducted by an interdisciplinary group of researchers. The selection of projects for this study was based on the criterion of maximum diversity in terms of (i) institutions and disciplines, (ii) topics, and (iii) types of practitioners involved. Consequently, the analysed projects encompass a variety of sustainability issues and include researchers from diverse disciplines

as well as practitioners with multifaceted professional backgrounds. The projects are part of two funding rounds (Table 2).

Data collection
We combined two types of materials. Firstly, we collected documents, including research proposals as well as programme documents such as the funding call and information material on the websites of the funding body. We conceive of such documents not as mere information containers that provide factual content on the (anticipated) research endeavour, but rather 'methodologically created communicative features' that require a consideration of the purpose (e.g., attracting funding), and the audiences for which they were produced (e.g., scientific reviewers) [60]. Secondly, we conducted 23 semi-structured interviews at different moments throughout the projects, consisting of 14 interviews with researchers and nine interviews with practitioners involved in the projects (Table 3). Relying on a purposeful sampling approach [61], we addressed principal investigators (PIs) as gatekeepers and asked them to establish contact with those researchers who were closely involved in research-practice interactions as well as practitioners who were participating in the projects. As data collection proceeded, a snowball technique [61] was used to enlist further interviewees.

The situatedness of this study in a research project that accompanied the funding programme had implications for the data collection process and our positioning in the field [55]. It entailed "fluid, every-changing positionalities" ([62], p., 747) in our relationship to the selected research projects and the actors within them, as well as to the funding body. Our position as 'official' accompanying researchers presumably gave legitimacy to the study and enhanced the researchers' motivation or even perceived obligation to participate in it. At the same time, being perceived in a role that was close to the funding body came with certain challenges, such as the fear of being evaluated and concomitantly a

Table 2 Main characteristics of the selected TD projects according to project proposals

Characteristics/project	A	B	C	D	E
Funding cohort	2015	2015	2014	2014	2014
Planned project duration	4 years	4 years	4 years	3 years	3 years and 3 months
Thematic cluster	Health and education	Regional development	Regional development	Urban development	Technology
Range of submitted project budget (EUR)	1–1.5 million	2.5–3 million	2.5–3 million	< 500,000	1.5–2 million
Number of academic institutes listed as applicants	4	8	7	3	7
Main type of practitioners involved	Public service providers, associations	Public sector actors	NGOs, associations	NGOs, associations, public sector actors, citizens	Private sector actors, public sector actors, 'consumers'
Letter of intent (LOI) of (selected) practitioners	Yes	Yes	No	Yes	No
Reference to notion of transdisciplinarity	Strong (but mostly in the interdisciplinary sense)	Strong	Strong	Strong	Weak
Financial resources for practitioners according to budget plan	No	No	No	No	No

reluctance to granting an inside view into on-going knowledge production processes[3]. Since how interlocutors perceive the interviewer is a key issue when conducting interviews [64], we paid due attention to explaining in detail the interest of the study (to better understand factors shaping TD research and participation processes therein) and to establish a trust relationship. Relations with the different interviewees varied according to their status (e.g. professors or PhD researchers) and gave rise to different power relations in interview situations [65]. The situatedness of this study within an accompanying research project introduced further actor dynamics to the research process. On the one hand, the relation between an accompanying research and the project 'under investigation' necessarily implies a relation of information asymmetries (i.e., we get to know their practices significantly better than they do ours). In order not to jeopardise the necessary trust relationship, anonymity, and confidentiality of any information obtained about the projects, its actors and processes were core principles of the accompanying research [66]. Throughout the research process, we affirmed interviewees that we were not evaluating projects and by no means reporting back to the funding body. On the other hand, the accompanying research heavily depended on the participation of the projects. In some situations, the interviewees clearly drew the boundaries of our access to their partners in the practice field, thus assuming a powerful position relative to our research.

The interviews were semi-structured and problem-centred [67]. An interview guidance was used and adapted case-by-case. The guidance consisted of narrative questions about the initiation of the collaboration and the framing of the problem, the structures and forms of interactions between researchers and practitioners (including questions on decision-making processes, the division of roles, the kind of expertise exchanged), and the factors and boundary conditions shaping these interactions (including questions on resources). Additionally, actor influence mapping supported the interview questions about actors and their relations in the participation process [68]. On their basis, interviewees were asked to weigh the importance of the respective actors for achieving the overall project goal using a scale of 'very important', 'important', and 'less important'. They were furthermore invited to label the forms of interaction as either 'information', 'consultation', or 'cooperation'—a scale

Table 3 Overview of interviews conducted with researchers and practitioners

Project	Interviewees Research	Interviewees Practice
A	1 PI 2 PhDs 1 collaborator	1 employee of public service provider
B	1 PI 1 Postdoc 1 PhD	1 political representative 2 public administration
C	1 PI, 1 Postdoc	1 NGO/association
D	1 PI (2×) 1 collaborator	2 NGOs/associations
E	1 PI 1 collaborator	1 entrepreneur (SME) 1 company employee

PI principal investigator, *NGO* non-governmental organisation, *SME* small and medium enterprise

---

[3]The reluctance to share experiences with knowledge production processes might more generally reflect the uneasiness of granting an inside view on the messy processes involved in conducting (TD) research in a research culture that focuses on communicating the finished product rather than its making [63].

commonly used to assess intensities of involvement (e.g., [69]). Applying actor mapping proved effective for breaking the ice and guiding interviewees' attention to something tangible: the actors with whom they interacted. This facilitated interaction and allowed us to refer to these visual elements throughout the interview.

The interviews were conducted in January 2016, June 2017, December 2017, and Mai-June 2018. Thus, while all projects were still on-going, they were in different project phases at the time of data collection (see Table 1 for project duration). All interviews were recorded and transcribed verbatim. With one exception, the transcripts as well as most of the documents are in German. We translated the quotes provided in this article into English.

Data analysis

All materials were managed, coded, and analysed with the qualitative data analysis software 'MAXQDA'. We applied a structuring qualitative content analysis [70]. Building on the theoretical framework elucidated in Theoretical framework section, the interview material was deductively analysed to derive codes from power theories (dimensions and sources) and pre-existing conceptual elements of participation (subject, objects, procedures).[4] After the initial development of a theory-based system and definition of each code, we pretested its practicability with a sub-set of the material and discussed necessary refinements among the authors before proceeding with coding and analysing the entire material [70]. Although structuring qualitative content analysis is a 'concept-driven' coding procedure [71], this approach allowed us to inductively refine the code system during the testing phase. Acknowledging pre-existing concepts while allowing for their adaptation to our study context was particularly apt for operationalising abstract power theories in knowledge production contexts. The aggregation of findings was done such that it enabled mapping the diversity of ways in which power is exercised and shifting between actors in participation practices in TD research while ensuring the anonymity of interviewees and projects.

We relied on a reduced coding system for the analysis of both programme documents and research proposals. Similarly to Felt et al. [34], we followed Akrich's [72] approach to studying technologies and analysed the 'script' embedded in the funding programme, which constituted the immediate structures of action in which the actors engaged. We analysed programme documents regarding the ways in which they prescribed the subjects, objects, and procedures of participation in the projects. The qualitative analysis of project proposals strove to capture imaginations and conceptions of participation and take

into account the discursive formations that provide a frame for the narrations of the actors involved [73]. The analysis was focused on the underlying understanding of TD, the actors involved, the procedures of participation planned, and their reflection in project structures and budgets. This approach supported the selection of projects for in-depth examination. Methods triangulation and data triangulation of sources were applied by combing different data collection methods and examining different data sources through similar methods [74].

Results

In this section, we present the ways in which the funding body, researchers, and practitioners wield power over the subject, objects, and procedures of participation in the five TD sustainability research projects analysed. For each element of participation analysed below, we differentiate the three actors' exercise of instrumental, structural, and discursive power, identify the sources on which they rely, and highlight shifts in power relations between them.

WHO: power in actor selection and (re-)positioning

The analysis of the subjects of participation unveils that power is exercised in the selection and assembling of actors as much as in the definition of the roles they assume and their respective positioning. Interviewees' narrations demonstrate that there is no one single power configuration in the sense of researchers over practitioners or vice versa.

Funding body

The funding body sets the requirement of involving practitioners into the research projects; however, it does not set any guidelines concerning whom to involve and ascribes the authority to do so to the applying researchers. While the funding body does not prescribe which types of actors should be included, it discursively frames potential participants as 'citizens' and 'concerned societal groups' (funding call 2014,15) and invokes broad concepts such as 'civil society' (webpage of funding body)—as opposed to constructing actors as 'stakeholders' or 'experts' for instance. According to programme regulations, only scientific actors, i.e., professors, are entitled to submit project proposals and assume project leadership. Co-leadership with practitioners is not an explicit consideration (funding call 2014,15). Based on its material sources, the funding body thus appears as a distant actor setting the cornerstones for the initial distribution of power over the selection of actors and in so doing wields structural power.

Researchers

Given the above-described structural conditions, the researchers wield instrumental power and decide whom to

---

[4]Due to the on-going nature of the projects analysed, exercises of power regarding the outputs of participation were not considered in the analysis.

include in and exclude from their projects. Their power to do so rests on their status as the legitimate decision-makers of the project as embedded in material and ideational sources and is reinforced by their authority over project structures and budget allocations. Consequently, the five analysed projects were each characterised by an initial definitorial moment in which power lies with one actor group. This general tendency was narrated by researchers (AR1, AR2, AR3, ER1, BR1) and practitioners (CP1, EP1, EP2) alike, as exemplified in the below excerpt of one practitioner's description of their happiness about being chosen by the researchers. The depiction clarifies that the decision on with whom to work was taken by the researchers:

> They [the researchers] had visited several organisations and said they would take a decision after talking to everyone. And yes, then the verdict has fallen on us, and we are glad about it [laughs] (CP1).

Thus, in these initial configurations, researchers exert power over practitioners, whom they position according to their needs. In the absence of detailed LOIs defining the roles of different actors (research proposals A-E), the researchers devise the initial conception and distribution of roles, including the TD interactions. Across the projects, researchers wielded discursive power in ascribing the practitioners a myriad of roles and characteristics; they appeared as those who are most legitimate and able to identify relevant problems (BR1, BR2, CR2, ER2), as gatekeepers and mediators between different fields and actors (AR2, BR2, CR2, ER1, ER2), as multipliers and disseminators who spread research findings within their networks (AR3, AR3, AR4), and as an extended arm of the projects who will implement the research outputs (AR2, AR4, BR2, BR3).

Despite the researchers' instrumental decision power, in some cases—particularly when researchers were not established in their respective practice contexts, the selection of actors was perceived less as picking and choosing, but rather as a cumbersome and time-consuming exercise of convincing practitioners of the added value of participating (AR2, BR2, BR3, ER1, ER2). In contrast, narrations by researchers with established networks show that their entrenched status gave them credit, increased their trustworthiness, and endorsed them as partners among potential participants (AR2, AR3, AR4, BR3, CR2, ER2).

Both researchers (DR1b, DR2) and practitioners (BP1, DP2, EP1) depicted the process of extending and accepting invitations to participate as a negotiation process involving struggles over ideas and agendas. In a few such negotiations, researchers claimed that some practitioners conditioned their participation on high returns (DR1b, DR2) or 'acted in opportunistic ways' (DR2). Such attempts at negotiating collaboration terms and influencing agenda and rule-setting pushed the researchers to select other practitioners, thereby wielding instrumental power over actor selection on the basis of their authority as project leaders (DR1b).

Practitioners

Although researchers of the analysed projects were in charge of selecting practitioners and initiating the collaboration, starting and maintaining a collaboration is not a unilateral decision. Practitioners influenced the selection by clearly demonstrating their interest in participating or, conversely, articulating their scepticism concerning the project (BR3, DR2, ER2). Therefore, researchers do not wield total power over actor selection; practitioners decide to accept or decline invitations to participate, thereby wielding instrumental power over the future direction of the TD project (BR3, ER2).

Reflecting on their decisions to engage in their respective projects, practitioners who were part of larger companies or institutions particularly stressed that they could not have engaged in the project without support from important actors in their networks such as a superior in the company, the mayor in the municipality, or the director of the institution (AP1, BP2, BP3, EP2). Even when they are external to the project, such actors shape the setting up of collaborations and are influential in sustaining them. As their support means being authorised to participate,[5] they exercise structural power over the subjects of participation. If such authorisation is not given or is revoked, then collaborations are ended or invitations for future collaborations are declined (BR3). This condition speaks of a more general observation of the individual participant's embeddedness in wider power relations, which are more or less conducive to their participation in the research projects.

Although researchers predefined practitioners' roles and positions in the project, the interviewees uncovered configurations in which the researchers were positioned by the practitioners and expected to assume certain roles. In practitioners' narrations, researchers were discursively constructed as idea-givers and advisors (BP2, BP3, CP1, DP2), facilitators, organisers and project responsible actors (BP1, BP2, BP3, EP1, EP2), distant observers, or unpleasant evaluators (AR2, AR4). The exercise of power in the ascription of roles and

---

[5]For both practitioners and researchers (AR2, AR4, CR2), the support of powerful actors in their reference field such as professors and PIs appears as a source of power: One interviewee who was positioned at the interface to practitioners explained that more PI support in the beginning would have facilitated the TD process. This suggests that PIs have power based on their status as professors; such support would have given more weight to the collaboration with practitioners and motivated practitioners to engage more deeply (CR2).

characteristics is particularly accentuated when researchers try to immerse in the field, i.e., interactions do not take place in spaces provided by the researchers such as workshops (AR2, AR3, AR4, DR2, DP1, DP2). One researcher in an urban development project described how she experienced being passively positioned by practitioners and reflected on ascriptions which she perceived as unjustified. Recalling her participation in practitioners' meetings, she described being perceived as arrogant and giving unsolicited advice. She was attributed authority based on preconceived images of 'researchers' or 'scientists', which hampered interactions among 'equals'. Stereotypes and assumptions about how the 'others' supposedly are and behave are discursively reproduced in the construction of actors. In her interpretation, her lack of knowledge of the cultural codes and behavioural norms in the practice context prevented her from being recognised as a legitimate actor, and the practitioners exercised power by delimiting her role in their association's meetings. Linked to this configuration of ideational sources, the practitioners exercised power by shaping the structural conditions of her entering the field.

The same researcher shared her struggles to define her own role amidst the contrasting expectations of the participating public and third sector actors. While some voiced their discontent about being advised, others explicitly expected to receive advice:

> On the other hand, other people wanted us, so to speak, to assist them and advise them on any actions […] Anyway, it was incredibly challenging to define your own role so that not too much expectation but also no rejection develops (DR2).

The PI of this project perceived that practitioners expected them to provide advice based both on their theoretical knowledge and relationships to important actors in the field. The PI interpreted the status of another researcher in the same project, who became a quasi-member of another participating association and was allowed to document their activities, as recognition of his collaborator's legitimacy (DR1b). Hence, whereas the latter researcher succeeded in building ideational sources, the abovementioned researcher (DR2) was not accepted as a legitimate participant in practitioners' meetings. In both cases, the practitioners decided who was allowed to enter their every-day practices and used mechanisms of inclusion and exclusion and positioning actors at the centre or the periphery. Such exercises of structural power are rooted on their position in the practice context and their knowledge of behavioural norms.

Such diverse ascriptions reflect the ways in which the actors position themselves vis-à-vis their main reference field, i.e., the academic or the practice context. Power particularly surfaces when practitioners reposition themselves in reaction to conflicts or overstressed capacities (AR2, BR3, DP2, DR2). Power shifts occur as practitioners assert themselves by positioning themselves at greater distance to the researchers, thereby invoking norms in the practice context. They defend their interests and resist the roles that are being ascribed to them within the projects. The following extract from a practitioner working in the third sector reveals how mastering the communication and behavioural norms in the practice context constitute ideational sources of power and how its lack can create conflict:

> There was this thing and someone was not happy recently and instead of calling this person—which is what we would do—she [the researcher] sent a very long email, which came across as offensive. And I told her, 'listen this is how you ruin relationships'. Since I was copied on her message, I received a call from [name of person] complaining what was going on. So, if the relationships here are lastingly spoiled, this is a problem. And I told her. Because this a cultural difference—while the researchers leave after the project, our work depends on sustainable networks (DP2).

Thus, not only the moment of initial selection of the subjects of participation, but also the sustained collaboration and commitment emerged in the interviews as decisive in the exercise of power. Particularly, practitioners' withdrawal or silent or outspoken threats of withdrawal constitute critical moments in shifting power relations through practitioners' manifestation of instrumental and structural power. According to the researchers' narrations, practitioners end their participation for manifold reasons. Some observed evidence of 'participation fatigue', which resulted in practitioners' decisions to refuse or end their participation despite repeated efforts from the researchers (BR3). Another researcher shared her disappointment in a practitioner's last-minute cancellation of a commonly developed teaching project due to a lack of financial and time resources, which strongly influenced the TD process and led to the collapse of the entire subproject. Researchers reported further experiences with the withdrawal of practitioners due to conflicts within their practice institutions (BR3), staff turnover, or a lack of trust in the relevance and usefulness of outputs (BR2, BR3). The latter reveals how practitioners exercise power by ending their participation or threating to do so if their concerns are not prioritised on the agenda or adequately addressed. In some practitioners' narrations, exercising power by withdrawing derived from a lack of sufficient financial support through the project and hence being neither responsible nor accountable for either the project's success or the quality of its outputs (BP1, DP2) (Table 4).

Table 4 WHO: forms of power exercised by funding body, researchers, and practitioners

WHO: power in actor selection	Funding body	Researchers	Practitioners
Instrumental	–	Deciding whom to involve or selecting practitioners; based on their authority as project leaders	Deciding to decline an invitation to participate, deciding to withdraw or re-position; based on a lack of accountability as formalised partners
Structural	Endorsing only researchers as applicants/PIs, transferring project authority to them, thus shaping the options of researchers and practitioners; based on material-structural sources	–	Shaping the structural conditions of researchers' entering the field (behavioural and communication norms), (de-)legitimising researchers as actors in the field; based on practitioners' legitimacy in the practice context; silent or outspoken threat of withdrawal, distant actors in the wider practice context, authorising individual actors to participate
Discursive	Framing practitioners in terms of 'citizens' and 'concerned societal groups' as opposed to 'experts', 'stakeholders'	Ascribing roles to and positioning the practitioners, constructing them as 'legitimate problem identifiers', 'implementers' or 'multipliers'	Ascribing roles to and positioning the researchers, constructing researchers as 'advisors', 'evaluators' or 'organisers', based on ideas of how the 'others' are

WHAT: power in agenda setting

Regarding the objects of participation, the funding body, researchers, and practitioners are found to exercise power in setting and shaping the agenda at different moments throughout the TD projects, in developing the research project and drafting the proposal, in defining and concretising research activities, and in setting the topics of meetings and workshops.

Funding body

The drafting of the research proposals that are submitted to the funding body constitutes critical moments of agenda setting. The funding body explicitly stresses its openness to any topic pertaining to sustainable development and does not predetermine the scope of possible issues to be included on the research agenda. Nonetheless, by calling for projects that promised to be not only societally relevant and contribute to sustainable development, but also scientifically excellent and original,[6] the funding body exercises structural power by means of its material sources and discursively frames the nature of research agendas worthy of funding (funding call 2014,15).

Researchers

Prior to project approval, researchers' dominance in setting the agenda is observed across projects. Interviewees' narrations about the genesis of the research projects reveal that instrumental power lay with the researchers,

who initially set the overall research agenda and chose the approach to implement it. Only at a later stage did they invite practitioners to contribute. In several narrations, this agenda-setting procedure was portrayed as an inevitable result of the funding application process. As mentioned above, the funding body wields structural power and exclusively authorises researchers to apply for funding, thereby putting them in the key position during the proposal development phase. Furthermore, the researchers hold the financial resources to do so, which in the absence of seed money for project development (AR1) marks a critical source of power. Hence, researchers' power over the initiation of the projects and the agenda setting is based on their status as researchers, which authorises them to draft and submit the project proposals.

The practitioners often struggled to delineate the research project from other activities in the field and did not generally consider researchers' dominance in initial agenda setting to be problematic (BP1, BP2, BP3, DP1, DP3, EP1, EP2). Only one practitioner explicitly established a link between being involved in agenda setting and commitment to and influence on the process as well as greater use of its outputs (CP1). Quite on the contrary, others claimed that due to limited time and financial resources, they would not want to be involved prior to the official project approval by the funding body. They lacked the material–structural sources to influence this early stage of agenda setting (AP1, EP1, DP2) or discursively reproduce ideas of what they considered a beneficial division of labour between research and practice (DP2). How the lack of material sources and the mobilisation of ideational sources can overlap is

---

[6]Researchers' reflections on the challenges they encounter in engaging in TD work suggest that these two requirements do not always converge (BR2, BR3) and are in their experience easier to combine for some disciplines (e.g., architecture) than for others (e.g., political science).

reflected in comments by a practitioner who worked in the third sector:

> There will be many, many preliminary talks and meetings about something, which I cannot, well, I really cannot afford to have preliminary talks, [...] because that is research—a lot of time is taken into account without any output. I don't have that time (DP2).

> I think it is great that researchers want to engage, but it is also dangerous because it politicises research. There is a great division of labour if research stays true to its neutral character in pursuit of knowledge. [...] Because otherwise research risks being guided or dictated by political interests and becomes dogmatic. This we would vehemently criticize if actors from the other end of the political spectrum would do, but if it fits our political colour, it is fine? I am not sure (DP2).

Practitioners

At the proposal stage, the degree of practitioners' influence on initial agenda setting diverged across projects. Interviewees participating in one project explained that problems and needs of practitioners were gathered during meetings and workshops in a preparatory phase and considered by the researchers drafting the proposal (BR1, BR2, BR3). Others recalled that the research agenda was developed based on scientific interests (AR2, AR4) before being discussed with the involved practitioners (AR1). Interviewees from two projects indicated that prior contact with practitioners or building on previous projects with the same practitioners enabled their interests to indirectly enter the research agenda. In such cases, the research agenda was developed against the backdrop of lessons learned from these previous collaborations (BR2, BR3, CR2). Across these configurations, the indirect influence and discursive power exercised by practitioners was rooted in the idea that research should be societally relevant and/or applicable.

Several narrations suggest that the initial research agenda is adjusted after the project begins. In this process, practitioners' interests and dynamics in the practice context are considered (BR2, DR1b) and shifts in power relations occur. According to one researcher, the agenda inevitably has to be adapted to the reality in the field:

> I am very critical concerning standard science - you put into an application what you will be doing in three years, and then once in the field, naturally you find out one or two things and knock things over because the field does not do what you had written in your application. Weird, eh, that reality does not adapt to your application [laughs] (DR1b).

To varying degrees, the concretisation of the research agendas or selected working packages took place jointly with the practitioners. Smaller sub-projects as well as student projects (BR2, BR1, BP1, BP2, BP3, DR1b, DR2, DP1, DP2, ER2, EP1, EP2) and teaching projects (DR2, DP1) were defined in collaboration with practitioners. In some cases, practitioners approached the researchers with consultation requests based on their needs (BR2). In these few cases, the practitioners wielded instrumental agenda-setting power, relying on their status and knowledge of matters of concern in the practice context. Across these configurations, the practitioners relied on ideational sources and activated the oft-mentioned desire of researchers of 'giving something back' (AR3, BR2, BR3, DR2, ER1) to the practitioners and of keeping 'giving and taking in balance' (BP3, CP1, EP2).

Researchers from across the projects expressed the ideal of researching what really matters and what can be used by practitioners (AR2, AR2, AR3, AR4, BR1, BR2, BR3, DR1b, DR2, ER1, ER2) as opposed to 'ivory tower' research (AR3, BR3, CR2, DR2, ER1, ER2). In this context, those researchers spoke of a dependency on the practitioners, who wield discursive power over the formation of the research object—mobilising the ideal of conducting relevant and useful research to contribute to sustainability. Practitioners assume a powerful role in filtering which problems according to their values and interests are considered germane on the one hand, and which are realistically manageable on the other. As has been mentioned regarding actor positioning, researchers construct practitioners as the legitimatised to judge the relevance of the topic (BR1, BR2, CR2, ER2) as well as sufficiently knowledgeable to estimate the chances of uptake (AR2, AR4, BR2, BR3).

Asked about the setting of the agenda, practitioners also addressed the researchers' dependence on their inputs (BP1, BP2, EP2). As one policymaker participating in a regional development project explained:

> Well, science depends on our bringing in problem areas, which we face. If we don't do that, they cannot do anything in these areas. So that's why I always had the feeling when I was there and participated that I was taken seriously and that I also had the opportunity to present our interest. That then it will also be taken into consideration (BP1).

The practitioner perceived themselves to exercise power over the research agenda due to their position in the practice context, which provided them with context knowledge and legitimised them to contribute to the identification of significant issues. Later in the interview, it became clear that mutual dependencies exist, while the researchers are dependent on practitioners for

problem identification and ensuring that what is relevant enters the research agenda, policymaking needs research in order to be able to 'actively shape the future' (BP1).

Several narrations indicate that practitioners see themselves not only as those most knowledgeable about the relevant problems, but also as the participants who are able and legitimised to assess the chances of implementing solutions and judge their practicability (AP1, BP1, BP2, BP3, CP1, EP1, EP2). This role perception is reflected in one policymaker's narration:

> You were allowed to freely develop your ideas in the room and people from practice like us, you sometimes have to suppress a chuckle when one or two things are presented, because you know exactly that the idea behind it is great, but has zero prospect of implementation for whatever reasons (BP3).

In this filtering process, some issues are organised in and others are discursively closed down. Depending on the practitioners who are involved and their ideas and worldviews, they base their problem-framing on the judgement of what is relevant, thus referring back to the discursive power involved in actor selection and construction. In this context, the PI of an urban development project reflected on how involving different associations into research is part of a political environment, shaping the core of the research agenda in important ways:

> When you join them at work, we are seen as revanchists and reactionary and with others, when

we work together with them, we are regarded as neo-Marxist revolutionaries (DR1b).

The discursive power inherent to judging the relevance of an issue is traceable in the normative positions of researchers and practitioners regarding sustainability. Depending on the context and types of actors involved, powerful societal discourses frame the agenda and problem-solving approach chosen. For example, interviewees participating in a project on sustainable technologies involving private sector actors expressed the need for sustainability solutions to be compatible with economic growth (ER1, EP1, EP2). As the PI argued:

> We really want to develop business models together with the companies, when they continue to have good returns, when they can continue to work profit-orientated, because otherwise it will not work, when you talk about zero-growth-society. Because we think otherwise the companies will disregard it and without them nothing will change (ER1).

The interviewed private sector practitioners also identified the requirement for the problem-solving approach to be compatible with economic principles, thus allowing for profit-making (EP1, EP2). Using discursive power, dominant ideas external to the TD project were reproduced in the collaboration process and framed the overall research agenda.

While researches and practitioners in the above project shared the same vision of sustainability, which

Table 5 WHAT: forms of power exercised by funding body, researchers, and practitioners

WHAT: power in agenda setting	Funding body	Researchers	Practitioners
Instrumental	–	Setting the research agenda in the research proposal; based on their authority as project leaders, their knowledge about proposal writing, and their financial/time resources; setting topics on workshop and meeting agendas	–
Structural	Setting the relevance of research agendas for sustainable development as precondition for funding; based on material-structural sources	–	Filtering topics which are considered relevant and manageable/having chances of implementation; based on their position as legitimate and knowledgeable actors as well as potential implementers; silent or outspoken threat of not participating if agenda is not adapted
Discursive	Framing the kind of agendas worthy of funding, referring to 'scientific excellence' and 'societal relevance/ contribution'	–	Framing sustainability understanding underpinning the agenda, reproducing discourses about pathways to sustainable futures; constructing practitioners as the actors capable of defining what is relevant and useable; activating ideals of 'moving out of the ivory tower', 'giving something back', 'balance of giving and taking'

shaped their perceptions both of the issue and possible solutions, perspectives diverged in other cases. Such situations reveal the powerful position of practitioners in making their values count in agenda setting (BR2, BR3). In a project on regional development and the role of the built environment, two interviewed researchers argued that the practices of the public sector actors involved in the project were inherently unsustainable due to the entailed land use and mobility practices. However, despite the clear divergence from the researchers' understanding of sustainability, both stated that they refrained from voicing this fundamental criticism to the practitioners and kept certain sensitive issues off the agenda due to their fear of scaring off the participating policymakers (BR2, BR3) (Table 5).

HOW: power in rule setting and contestation

The analysis of procedures of participation illuminates the capacity of the three groups of actors to set the terms of interactions and define 'the rules of the game'. The exercise of power in rule-setting includes the timing of interaction, the design of formats, and the norms that govern the participation process.

Funding body

The funding body appears in researchers' narrations as a distant actor pre-determining the rules of participation. This perception of the power of the funding body is notably evinced in narrations about the rules according to which financial resources are allocated to researchers and practitioners (BR1, BR3, DR1b, ER1, ER2). For example, one researcher described the funding structures being such that 'traditional' scientific projects were called for:

> Well, that was predetermined by the funding body, it is a really, a purely scientific project. No practitioners are directly involved, like for example in other programmes [name of programmes], who make some own contribution or co-finance the project; there you are tied to the funding body, so to speak. (...) But now you cannot influence it with this funding scheme (ER1).

This researcher interpreted the role of the funding body as setting the rules of interaction and structural conditions shaping their own behavioural options. The funding call does not mention the possibility of applying for funding for practitioners (funding call 2014,15). Hence, while not explicitly prohibiting financial compensation of practitioners, neither does it incentivise accounting for them in the budget plans. Accordingly, in only one project did both the interviewed researcher and practitioner mention financial resources provided for the latter in the form of a part-time employee's salary (CR2, CP1). Whereas various researchers perceived the unequal distribution of financial resources built into the funding programme as undermining their goals of co-creation and collaborating on equal footing (BR1, BR2, DR1b, DR2), practitioners' reflections on the role of financial resources were ambivalent. The lack of financial support was particularly problematized by interviewees from third sector organisations (DP1, DP2), who struggled with precarious financial situations, whereas public service and private sector actors did not perceive their capacities to engage to be circumscribed by a lack of material sources (BP1, BP2, BPs, EP1, EP2). Rather than financial resources for participating in the process, the latter emphasised the provision of resources for implementing outputs.

Researchers

Even though the funding call uses 'transdisciplinarity' as a framing concept and refers to it in the very first paragraph (funding call 2014,15), it remains vague regarding the desired form of practitioner involvement and delegates the authority to set the rules of involvement to the project leaders. Across the five projects, the instrumental rule-setting power lay with the researchers. By means of their role as legitimate project authorities entitled by funding contracts and equipped with the necessary knowledge for developing and conducting research projects, they regulated the procedural formats of participation. Formal co-leadership with practitioners that would endow practitioners with rule-setting power was not practised in any of the projects.

Accordingly, in narrations across projects, researchers appear as the prime actors when it comes to setting the formats of interactions, planning of interactive events, selection of methods used to structure the interaction, and determining meeting locations (AR2, BR2, BR3, ER1, ER2). Likewise, the timing of interactions and the structuring of time schedules constitute powerful means of influencing the process. With few exceptions, the timing of interactions was determined by the researchers in accordance with their research schedules. Several practitioners perceived the exchange as driven by researchers' demands (BP2, BP3, DP1, DP2). Statements such as 'when from the perspective of the university there is reason to meet' (BP2) or 'when it is time for feedback' (AR2) indicate that the researchers determined when and on which occasions to meet and how to involve practitioners. While most practitioners did not problematize the control of time plans by researchers, one interviewee perceived his lack of information on what should happen when to hamper his involvement (DP2). Reflections on the setting of timing and formats of interaction unveil the discursive power of norms and perceived structural constraints related to wider temporalities in both the academic and practice contexts. Externally set project durations determined by the funding

body (DR1b, ER2) and the 'projectification' of work in the third sector (DR1b, DP2) were critically evoked, and a synchronicity problem between research and practice (DP2) was perceived to confine the participants' behavioural options.

For some researchers, decision-making and rule setting in a TD context meant sharing control of the process with practitioners. They referred to ideal principles such as engaging on 'equal footing' and at 'eye level' (BR1, BR2, CR2, DR1b, DR2, DP1). However, this sharing of control was not formalised in the decision-making structures of the five projects (AR2, AR3, AR4, BR2, BR3, ER1, ER2). The following researcher experienced this situation as a loss of control:

> And yes, therefore my interim assessment is in the end: it is frighteningly challenging, and you must just put up with a lot and also accept it as it is and not try to change it according to your own ideas [....] Well, some interesting experience to work with practitioners, because, no matter how well you are prepared, you have a totally uncontrollable part in the whole thing (DR2).

Only in the project in which financial resources were allocated to a selected practitioner did interviewees from research and practice recall how they jointly set the formats used in workshops and meetings. Based on the practitioners' reactions, adaptations are made to the rules (CP1). While the practitioner in this project is involved in rule setting because her context knowledge allows her to judge whether the approach fits the local circumstances, the organisational decisions are nonetheless adapted to the professor, who indirectly influences rule setting. Inversely to examples discussed in the other projects, the practitioner explained that they set the dates and adapted their time plans to the availabilities of the PIs and professors (CP1). Concomitantly, the researcher managing the TD case restricted other researchers' access to the case in order to keep it functional. As she asserted, involving more people in setting rules and taking process-related decisions requires more time, thus illuminating a perceived trade-off between diversity and functionality (CR2). The following extract relates to power in so far as involving fewer people in setting rules and taking decisions allows for greater control and influence over the interactions:

> [M]ore diversity would have been a lot more beneficial, of different people, minds; at the same time, it's a matter of focus what I could have done because diversity and co-creation processes and decisions on process, just how to get by with something, equals time (CR2).

Regarding participation in knowledge production, the negotiation and contestation of rules governing the process appear as exercises of power in which discursive formations are crucial. Interviewees from both groups narrated moments in which they renegotiated the rules of interactions. Such situations reveal tensions of engaging in TD processes (AR2, AR4, DP2). In their attempts to influence the rules of interactions, actors mostly relied on ideational sources such as norms and values regarding the appropriate relationship between research and practice. Three researchers from a project in the field of health and education recalled a conflictual situation in which a practitioner's attempt to erase questions from a survey resulted in their defence of scientific freedom (AR2, AR3, AR4)—an act of rule assertion. In this context, the researchers' discursive power mobilised widely acknowledged norms of good scientific practice and was rooted in their perceived legitimacy and self-conception as the actors in charge of setting the research approach. In reaction to a perceived attack on these norms, one researcher repeatedly stressed that a clear boundary with the practitioners was drawn when developing the data collection instruments because data collection needs to be a 'one-way street' (AR2). Her argumentation uncovers that the practitioners, in this case public service providers, are invited to participate in temporarily delimited ways. Asked about how the researchers deal with the practitioners' attempts to bend the rules of data collection practices, this researcher drew boundaries in order to preserve what she considered good scientific practice:

> Because otherwise we move into an area where it becomes consultancy work, and that doesn't work that way. [...] We try to find a diplomatic way, but it is not that easy to meet everyone's' interests. I think we are in a negotiation position to say, if you do not accept our way of doing it, then we can't realise it in [your institution]. Because I think that would be the end of any scientific institution, if we let them dictate the questions of our survey (AR2).

In her perception, the researchers are in a strong 'negotiation position' to defend their interests, because as a last resort they can replace the practitioners by others—this is a position that she was convinced was supported by the PI. In this context, threating to end the collaboration—which was previously identified as a mechanism for practitioners to steer the process and its content—was used as an exercise of the researcher's power and relates to their perception of the practitioners as being 'exchangeable' (AR2).

Practitioners

While researchers across the five projects were authorised as official project actors to set the rules, practitioners indirectly influenced rule setting or affected the procedures of participation through their decisions, thus emphasising the necessity of looking beyond formal decision-making when analysing power relations. Due to a perceived dependence on the continuous participation of practitioners, in setting the rules and terms of interaction, researchers strove to anticipate and accommodate the (imagined) preferences of practitioners, whether regarding locations (ER2), time schedules (ER1, ER2), or methods (BR2, CR2 ER1, ER2). In doing so, they set up the process such that it allegedly satisfied practitioners and complied with their habitual ways of collaborating. Thus, practitioners indirectly wield structural power over the setting of rules. The following reflection exemplifies how the researcher perceived a threat of losing needed practitioners, which affected the researcher's behaviour in subtle ways and resulted in her relaxing and adapting some rules:

> I let a lot of flexibility, also trying to somehow compensate for their lack of commitment and accountability a bit. So, when I felt that they were not so committed, then I made it more flexible for them. And now I would probably, I would be more discipline[d] with them and say 'I expect this and this from you', 'deliver!', no [Laughing] (CR2).

How practitioners indirectly influence the rules of the participation process through their decisions becomes even more tangible when looking at data collection practices and researchers' field access. Practitioners' exercise of structural power rests on their position in the respective practice context in which they are perceived as the ones legitimised to take decisions. In collaborations with politicians and policymakers, this legitimacy is linked to their democratic legitimacy. Similar observations were made for practitioners who were not representative for the field or legitimised to speak on behalf of others. In these cases, their exercise of power rested mainly on their access to networks and the projects' target groups (AR2, BR2 CR2, ER1, ER2) as well as potential beneficiaries and multipliers of its outputs (AR3, AR3, AR4). This position in the practice context allowed them to mobilise further actors to engage with the project or its outputs. Their decisions to facilitate or complicate the data collection—such as the dissemination of surveys—affect the TD process. Practitioners across the projects explained that they approved data collection tools (AP1, BP1, BP2, BP3) or assumed the role of respondents themselves (DP1, DP2, EP1, EP2) in the case of both qualitative and quantitative approaches. Thus, they tacitly influenced the knowledge production process and shaped inputs into the research process. Being authorised by the practitioners and giving authorisation, respectively, likewise appears in researchers' narrations (AR2, AR3, AR4, BR2, BR3, ER2).

Taking up the previously mentioned conflict about data collection in a practice institution exemplifies how rules of data collection are contested by both actor groups, thus illustrating the back and forth shifting nature of power. Researchers of one project recounted how the involved public service provider prevented them from doing participatory observations and tried to

Table 6 HOW: forms of power exercised by funding body, researchers, and practitioners

HOW: power in rule setting	Funding body	Researchers	Practitioners
Instrumental	–	Setting the rules, formats, and timing of participation; based on their authority as project leaders as well as their financial and time resources	–
Structural	Shaping the rules of resource allocation among researchers and practitioners and of project (co-)leadership (not involving practitioners); based on material sources shaping the structural conditions and the procedural options of the actors involved	Silent or outspoken threat of ending collaboration due to actors' disrespect of rules or refusal to adapt rules; keeping practitioners away from certain activities (e.g., data collection); based on their authority as project leaders and their legitimacy as researchers	Silent or outspoken threat of withdrawal due to actors' disrespect of rules or refusal to adapt rules; shaping the terms of researchers' entering the field, access to data or actors in the field; based on their legitimacy in the field and their actor networks
Discursive	Referring to 'transdisciplinarity' as an ideal of how researchers and practitioners should interact	Referring to 'equal footing' as an ideal of how researchers and practitioners should interact, questioning clear-cut boundaries between research and practice; referring to norms of 'good' scientific practice to reinforce rules	Referring to/upholding division of labour between research and practice as ideal

influence survey questions,[7] thus delimiting the space of interaction (AR2, AR3, AR4). Besides restricting certain forms of data collection, the practitioners shaped rules on its timing and organisation; researchers were asked not to repeatedly bother employees, but rather to combine data collection activities. In such situations, the practitioners' structural power lies in their decision authority regarding any activities in their institution and in the silent threat of withdrawing from the project. In the researchers' interpretation, the circumstance that a presumably sensitive topic is to be investigated and the practitioners' fear to be evaluated leads them to contest the rules, i.e., keeping researchers away from activities that they consider to be sensitive (AR2, AR4). The practitioners exercise structural power by delimiting the researchers' access to their institutions, which allows them to keep certain issues off the agenda. In their role as 'gatekeepers'—which several researchers ascribed to their practitioners (AR2, BR2 CR2, ER1, ER2), they control researchers' access to the field (Table 6).

Discussion and conclusions

This article aimed at understanding how power is exercised in participation practices in TD sustainability research. For this purpose, it proposed and empirically applied a theoretical framework that links three dimensions of power (instrumental, structural, discursive) to three elements constituting participation (subjects, objects, procedures). The analysis of five TD projects—all part of the same sustainability-oriented funding programme—has shown that the three elements of participation practices each provide important, albeit interrelated entry points for the exertion of power in defining the actors, their roles, and respective positioning as well as in setting the research agendas and rules governing their interactions (Additional file 1: Table S1). In this section, we discuss the empirical findings in regard to the theoretical framework presented and to ideals of TD research. We highlight the interplay and simultaneity of dimensions of power and the context embeddedness of sources of power and reflect on the implications of our findings for research practice and governance.

The interplay and simultaneity of different dimensions of power

In this article, we have shown that TD interactions of researchers and practitioners are pervaded by an interplay of different dimensions of power. The diverse manifestations of power identified in our analysis (Tables 4, 5, 6) illuminate discrepancies between the ideals of TD of shared control, ownership, and co-leadership [11, 12]

---

[7]The researchers described how they then relied on power of reframing their activity in order to lower the resistances of the practitioners regarding such methods (AR2, AR4).

and actual practices in the five projects. Firstly, focusing on formal decision-making and the most visible form of power in its instrumental usage, researchers appeared as powerful actors across all three constitutive elements of participation. This interpretation supports previous findings on the powerful role of researchers in initiating and controlling TD as well as corresponding power asymmetries among researchers and practitioners [24, 30, 31]. Mapped on the continuum between consulting and participatory TD, four of the five projects (with slightly varying distances) would appear closer to the 'consulting' than the 'participatory' end of the spectrum [36].

Secondly, applying the multidimensional conceptualisation of power underpinning our analysis reveals that looking at the exercise of instrumental power manifested in the abovementioned power asymmetries provides only a partial picture. A consideration of structural and discursive power as well as instrumental forms illuminates the funding body's and the practitioners' influence on actor selection, agenda setting, and rule setting. The different actors' exercises of power uncovered a relational interplay of power between the funding body, the researchers, and the practitioners, thus revealing a more nuanced picture of power dynamics. By prescribing the kinds and ranges of project leadership, resource allocation, and topical foci, the funding body wielded structural and discursive power over participation practices in the projects. Given these structural conditions, by way of the authority transferred to them as project leaders, researchers simultaneously wielded instrumental power over the (pre-)selection of actors, the setting of the agenda, and the rules of interaction. However, situations of shifting power relations between researchers and practitioners and an interplay of different dimensions of power were exposed. Across the three elements of participation, the decisions of practitioners were influential and, in some cases, strongly impacted the process. Their influence became particularly tangible in their threats to withdraw or actual withdrawal from the process as well as in the contestation of rules, most notably regarding researchers' field access. Such exercises of instrumental and structural power were intertwined with the conditions prescribed by the funding body, which resulted in largely non-formalised collaborations and a limited accountability of practitioners. Moreover, the simultaneous exercise of discursive power by researchers and practitioners shaped the ascription of roles, largely upholding a traditional division of labour between those producing and those using knowledge.

These findings across the three elements of participation stress the need for a nuanced view on power relations that extends beyond dichotomies and binary conceptions of 'the powerful' and 'the powerless' actors in participation practices and their conceptual representations [19]. The

need for more nuanced actor understandings is also reflected in the circumstance that practitioners do not problematize the described dominance of researchers. Unlike implicit to TD ideals of shared control [12, 13], practitioners in the projects analysed herein did not necessarily want to play any decision-making roles or assume responsibility for the entire process [75]—not only due to a lack of financial resources, but also because the observed division of labour between researchers and practitioners aligned with their epistemological values regarding appropriate science-society relations. Since previous studies have established direct links between inequalities in funding structures and the lack of ownership for the process and conclude that the provision of financial resources will correct this shortcoming [38], it remains to be investigated to what extent our findings are sensitive to the type of practitioner as well the specificities of the funding context.

Assessing the funding body, researchers, and practitioners may support the recognition and reinterpretation of different actors' influence over the process. Such reinterpretations are especially relevant if we follow Kanter's reflections [76] that power perpetuates power and powerlessness perpetuates powerlessness, thus suggesting that actors' behaviour is influenced by their assumptions about their own and others' power. We concur with Purdy [54] that a multidimensional examination of power can uncover 'mistaken beliefs and hidden sources of power that may reduce overconfident, defensive, or domineering behaviours' also in TD research, in which—according to self-proclaimed goals and design principles of egalitarian interactions—the use of power might be unintentional.

Context embeddedness of sources of power

Our findings show that in their exercise of power the funding body, the researchers and practitioners relied on diverse sources, including financial and time resources and networks (material sources), authority, legitimacy in relation to norms and values, and knowledge (ideational). Contrary to our expectation, expertise and knowledge were only marginally addressed as sources of power in our empirical material. Considering that TD scholars have widely argued for expertise to be the main criterion for involvement in TD and knowledge generation to be its main goal [77], this counterintuitive finding requires further investigation. One possible explanation relates to our observation that researcher-practitioner interactions often took place in clearly delimited spaces and sub-projects primarily designed to accomplish transformational goals rather than knowledge production goals.

Our analysis of actors' ideational and material sources of power unveiled the importance of the different contexts. Firstly, in support of earlier findings [29, 31, 34], the study exposed the powerful role of funding bodies in shaping

the behavioural options of researchers and practitioners and showed how ambiguous or partly incoherent signals built into the programme script affected actors' sources of power—in this case, calling for participation without adapting funding mechanisms accordingly. Secondly and closely linked to the funding context, a few sources of power, such as the authority of project leaders, as well as norms and ideals of how TD processes should be (e.g., on equal footing, moving out of the ivory tower, a win-win for all participants) reside in the immediate project context. Thirdly, most sources of power are embedded in the wider context (Fig. 1); they stem from the practitioners' position in the practice context, e.g., their decision authority or legitimacy therein, as well as the researchers' position in the academic context and their status as knowledge authorities. Thus, they relate to established norms regarding the appropriate relation between research and practice which—when perceived to be in tension with TD—can undermine the exercise of power.

The context embeddedness of sources of power manifested particularly regarding agenda setting. Since the funding programme required research agendas to be relevant for sustainability transformations, they were inherently normative, value-laden, and contested [9]. Due to their position in the practice context, practitioners in the five projects appeared as the legitimate actors to judge which issues—albeit mostly pre-selected by the researchers—were relevant to be placed on the agendas of sub-projects. Due to their authority to implement decisions in the practice context, they appeared as the legitimate figures to judge which solutions were worth pursuing. What is perceived to be worth researching or developing relates to whose values count and where the power to realise them is located [78]. In thus shaping which futures are considered desirable or even possible and plausible [79], participation practices within TD projects may shape socio-political developments in the practice context (two-way interactions as depicted in Fig. 1). This transfer of actors' power in the practice context into TD projects runs the risk of reproducing dominant societal discourses in agenda setting, rather than breaking loose of them. Concomitantly, it risks marginalising less visible and powerful ideas and actors, thus jeopardising the transformative potential of TD [10].

Context embeddedness also crystallised in the influence of distant actors on the process and its subjects. Powerful actors in the practitioners' networks influence their participation and can in extreme cases prompt their withdrawal by revoking authorisation. Power regarding the composition of actors relates not only to this wider context, but also needs to be seen in the sense of objects and procedures within the project. That subjects, objects, and procedures of participation are co-produced [21] is supported by findings on agenda setting. Not only

did the actor constellation shape which issues were put on the agenda, but the agenda also affected the actor composition. Depending on whether the agenda is perceived as truly relevant or at least not harmful to practitioners' interests, the actor constellation may change. Furthermore, the negotiation or contestation of rules and procedures of participation was identified as a strategy of keeping sensitive issues off the agenda and limiting the kinds of actors, opinions, or discourses that are rendered visible in the practice context. Thus, power in agenda setting can only be understood in the context of the subjects and procedures of participation and requires reflexivity in order to prevent the instrumental circumscription of issues previously identified for participatory technology appraisals [80]. This example also illustrates how the three components of participation interact and power-strewn path depend decisions can occur throughout TD projects.

Overall, the context embeddedness of power sources urges us to understand participation practices in TD projects as situated in the wider socio-political context and predominant science-society relations [19, 25]. Power constellations within TD projects vary according to the prevailing knowledge hegemonies and hierarchies in the socio-political context as well as the dominant knowledge regimes and value orders entrenched in the academic context [34]. Thus, our analysis reinforces previous calls for considering both structure and agency in order to understand power dynamics in TD settings [23].

Implications for research practice and governance

The exercises of power identified in this article give guidance for future (self-)reflexive processes to researchers and practitioners engaging in TD practices as well to funding bodies and science institutions calling for TD and co-creation processes.

For researchers, such an assessment provides not only the opportunity for reflexivity about their own powerful roles, but also can assist in unveiling the effects of non-formalised or weakly formalised collaborations with practitioners. In these constellations, instrumental power lies predominantly with one actor group; however, responsibilities and accountabilities are also likely to be unequally distributed. Accounting for power dynamics is useful for illuminating their potential dependencies on practitioners throughout the process and communicating and planning accordingly, thus enabling researchers to reduce their vulnerabilities to the risk of practitioners withdrawing from the process. For both researchers and practitioners, identifying the sources of power on which they rely in order to shape the TD process can help to steer or counterbalance power dynamics, i.e., by deliberately creating these sources. Moreover, reflexivity regarding the discursive power exercised by practitioners

enhances awareness of the kinds of societal discourses and structures that the TD project potentially stabilises or transforms. An analysis of 'power over', as suggested by Table 1, can serve as a basis for explorations of the potential of projects to unleash transformative power (e.g., 'power to' and 'power with').

For funding bodies, an assessment of the structural and discursive forms of power exercised through the funding regulations is particularly relevant. Funders are in a key position to transform norm systems in research practice and governance [29]. A power analysis such as illustrated in Table 1 can be useful to assess whether the programme goals are coherently reflected in the funding structures and whether these are conducive to the kinds of research processes the funding body wants to promote. If the funder aims to realise the ideals of TD, including shared ownership and responsibility, then co-leadership as well as—depending on the type of practitioners—the provision of financial means can provide critical sources of power that partly countervail asymmetries.

Similar conclusions can be drawn concerning the implementation and design of agenda-setting processes. The power analysis along the dimensions suggested in Table 1 provides insights into challenges and barriers of participatory agenda-setting processes in research. Being sensitive to power relations in agenda setting requires those initiating the process to be reflexive and transparent about how their pre-selection of issues and the rules governing the processes result in the inclusion of some and exclusion of other values and knowledge. They should be aware that within the frameworks set by the governing actors, hidden power dynamics unfold during the processes and require continuous reflection in order to ensure robust outcomes.

Limitations and future research

While a meta-analysis of power as performed in this article produces valuable insights into the diverse manifestations of power, its analytical scope remains partial. The meta-analysis and aggregation of findings were done such that it enabled the mapping of the diversity of power exercised by three types of actors in five projects while ensuring the anonymity of interviewees and projects. Consequently, the specificities and situatedness [55] of the actors and processes could only be addressed to a limited extent. In addition to analyses of power in researcher-practitioner interactions, similar analyses of power within both actor groups are needed to draw a more holistic picture of power in TD research. Observations in our empirical material about power relations among researchers, such as the powerful roles of knowledge brokers and intermediaries and the corresponding 'responsibilisation' of a few individuals [14] at the research-practice interface as well as among

practitioners could not be exploited. Within the heterogeneous group of practitioners, we saw actor differences with regard to whether project-based financial resources appeared as a necessary source of power for practitioners. While NGOs and associations tended to see them as a prerequisite to ensure egalitarian interactions and practitioners' capacities to influence the process, interviewees from the private and public sectors less so felt their power over the participation process circumscribed by a lack of financial resources. At the same time, it seems, the equation of being powerful in the practice field equals power within the TD process seems oversimplified. The researchers identified strong dependencies also on practitioners such as NGOs and associations which might not have been the most powerful players in the practice field, but which were irreplaceable with regard to achieving the project-specific goals. The heterogeneity of actors within the broad groups thus warrants further attention. Moreover, the presented findings are context-bound to one funding programme in the global North and should be compared and complemented with analyses from other settings.

Although the tripartite differentiation of instrumental, structural, and discursive forms of power provided useful analytical categories and enabled a clarification of the diverse manifestations of power in our empirical data, their malleable and fluid character should be noted. Moreover, because power is relational and shaped by interaction, the static depictions in Tables 1, 4, 5, and 6 are limited in their ability to fully account for power dynamics as well as for path dependencies throughout TD projects. The latter might manifest, for example, if the terms of participation are largely pre-determined by the funder. In such a case, there is arguably diminished scope for other actors to exercise power at each of the three entry points identified in this article (subjects, objects, procedures). The methods applied and our own positionality in an accompanying research project to the funding programme limited the extent to which dynamics in everyday research practices could be grasped. Despite the fact that data collection took place at multiple times during the ongoing projects, only snapshots of steadily evolving projects could be taken. Hence, actor dynamics over time were primarily accessed based on interviewees' perceptions and narrations. Some of the tacit dynamics related to power necessitate further empirical research based on a diverse methodological repertoire, including participatory observations and an assessment of project outputs with regard to whose knowledge and values are captured in them. The power and participation framework used in this article can be applied for future studies to conduct multiple analyses over the course of a TD project, thereby examining how power dynamics and perceptions thereof change and/or are cemented.

Examining the very practice of participation through a power lens opens up avenues for critical sustainability and future-orientated studies that are sensitive to power dynamics and reflexive toward their own practices. We hope to incite TD sustainability scholars to share their experiences with power within TD knowledge production processes and build a practice-related knowledge base on diverse facets of power. Such a knowledge-base will also enhance our understanding of which kinds of power structures hamper joint knowledge production and problem-solving and which structures leverage the potential of reaching knowledge production and transformational goals of TD research.

Supplementary information

> **Additional file 1: Table S1.** Overview of findings per form of power, participation component and actor

Abbreviations
NGO: Non-governmental organisation; PI: Principal investigator; SME: Small and medium enterprise; TD: Transdisciplinary

Authors' contributions
This research was designed, carried out, and written principally by LF. LF developed the conceptual perspective, collected the empirical data, and performed the analysis. CRB supported the interpretation of findings. All authors read and approved the final manuscript.

Authors' information
Livia Fritz, studies in development studies and political science at the University of Vienna (Austria) and the Institut d'études politiques de Paris (France); previously junior research at the Austrian Foundation for Development research and the University of Munich (Germany); currently doctoral assistant at the Laboratory for Human-Environment Relations in Urban Systems at EPF Lausanne (Switzerland); research interests: interlinkages between research, policy-making, and societal change in the field of sustainability; discourses and practices of participation in knowledge production; science policy.
Prof. Dr. Claudia R. Binder, studies in biochemistry, doctorate, and habilitation in environmental sciences at ETH Zurich, Switzerland. Since March 2016 head of the Laboratory for Human-Environment Relations in Urban Systems and Swiss Mobiliar Chair for Urban Ecology at École Polytechnique Fédérale de Lausanne (EPFL), Switzerland. Research interests: analysing, modelling, and assessing sustainability transitions of urban systems.

Availability of data and materials
For reasons of anonymisation, the empirical material is not available.

Ethics approval and consent to participate
All interviewees in the study gave their informed consent to participate.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

References

1. United Nations (2015) Transforming our world: the 2030 agenda for sustainable development, A /RES/70/1. New York
2. Schneider F, Kläy A, Zimmermann AB, Buser T, Ingalls M, Messerli P (2019) How can science support the 2030 Agenda for Sustainable Development? Four tasks to tackle the normative dimension of sustainability. Sustainability Science 14:1593. https://doi.org/10.1007/s11625-019-00675-y.
3. Hoppe R (1999) Policy analysis, science and politics: from 'speaking truth to power' to 'making sense together'. Sci Public Policy 26:201–210. https://doi.org/10.3152/147154399781782482
4. European Commission (2019) Horizon 2020 - work programme 2018–2020. Science with and for Society. Decision C(2019)1849 of 18 March 2019. doi: http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-swfs_en.pdf
5. Schneider F, Buser T, Keller R, Tribaldos T, Rist S (2019) Research funding programmes aiming for societal transformations: ten key stages. Sci Public Policy 46:463–478. https://doi.org/10.1093/scipol/scy074
6. Van der Hel S (2016) New science for global sustainability? The institutionalisation of knowledge co-production in Future Earth. Environ Sci Pol 61:165–175. https://doi.org/10.1016/j.envsci.2016.03.012
7. Gudowsky N, Sotoudeh M (2017) Into blue skies—a transdisciplinary foresight and co-creation method for adding robustness to visioneering. NanoEthics 11:93–106. https://doi.org/10.1007/s11569-017-0284-7.
8. de Jong SP, Wardenaar T, Horlings E (2016) Exploring the promises of transdisciplinary research: a quantitative study of two climate research programmes. Res Policy 45:1397–1409. https://doi.org/10.1016/j.respol.2016.04.008.
9. Polk M (2014) Achieving the promise of transdisciplinarity: a critical exploration of the relationship between transdisciplinary research and societal problem solving. Sustain Sci 9:439–451. https://doi.org/10.1007/s11625-014-0247-7
10. Marshall F, Dolley J, Priya R (2018) Transdisciplinary research as transformative space making for sustainability: enhancing propoor transformative agency in periurban contexts. Ecol Soc 23. https://doi.org/10.5751/ES-10249-230308
11. Scholz R, Steiner G (2015) The real type and ideal type of transdisciplinary processes: part II—what constraints and obstacles do we meet in practice? Sustain Sci 10:653–671. https://doi.org/10.1007/s11625-015-0327-3
12. Lang DJ, Wiek A, Bergmann M, Stauffacher M, Martens P, Moll P, Swilling M, Thomas CJ (2012) Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustain Sci 7:25–43. https://doi.org/10.1007/s11625-011-0149-x
13. Luthe T (2017) Success in transdisciplinary sustainability research. Sustainability 9:71. https://doi.org/10.3390/su9010071
14. Maasen S, Lieven O (2006) Transdisciplinarity: a new mode of governing science? Sci Public Policy 33:399–410. https://doi.org/10.3152/147154306781778803.
15. Stauffacher M, Flüeler T, Krütli P, Scholz RW (2008) Analytic and dynamic approach to collaboration: a transdisciplinary case study on sustainable landscape development in a Swiss prealpine region. Syst Pract Action Res 21:409–422. https://doi.org/10.1007/s11213-008-9107-7
16. Arnstein SR (1969) A ladder of citizen participation. J Am Inst Plann 35:216–224
17. Avelino F (2017) Power in sustainability transitions: analysing power and (dis)empowerment in transformative change towards sustainability. Environ Policy Gov. https://doi.org/10.1002/eet.1777
18. Grunwald A (2013) Modes of orientation provided by futures studies: making sense of diversity and divergence. Eur J Futures Res 2:30. https://doi.org/10.1007/s40309-013-0030-5
19. Fritz L, Binder CR (2018) Participation as relational space: a critical approach to analysing participation in sustainability research. Sustainability 10:2853. https://doi.org/10.3390/su10082853
20. Klenk NL, Meehan K (2017) Transdisciplinary sustainability research beyond engagement models: toward adventures in relevance. Environ Sci Pol 78:27–35. https://doi.org/10.1016/j.envsci.2017.09.006
21. Chilvers J, Pallett H, Hargreaves T (2018) Ecologies of participation in socio-technical change: the case of energy system transitions. Energy Res Soc Sci 42:199–210. https://doi.org/10.1016/j.erss.2018.03.020
22. Nowotny H, Scott P, Gibbons M (2001) Re-thinking science: knowledge and the public in an age of uncertainty. SciELO Argentina. p. 211.
23. Bréthaut C, Gallagher L, Dalton J, Allouche J (2019) Power dynamics and integration in the water-energy-food nexus: learning lessons for transdisciplinary research in Cambodia. Environ Sci Pol 94:153–162. https://doi.org/10.1016/j.envsci.2019.01.010
24. Rosendahl J, Zanella MA, Rist S, Weigelt J (2015) Scientists' situated knowledge: strong objectivity in transdisciplinarity. Futures 65:17–27. https://doi.org/10.1016/j.futures.2014.10.011
25. Schmidt L, Neuburger M (2017) Trapped between privileges and precariousness: tracing transdisciplinary research in a postcolonial setting. Futures 93:54–67. https://doi.org/10.1016/j.futures.2017.07.005.
26. MacMynowski DP (2007) Pausing at the brink of interdisciplinarity: power and knowledge at the meeting of social and biophysical science. Ecol Soc 12. https://doi.org/10.5751/ES-02009-120120.
27. Bieluch KH, Bell KP, Teisl MF, Lindenfeld LA, Leahy J, Silka L (2016) Transdisciplinary research partnerships in sustainability science: an examination of stakeholder participation preferences. Sustain Sci:87–104. https://doi.org/10.1007/s11625-016-0360-x
28. Pohl C, Rist S, Zimmermann A, Fry P, Gurung GS, Schneider F, Speranza CI, Kiteme B, Boillat S, Serrano E (2010) Researchers' roles in knowledge co-production: experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. Sci Public Policy 37:267–281. https://doi.org/10.3152/030234210X496628
29. Benner M, Sandström U (2000) Institutionalizing the triple helix: research funding and norms in the academic system. Res Policy 29:291–301. https://doi.org/10.1016/S0048-7333(99)00067-0
30. Raymond CM, Fazey I, Reed MS, Stringer LC, Robinson GM, Evely AC (2010) Integrating local and scientific knowledge for environmental management. J Environ Manag 91:1766–1777. https://doi.org/10.1016/j.jenvman.2010.03.023
31. Schmidt L, Pröpper M (2017) Transdisciplinarity as a real-world challenge: a case study on a North–South collaboration. Sustain Sci 12:365–379. https://doi.org/10.1007/s11625-017-0430-8
32. Vilsmaier U, Engbers M, Luthardt P, Maas-Deipenbrock RM, Wunderlich S, Scholz RW (2015) Case-based mutual learning sessions: knowledge integration and transfer in transdisciplinary processes. Sustain Sci 10:563–580. https://doi.org/10.1007/s11625-015-0335-3
33. Westberg L, Polk M (2016) The role of learning in transdisciplinary research: moving from a normative concept to an analytical tool through a practice-based approach. Sustain Sci 11:385–397. https://doi.org/10.1007/s11625-016-0358-4
34. Felt U, Igelsböck J, Schikowitz A, Völker T (2016) Transdisciplinary sustainability research in practice: between imaginaries of collective experimentation and entrenched academic value orders. Sci Technol Hum Values 1:732–761. https://doi.org/10.1177/0162243915626989
35. McKee A, Guimaraes MH, Pinto-Correia T (2015) Social capital accumulation and the role of the researcher: an example of a transdisciplinary visioning process for the future of agriculture in Europe. Environ Sci Pol:88–99. https://doi.org/10.1016/j.envsci.2015.02.006
36. Mobjörk M (2010) Consulting versus participatory transdisciplinarity: a refined classification of transdisciplinary research. Futures 42:866–873. https://doi.org/10.1016/j.futures.2010.03.003
37. Cundill G, Roux DJ, Parker JN (2015) Nurturing communities of practice for transdisciplinary research. Ecol Soc 20:22. http://dx.doi.org/10.5751/ES-07580-200222.
38. Zingerli C (2010) A sociology of international research partnerships for sustainable development. Eur J Dev Res 22:217–233. https://doi.org/10.1057/ejdr.2010.1
39. Fuchs D, Glaab K (2011) Material power and normative conflict in global and local agrifood governance: the lessons of 'Golden Rice'in India. Food Policy 36:729–735. https://doi.org/10.1016/j.foodpol.2011.07.013.
40. Partzsch L, Fuchs D (2012) Philanthropy: power with in international relations. Journal of political power 5:359–376. https://doi.org/10.1080/2158379X.2012.735114.
41. Partzsch L (2015) Kein Wandel ohne Macht-Nachhaltigkeitsforschung braucht ein mehrdimensionales Machtverständnis. GAIA-Ecological Perspectives for Science and Society 24:48–56. https://dx.doi.org/10.14512/gaia.24.1.10.

42. Fritz L, Meinherz F (2020) The politics of participatory sustainability assessments: An analysis of power. In: C. R. Binder, E. Massaro, R. Wyss (Eds.): Sustainability Assessment of Urban Systems. Cambridge: Cambridge University Press, 87–122.

43. Fuchs D, Di Giulio A, Glaab K, Lorek S, Maniates M, Princen T, Røpke I (2016) Power: the missing element in sustainable consumption and absolute reductions research and action. J Clean Prod 132:298–307. https://doi.org/10.1016/j.jclepro.2015.02.006.

44. Weber M (1972) Wirtschaft und Gesellschaft. 5. rev. Aufl, Tübingen 242

45. Dahl RA (1957) The concept of power. Syst Res Behav Sci 2:201–215

46. Gaventa J, Cornwall A (2008) Power and knowledge. In: Reason P; Bradbury H (eds.) The sage handbook of action research: participative inquiry and practice, Sage, London, 172–189

47. Gaventa J (2006) Finding the spaces for change: a power analysis. IDS Bull 37:23–33

48. Bachrach P, Baratz M (1962) Two faces of power. Am Polit Sci Rev 56

49. Hayward CR (2000) De-facing power. Cambridge University Press, New York a.o

50. Lukes S (1974) Power: a radical view. Macmillan, London and New York

51. Digeser P (1992) The fourth face of power. J Polit 54:977–1007. https://doi.org/10.2307/2132105.

52. Foucault M (1977) Discipline and punish: the birth of the prison. Vintage Books, New York

53. Greenwald HP (2007) Organizations: management without control. Sage Publications, Los Angeles a.o.

54. Purdy JM (2012) A framework for assessing power in collaborative governance processes. Public Adm Rev 72:409–417. https://doi.org/10.1111/j.1540-6210.2011.02525.x

55. Haraway D (1988) Situated knowledges: the science question in feminism and the privilege of partial perspective. Fem Stud 14:575–599. https://doi.org/10.2307/3178066.

56. Collins HM, Evans R (2002) The third wave of science studies: studies of expertise and experience. Soc Stud Sci 32:235–296. https://doi.org/10.1177/0306312702032002003.

57. Harding S (1992) Rethinking standpoint epistemology: what is "strong objectivity?". The Centennial Review 36:437–470

58. Jasanoff S (2003) Technologies of humility: citizen participation in governing science. Minerva 41:223–244. https://doi.org/10.1023/A:1025557512320.

59. Schneidewind U, Augenstein K, Stelzer F, Wanner M (2018) Structure matters: real-world laboratories as a new type of large-scale research infrastructure: a framework inspired by Giddens' structuration theory. GAIA-Ecological Perspectives for Science and Society 27:12–17. https://doi.org/10.14512/gaia.27.S1.5.

60. Wolff S (2004) Analysis of documents and records. In: Flick U; von Kardoff E; Steineke, I (eds): A companion to qualitative research. Sage: London a.o. 284–289

61. Lincoln YS, Guba EG (1985) Naturalistic inquiry. SAGE

62. Kohl E, McCutcheon P (2015) Kitchen table reflexivity: negotiating positionality through everyday talk. Gend Place Cult 22:747–763. https://doi.org/10.1080/0966369X.2014.958063.

63. Bourdieu P, Wacquant LJ (1992) An invitation to reflexive sociology. University of Chicago Press, Chicago

64. Gunasekara C (2007) Pivoting the centre: reflections on undertaking qualitative interviewing in academia. Qualitative Research 7:461–475. doi: https://doi.org/10.1177/1468794107082302

65. England KV (1994) Getting personal: reflexivity, positionality, and feminist research. Prof Geogr 46:80–89. https://doi.org/10.1111/j.0033-0124.1994.00080.x.

66. Defila R, Di Giulio A (2018) What is it good for? Reflecting and Systematizing Accompanying Research to Research Programs. GAIA - Ecological Perspectives for. Science and Society 27:97–104. https://doi.org/10.14512/gaia.27.S1.17

67. Witzel A, Reiter H (2012) The problem-centred interview. Sage, Los Angeles a.o.

68. Schiffer E, Hauck J (2010) Net-Map: collecting social network data and facilitating network learning through participatory influence network mapping. Field Methods 22:231–249. https://doi.org/10.1177/1525822X10374798

69. Schneider F, Buser T (2018) Promising degrees of stakeholder interaction in research for sustainable development. Sustain Sci 13:129–142. https://doi.org/10.1007/s11625-017-0507-4

70. Mayring P (1991) Qualitative in halts analyse. In: Handbuch Qualitative Sozialforschung. Grundlagen, Konzepte, Methoden und Anwendungen. Psychologie Verlags Union, München

71. Gibbs GR (2008) Analysing qualitative data. Sage

72. Akrich M (1992) The description of technical objects. In: Bijker WE, Law J (eds) Shaping technology/building society, studies in socio technical change. MIT Press, Cambridge, MA, pp 205–224

73. Völker T (2014) "Futuring" in transdisciplinary sustainability research. University of Vienna

74. Patton MQ (1999) Enhancing the quality and credibility of qualitative analysis. Health Serv Res 34:1189

75. Di Giulio A, Defila R, Brückmann T (2016) "Das ist halt das eine … Praxis, das andere ist Theorie"-Prinzipien transdisziplinärer Zusammenarbeit im Forschungsalltag. In: Defila R, Di Giulio A (eds) Transdisziplinär forschen-zwischen Ideal und gelebter Praxis: Hotspots, Geschichten, Wirkungen. Campus Verlag

76. Kanter RM (2008) Men and women of the corporation: new edition. Basic books, New York

77. Defila R, Di Giulio A (2019) Eine Reflexion über Legitimation, Partizipation und Intervention im Kontext transdisziplinärer Forschung. In: Ukowitz M; Hübner R (eds) Interventionsforschung alsVermittlung zwischen Wissenschaft und Praxis. Einblicke in methodologische Fragen transdisziplinärer Forschung. Springer, Wiesbaden, 85–108

78. Castree N, Adams WM, Barry J, Brockington D, Büscher B, Corbera E, Demeritt D, Duffy R, Felt U, Neves K (2014) Changing the intellectual climate. Nat Clim Chang 4:763. https://dx.doi.org/10.1038/nclimate2339.

79. Tötzer T, Sedlacek S, Knoflacher M (2011) Designing the future—a reflection of a transdisciplinary case study in Austria. Futures 43:840–852. https://doi.org/10.1016/j.futures.2011.05.026.

80. Stirling A (2008) "Opening up" and "closing down" power, participation, and pluralism in the social appraisal of technology. Sci Technol Hum Values 33: 262–294. https://doi.org/10.1177/0162243907311265.

Publisher's Note

6 Manuscript VI

Bibliographic details:

Fritz, L., Meinherz; F. 2020. Tracing power in transdisciplinary sustainability research: an exploration. *GAIA - Ecological Perspectives for Science and Society*, in press.

Contribution of the doctoral candidate:

The doctoral candidate was the main responsible for conceptualising this research, conducted the expert workshop and wrote the manuscript. The co-author supported the development of the theoretical power lens (table 1), the interpretation of empirical examples (table 2), and provided feedback on the manuscript.

Tracing power in transdisciplinary sustainability research: an exploration

Author 1*and Author 2

*anonymised for double-blind peer review

Lead text

In this article, we draw the contours of a power lens on transdisciplinary sustainability research and distil empirical questions for systematically studying the role of power throughout transdisciplinary knowledge production processes.

Abstract

While transdisciplinary (TD) sustainability research is closely tied to ideas of societal change, critical enquiries into power dynamics within as well as stemming from these practices have been scant. In this article, we operationalise theories of power for an exploration of the multiple ways in which power relations pervade interactions between researchers and practitioners in sustainability research. Combining theories of *power over, to* and *with*, we propose a set of empirical questions for systematically studying productive as well as repressive forms of power. With empirical examples, we illustrate how the proposed approach allows for tracing power throughout TD processes: (i) in developing the project and framing the research problem, (ii) in co-producing knowledge and (iii) in bringing results to fruition. The proposed power lens can guide both self-reflections of actors involved in TD processes and meta-analyses by third parties. An enhanced understanding of the workings of power can improve process design and facilitate a reflexive TD practice.

Keywords: participation, power, transdisciplinary research, sustainability, co-production

1. Introduction

In sustainability research, transdisciplinary (TD) knowledge production is seen as a promising approach for addressing complex problems, characterised by high uncertainties, inevitable trade-offs and at times incommensurable values (Kates 2016). Tools have been developed with the expectation that the participation of practitioners and the inclusion of their expertise in TD research processes allows for co-producing societally relevant knowledge and leverages the potential of research to stimulate societal change (Schneider and Buser 2018). While as knowledge production processes TD research pursues primarily epistemic goals, it is often also motivated by transformational goals, such as the empowerment of marginalised actors (Marshall et al. 2018) or the stimulation of societal learning (Westberg and Polk 2016).

The participation of diverse actors in TD knowledge production, however, does not necessarily live up to these ideals or produce these desired outcomes. The design of the participation process and the context within which it is situated matter for how actors relate to it and for the values and expertise which are included in/excluded from it (Bieluch et al. 2016). In the case of TD knowledge production in the field of sustainability, we argue, such processes are likely to involve some kind of power dynamics because they consist of social interactions of heterogeneous actors (researchers and practitioners), are embedded in dominant structures and discourses in the wider academic and practice contexts and deal with value-laden and contested issues (Avelino 2017). Recognising participation and co-production of knowledge in TD research as relational and social processes (Fritz and Binder 2018), thus, requires the disclosure of negotiations and power dynamics shaping them.

The role of power in TD knowledge production and the need for unfolding how participation is entangled with power and politics throughout such research processes have increasingly been acknowledged (Bieluch et al. 2016; Bréthaut et al. 2019; Marshall et al. 2018; Pohl et al. 2010; Schmidt and Neuburger 2017). TD scholarship has

1

previously found power to manifest in the unequal distribution of financial and time resources between researchers and practitioners (Raymond et al. 2010; Rosendahl et al. 2015), pointing to the influence of the wider academic system on these practices. Linked to macro-societal structures, group dynamics and dominance of some individuals are observed as another manifestation of power in TD processes (Westberg and Polk 2016). Drawing on diverse knowledges has further called attention to their different epistemological foundations as well to varying degrees of credibility and authority ascribed to them in TD processes (McKee et al. 2015; Rosendahl et al. 2015). Despite the wide acknowledgement that power relations pervade TD processes, their role is rarely explored in detail or in a systematic way (Zingerli 2010). Analytical tools for studying power relations and their effects in such research processes are needed.

In this article, we ask how we can empirically grasp different forms of power in TD sustainability research. We aim at operationalising abstract theories of power for an exploration of the ways in which power relations shape interactions between researchers and practitioners in sustainability-oriented knowledge production processes. Guided by social theories of *power over, to* and *with*, we propose a set of empirical questions that take into account the repressive and productive sides of power. Relying on examples from TD practice, we illustrate how this approach allows us to trace power throughout TD processes: (i) in developing the project and framing the research problem, (ii) in co-producing knowledge and (iii) in bringing results to fruition. The proposed power lens can guide self-reflections of researchers and practitioners involved in a TD process and meta-analyses by third parties, including accompanying research. Unveiling the often tacit ways in which power affects TD processes provides a first step towards dealing with them in a constructive manner. Greater knowledge of the workings of power subsequently contributes to reflexive process design and implementation and facilitates a conscious management of (un-)desired power dynamics.

With this exploration we aim at building a platform for future discussions on fundamental questions such as which kind of power impedes joint knowledge production and problem-solving and which kind of power leads to an increased potential of reaching epistemic and transformational goals. Such questions show that analysing power is not only of theoretical interest, but also of practical relevance for those engaging in TD practices.

2. Methods and material

This article combines theoretical and exploratory qualitative research. The theoretical framework was conceived from an integration of existing social theories of power and TD sustainability scholarship. It was then applied and refined in an expert workshop with seven TD researchers from across Switzerland, taking place in Lausanne in November 2018. The following criteria guided the selection of participants: experience in practicing and researching TD, focused on sustainability-related topics, diverse Swiss institutions. The goal was to test the usefulness and refine on the basis of the experience and expertise of the workshop participants a framework for analysing diverse forms of power throughout a TD research process. Participants were asked to choose one TD project that they had been closely involved in and that was finished by the time of the workshop[1]. Guided by an earlier version of the empirical questions (table 1), they mapped their experiences with power on a matrix crossing power forms and process phases (see annex). Based on these real-world situations in which power manifested, the analytical categories of the framework were refined and mechanisms and sources of power were derived (table 2). The workshop lasted three hours and was documented by two note-takers. The first author merged the notes of the two observers, discussed unclear passages with them and combined them with the photo documentation of flipcharts and mapping grids and her own verbatim from memory. This material provided the basis for the qualitative analysis which combined deductive and inductive elements. Workshop results are presented in aggregated form in order to ensure anonymity and prevent traceability to individual projects.

While this serves the purpose of illustrating the application of the power lens proposed, it does not allow for a fully-fledged analysis of when and under which circumstances different manifestations of power occur. The explorative character of the workshop limited the extent to which the specificities and situatedness of the projects could be considered. Since only researchers took part in the workshop, the interpretation of power situations from the practitioners' standpoints are not accounted for. In the workshop setting with limited time available, some

---

[1] The projects were in the field of energy, land use, water and regional development.

forms of power were more challenging to reveal than others. Notably, discursive and invisible forms of power related to norms of 'good' participation or 'appropriate' science-society relations as well as to epistemic authority and knowledge hierarchies remained underexplored. These require further research relying on a rich methodological repertoire (including participatory observations, analysis of projects outputs, multi-sited ethnography, in-depth interviews gathering different actors' perspectives).

3. The contours of a power lens on TD sustainability research

In this section we present the theoretical premises and derived empirical questions that we propose for systematically studying power in TD sustainability research. The proposed power lens rests on two building blocks: (i) conceptual elements of TD and (ii) selected theories of power.

3.1. Conceptual elements of a generic TD sustainability research process

For the development of a power lens on TD, we focus on the following conceptual elements that are referred to in TD research:

Consists of interlinked process phases: We adopt a process-oriented perspective and rely on a frequently used distinction of three inter-linked phases structuring TD research: (i) the development phase: framing of the problem, choosing the appropriate sustainability approach, defining goals; (ii) the knowledge production phase: applying (participatory) methods for knowledge generation, (iii) the dissemination phase: re-integrating results in research and practice, in some cases implementation of findings (Schneider and Buser 2018). We acknowledge that in practice this linearity is oversimplifying and that the process can be iterative.

Involves diverse societal actors: The participation of and interaction between researchers and practitioners[2] constitute a defining features of TD. Concomitantly, TD research processes, as understood here, are social and interactive processes (Fritz and Binder 2018). Interactions between researchers and practitioners can, but not necessarily do, take place across all phases. Furthermore, intensities of these interactions oscillate throughout the process (Stauffacher et al. 2008).

Pursues epistemic ends: TD processes, as understood in this article, are knowledge (co-)production processes and the participation of practitioners serves primarily these epistemic ends (Defila and Di Giulio 2018). In sustainability research with a transformative ambition, epistemic and social or democratic ends of TD might co-exist or overlap (Lamine 2018). Here we are particularly interested in the epistemic role of participation and less in its democratic function as in the case of political decision-making processes.

Is situated and interacts with context: Whereas a TD process creates its own social context (the project context), it is also embedded in the wider social context of which the participating researchers and practitioners are part (practice and academic context; fig. 1). Norms, discourses and structures in this wider context can shape power relations within a TD project . Likewise, a project or some of its actors might implicitly or explicitly aim at transforming the surrounding structures, discourses and norms, especially in TD research with a transformative ambition (Schneidewind et al. 2018).

---

[2] For the sake of simplicity, we differentiate two types of actors: researchers and practitioners. Researcher designates a person who conducts research as main profession and acts in her/his function as 'certified expert' (Collins and Evans 2002) in the field of interest. Although practitioners might have academic training, they do not conduct research as their main profession. They, however, also hold issue-specific expertise. These actor groups are not homogenous entities. Researchers include scientists from the natural and social sciences, at different career stages, holding diverse epistemological and ethical values. Practitioners include policy-makers and politicians, public service providers, private sector actors, third sector actors and individual citizens. We focus on research-practice interactions and put aside other features of TD, such as interdisciplinary exchanges (Schneider and Buser 2018).

Fig. 1. Process view of a generic TD process interacting with wider context
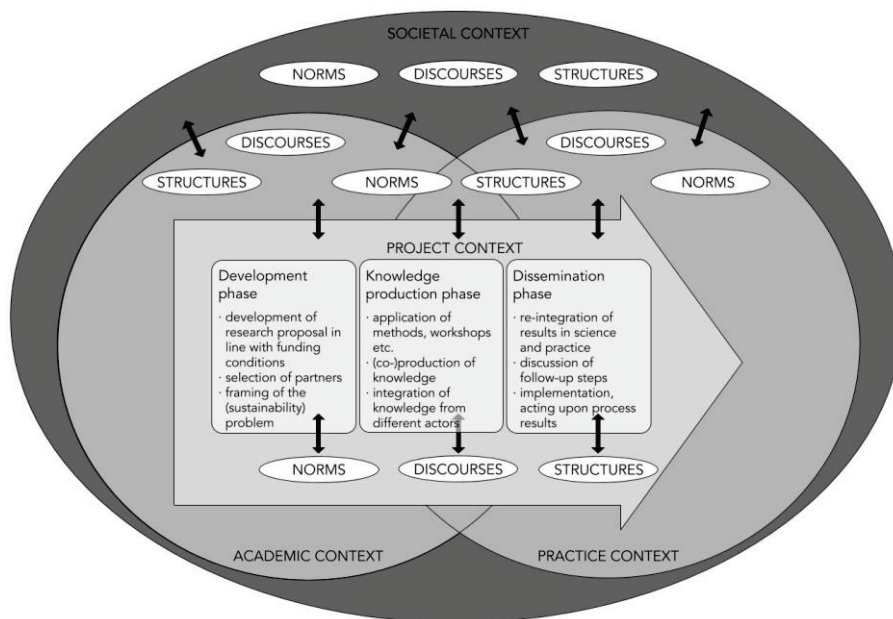
3.2. Theories of power[3]

Power is a contested concept filled with a myriad of meanings. Some theorists conceive of power as being held by actors, some of whom are powerful and others correspondingly powerless. Power in this conception is a 'zero sum game' in which the gain of power by some happens at the expense of others. For other theorists, power is embodied in complex relations and discourses. In such approaches power is fluid and accumulative - it can be shared or created by actors and their networks (Gaventa 2006). Given our aim to study power in researcher-practitioner interactions, we focus on relational theories of power and follow approaches that integrate both structures and actors in the analysis of power. Manifestations of power, in this sense, result from the configuration of the contexts in which actors and their interactions are embedded as well as from actors' relative positions in these contexts. The latter are in part shaped by actors' capacity to mobilise contextually relevant resources (Bourdieu 2016).

In order to grasp the diverse and complex manifestations of power, we follow Partzsch's (2015) work on power in sustainability research and base our reasoning on Allen's (1998) multidimensional conceptualisation. She combines theories of *power over, power to* and *power with*. We complement her conceptualisation with elements which seem particularly relevant regarding participation in knowledge production processes and the specificities that flow from their epistemic ends. For this, we rely on literature on power and participation in development research as well as in science and technology studies.

3.2.1. Power over

Power over refers to power that is exerted over actors, structures and discourses and is often distinguished in four dimensions, also referred to as "faces of power" (Partzsch 2015).

The 1st face of power describes the ability of A to get B to do something that B might not otherwise do (Dahl, 1957). The capacity of actors to mobilise financial and symbolic resources, such as knowledge, in order to influence a decision or process is key in this face of power (Gaventa and Cornwall 2008). This form of power is considered fairly visible in decision-making processes.

With their work on "The two faces of power", Bachrach and Baratz (1962) redefine much of the power debate. In their expansion, the powerful can prevent conflict from arising by limiting the scope of decision-making to issues

---

[3] This section is based on the book chapter «The Politics of Participatory Sustainability Assessments: an Analysis of Power» (Fritz and Meinherz in press), in which we provide a more extensive review of theories of power and propose a theoretical framework for the context of sustainability assessment.

which do not threaten the status quo (Hayward, 2000). Limiting power to the 1st face means that the absence of certain voices in a debate is due to their own disinterest. In the 2nd face, this very mechanism results from an exclusion from the process (Gaventa and Cornwall 2008; Hayward 2000). This form of power is hidden, for instance when certain actors control what is put on the agenda prior to a participatory process. It is exercised through mechanisms that exclude and delegitimise the concerns or knowledge of some actors (Gaventa 2006). The rules of the game – i.e. the configuration of the context in which interactions take place and actors' capacity to mobilise resources which matter therein - facilitate access to a process for established actors and complicate meaningful participation for others. Initially excluded actors who are given access may be required to imitate the language, behaviour or knowledge of established actors, pointing to social positioning as a source of power (Gaventa and Cornwall 2008).

Lukes (1974) adds a 3rd view on power according to which power can also be exerted if B consciously wants to do what A desires. In this face, power is wielded by means of manipulating the desires and beliefs of B (Digeser 1992). The 3rd face refers to invisible forms of power which are exercised by covertly manipulating others to do something, by changing what they think they want (Gaventa 2006). Knowledge and its control appear as crucial for influencing people's consciousness (Gaventa and Cornwall 2008).

Following Foucault's work, interrelations between knowledge, power and politics refer to a 4th face of power (Digeser 1992). While in the first three faces As and Bs are taken for granted, the 4th face goes one step further in that subjects do not exist in a natural state. Power here means that subjectivity and individuality are historically and socially constructed (Partzsch 2015). In our case this implies that categorisations of actors as knowledge-holders and epistemic authorities are not pre-given[4]. To understand power, the construction and effects of norms and values need to be tackled. The power of an idea or discourse—in our case e.g. practitioners' participation in science - exists only in relation to other ideas or discourses—e.g., objective science. Moreover, actors tend to be perceived as more legitimate when they invoke knowledge which is aligned with established ideas and discourses (Fuchs and Glaab 2011). Knowledge and power, thus, mutually constitute each other (Foucault 1977). What is considered reliable knowledge or even truth is shaped by actors' standpoints (Harding, 1992) and their status as 'certified experts' (Collins and Evans 2002). This form emphasises the role of accepted truths and knowledge regarding desirable developments in stabilising certain paths of action. Within this perspective, knowledge production, thus, is not only an epistemic endeavour, but also an ontological one, an act "of making, rather than merely depicting, what is at stake" (Passoth and Rowland 2016, p. 38). Whereas in the other faces, it is possible for relationships to not be mediated by power, here power is ubiquitous and cannot be obliterated.

3.2.2. Power to

In this view, power is the capacity of individual actors to form and shape processes despite resistance (Haugaard 2012) and is roughly synonymous with empowerment[5] (Allen 1998). Allen (1998, pp. 34–5) defines *power to* as "the ability of an individual actor to attain an end". She illustrates that just as one can assert power to act "in response to a system of domination", one can wield "power to act by dominating others, not simply by resisting". Resistance appears as one possible manifestation of *power to*, just as domination is one particular manifestation of *power over* (Allen 1998). The emphasis in this conceptualisation lies on the agency of individuals and their capacity to act and achieve their goals.

3.2.3. Power with

In *power with*, power appears as the capacity to collectively learn and act. Finding commonalities across different interests and developing collective strengths are the core of *power with*. The notion refers to learning processes and the development of a new consciousness of a group or a community of individuals (Partzsch 2015). *Power with* is associated with Arendt's (1970, p. 44) view on power being "the human ability not just to act but to act in

---

[4] Rather they are constructed based on norms, discourses and structures which prevail in a given social context. Such categorisations shape actors' position in the social context and hence their interactions. This way, discourses and structures are reproduced or altered, so that there is an interdependence between subjectivities and the context in which they are constructed.

[5] Throughout this article, we rely on the notion of empowerment simply to designate an actor's capacity to act. We, furthermore, concur with Cashmore (2019, p. 26) that "irrespective of the precise way in which empowerment is understood, what is central to the notion is that empowerment allows individuals or collectives to positively shape their futures".

concert". Following this interpretation, Allen (1998 p. 35) defines *power with* as "the ability of a collectivity to act together for the attainment of a common or shared end". The emphasis in this conceptualisation lies on the productive forces of power (Partzsch 2015).

3.3. Combining multiple forms of power and phases of TD

Rather than following the approaches of scholars who interpret power in either one of its dimensions (Haugaard 2012), the power lens proposed in this article explicitly highlights the interrelatedness of *power over, to,* and *with.* The three dimensions are analytical rather than ontological categories[6]. In any given situation they might be observable simultaneously (Allen 1998) and categorising them depends on the analyst's standpoint and the scale considered in the analysis. They provide us with the analytical tools for grasping the complexity of power dynamics throughout a TD process and the diverse experiences with power. Combining them in one approach highlights that consensual forms of power or empowerment at a local scale are not free of macro-societal *power over* mechanisms, which shape the capacities of individual actors to articulate themselves and lead to the marginalisation of some groups, discourses or knowledges within a community. Likewise it incites us to look for the ways in which *power with,* e.g. through collective action, disrupts discourses and structures that maintain *power over* (Partzsch 2015). Thus, a multidimensional approach allows for scrutinising the productive aspects of power without neglecting the unproductive ones.

Based on these theoretical foundations, in table 1 we distil empirical questions[7] for systematically studying power throughout TD sustainability research processes. While some questions are equally relevant for each phase of a generic TD process, others are particularly important at specific moments of the process. The main process phase attributed in table 1 provides an analytical starting point - it does not mean that the questions are exclusively relevant in the phase indicated.

---

[6] The three dimensions put the analytical focus on different facets and mechanisms of power. *Power over* calls attention to the ways in which actors, structures and discourses wield power over others and points to the conflictual nature of power. *Power to* directs analysis to the capacity of individual actors to act and achieve their respective goals. *Power with* suggests we focus on situations in which collectives form and act for achieving joint goals. Here consensual aspects of power are emphasised (Fritz and Meinherz in press).

[7] In order to stimulate reflection, the questions are deliberatively framed as open and not as closed yes-or-no questions. Answers, thus, need to be interpreted. For instance, if the answers to the questions on power *over* reveal that only one actor group takes decisions, that project structures privilege some actors over others, that the distribution of resources is unequal or that any other imbalances exist, *power over* is likely to be at work.

6

Table 1. Empirical questions for multidimensional analysis of power in TD sustainability research [adapted from Fritz and Meinherz in press]

FORM OF POWER	EMPIRICAL QUESTIONS	MAIN PROCESS PHASE
POWER OVER is wielded over actors, structures and discourses	▪ Which actors from research and/or practice define the problem to be assessed, the sustainability approach adopted and the research design?	Development phase
	▪ Which actors from research and/or practice hold the decision of who is (not) invited to participate and set the terms and formats of how participants in the TD process interact? Which criteria, norms or discourses orient these decisions?	Development phase
… the capacity to overtly influence decisions and action of others (1st face)	▪ How are the resources needed to participate in the TD process and to influence decisions/processes/outputs distributed among actors from research and/or practice?	All phases
… the capacity to set the agenda and to covertly influence decisions (2nd face)	▪ For which tasks and in which situations along the TD process do researchers depend on practitioners or vice versa?	All phases
	▪ In which ways do the funding conditions and other structural factors influence the set-up and evolution of the TD process?	All phases
… the capacity to shape ideas, norms and intentions (3rd face)	▪ In which ways does the process set-up influence the capacity of actors from research and/or practice to articulate their concerns and contribute their expertise?	Knowledge production phase
… the social constructed-ness of subjectivity in social and historical processes (4th face)	▪ In which ways do epistemological values and norms of what characterises valid knowledge and appropriate science-society relations shape the boundaries of participation in the TD process?	Knowledge production phase
	▪ To which extent does the TD process and the results it produces question established discourses, institutions and practices?	Dissemination phase
POWER TO is the individual capacity to act	▪ Which individual actors involved in the TD process achieve their goals?	All phases
	▪ In which situations are actors from research and/or practice opposed to decisions or actions by other actors involved in the TD process?	All phases
	▪ In which ways does the TD process enhance the capacities of actors from research and/or practice to achieve their goals?	All phases
POWER WITH is the capacity to collectively learn and act	▪ Which new project goals and problem understandings emerge in the TD process?	Development phase
	▪ Which new collectives, discourses or practices emerge through the TD process?	Knowledge production phase, dissemination phase
	▪ How do actors from research and/or practice build bridges across different knowledges and collectively learn from the TD process?	All phases

4. An illustrative application of the power lens on TD sustainability research

In this section, we schematically show how the power lens can be applied for an empirical study of TD sustainability research. Rather than providing a comprehensive analysis of power in TD knowledge production, we use examples discussed in an expert workshop to illustrate how various forms of power can manifest themselves and shape interactive processes. Presenting these examples, we point to the interrelatedness of the three forms of power within one project phase, their potential to change throughout project phases and their embeddedness in structural contexts at different scales. The illustration serves the purpose of demonstrating how the empirical questions can be applied and how the answers obtained can be systematically interpreted. In this attempt, in table

7

2, for each power manifestation, we identify the mechanism through which researchers, practitioners or funders exercise power, point to the sources which actors mobilise and to the structural (project, academic, or social) context in which these sources reside. This, we hope, gives ideas for more in-depth empirical analyses of power in TD projects.

In the following, we elaborate on table 2. <insert table here>

4.1. Development phase

Workshop participants identified funding bodies as directly influencing the development of the TD endeavour. By determining the framework within which the research project had to fit, they wielded *power over* it, reaffirming the crucial role of the funding context and the control of financial resources in shaping TD practices. Some workshop participants identified specific actor constellations, where the funder was at the same time a practitioner involved in the project and in this role influenced decisions at the micro-level of the project. This constellation entailed hierarchies among different practitioners. Workshop participants shared the experience that while project proposals had to comply with the funding requirements, decisions on the formats, timing and agenda of interactions and the selection of participants were taken by project actors, mostly researchers. After project approval, the researchers emancipated from the funding requirements and developed *power to* act according to their research interests. In specific cases, *power to* manifested in the empowerment of researchers as legitimate actors in the practice field because they were financially supported by renowned institutions with well-established social relations, such as Ministries and governmental agencies. These examples illustrate how power dynamics in one actor relationship – here between researchers and the funder – can take different forms depending on the funding context and the process step. This exemplifies the importance of analysing power relations as dynamically constructed in interactions.

When researchers unilaterally took the above mentioned decisions on the terms of involvement and the research problem, the workshop participants referred to *power over* dynamics in researcher-practitioner relations. In several projects, the allocation of resources from the outset was conducive to such dynamics. When practitioners did not receive financial support, their capacities to engage were circumscribed. Alternatively, examples were provided in which one practitioner or a small group of practitioners strongly influenced the problem framing. In this case, the interests and values of (some) practitioners dominated the development phase. An overt exercise of *power over* was observed in a project where one actor explicitly omitted a research question from the set of possible questions. This shows how mobilisations of *power to* - one actor is able to achieve his/her goals - relate to exercises of *power over* in his/her relationship to others. It also exemplifies how depending on an actor's standpoint, the same interaction reflects different forms of power, thus stressing their analytical, rather than ontological, character.

In this project phase, workshop participants identified trust building among the actors involved as an indication of *power with*. Regarding early trust building, workshop participants found path-dependencies of power relations: projects which at early stages were dominated by only a few actors, were experienced to be less likely to unfold *power with* at later stages. Still, oscillations of different forms of power were described: while the overall project design might be unilaterally shaped by researchers, responsibilities for designing and conducting workshops might be shared between researchers and practitioners and yet other steps might be dominated by practitioners' preferences.

4.2. Knowledge production phase

Workshop participants detected researchers' *power over* formats of interaction and timing of participatory knowledge production steps. Their *power over* the structuration and implementation of the process was reinforced in situations of unequal allocation of financial resources, e.g. when practitioners did not benefit from support structures and lacked the time resources to form the process. The workshop participants found practitioners to wield *power over* the process on the basis of their position and social relations in the practice context. Researchers depended on the latter's participation for gaining access to the field, facilitating data collection and for being recognised as valuable partners by other actors in the field. *Power over* also shaped interactions among practitioners. In participatory events such as scenario workshops, the distortion of group dynamics was observed when the presence of actors who are powerful outside the TD space (albeit

8

unintentionally) intimidated other actors or subtly influenced their behaviour in the participatory setting. In one case, the presence of a mayor impeded administrative representatives from voicing visions and thoughts on development strategies. In a second workshop in another municipality which was part of the same project and applied the same methods, a different actor constellation – high-ranking political representatives did not participate - resulted in dynamics of mutual learning (*power with*). This points to the importance of considering the situatedness of TD processes and the interactions between project and practice context in an analysis of power.

The experts' narrations of *power to* in the knowledge production phase refer to the empowerment of participating farmers, whose awareness of a soil degradation problem was raised through TD encounters, allowing them to build capacities for acting in their interest. *Power with* manifested when results were jointly created. This was narrated by workshop participants regarding the co-development of a natural resource management plan[11]. For such steps, researchers depended on practitioners and vice versa. Workshop participants noticed similar manifestations of power in the co-creation of visions, scenarios and strategies. As a result of these processes, the practitioners felt that 'their' topic gained traction and caught the attention of new actors. Additionally, they developed the capacities to jointly act despite diverging standpoints, i.e. they accumulated *power with*. These examples illustrate the interrelatedness of dimensions of power and how the interpretation of a power manifestation is tied to the scale of analysis: What is perceived as *power with* within the TD space (micro-scale) can lead to *power over* other actors in the practice context (macro-scale) who were not involved in the process. Depending on the structural context and the actor constellations within it, it is conceivable that the same mechanism contributes to changes in power structures (*power over*) by offering alternative problem framings, options or evidence as a basis for decision-making.

4.3. Dissemination phase

With regard to bringing results to fruition, workshop participants recalled situations in which researchers asserted *power over* knowledge compilation, mostly via the writing of publications. In doing so, researchers partly responded to implicit or explicit expectations by funders and practitioners who to varying degrees wielded *power over* dissemination practices or requested the adaption of dissemination formats so as to increase their usability. Likewise, workshop participants found norms of project evaluation and academic reward structures to shape dissemination strategies. Again, this illustrates how one actor – here the researchers – can simultaneously be in a position to exert *power over* others – here the practitioners – and be subjected to exercises of *power over* by others – here the funding bodies. It further illustrates how different faces of power over can interact, here its 1st face through explicit requirements by funders and its discursive 4th face through established norms regarding knowledge dissemination.

Workshop participants experienced situations of *power to* when practitioners were empowered with new knowledge resources that enhanced the legitimacy of certain actions, e.g., policy measures. *Power to* also unfolded when participants developed the capacity to use methods for co-producing knowledge in their day-to-day business. Likewise, *power to* manifested in the empowerment of researchers by practitioners, who informally endorsed them as valuable partners and invited them to other activities in the practice field. *Power with* was discerned in processes of co-validation of results as well as when co-created plans and visions were acted upon. The development of networks, long-term partnerships and joint follow-up projects appeared as another indication of *power with* stemming from the TD process. These examples point to interrelations between power *to* and *with*: Collective learning in the TD space (*power with)* can enhance individual actors' capacities to achieve their goals in the practice context (*power to).*

---

[11] In the example discussed this concerned a watershed management plan, which the researchers were initially in the lead to develop, but could do so only in a co-design process with local practitioners who implemented the plan.

9

Table 2. Examples of manifestation of power in the TD case studies discussed in the expert workshop [R=researcher P=practitioner; F=funding body]

PHASE	FORM	MANIFESTATION OF POWER	ACTOR	MECHANISM	STRUCTURAL CONTEXT	SOURCE OF POWER
DEVELOPMENT PHASE	Power over	▪ funding conditions shaped the design of the project and the allocation of resources	F	resource allocation	funding context	capacity to mobilise financial resources
		▪ researchers determined formats, timing, agenda of interactions and selected participants	R	planning and agenda setting	project/process and academic context	capacity to mobilise financial resources and knowledge
		▪ practitioners influenced definition of the research problem and question	P	planning and agenda setting	project/process and practice context;	capacity to mobilise financial resources, social relations, and knowledge
		▪ only researchers received funding, providing them the means to shape the process	R; F	resource allocation	funding context; project/process	capacity to mobilise financial resources
	Power to	▪ taking project decisions, researchers "emancipated" from funding structures	R	planning and agenda setting	project/process	building capacity to mobilise knowledge and experience
		▪ researchers were legitimised by funding body to approach practitioners	R	empowerment	practice context	building capacity to mobilise social relations and status
	Power with	▪ trust built as basis for further collaboration	R; P	trust building	project/process	jointly building various resources that can be mobilised together
		▪ joint initiation of project based on previous collaboration	R; P	joint action	project/process	drawing on jointly built experiences and understandings
KNOWLEDGE PRODUCTION PHASE	Power over	▪ researchers determined methods used for TD activities and knowledge integration	R	planning and agenda setting	project/process	capacity to mobilise social status, knowledge and experience
		▪ unequal distribution of resources reduced capacities of practitioners to actively shape the process	R	resource allocation, knowledge constellation	project/process	capacity to mobilise financial resources, knowledge and experience
		▪ practitioners granted researchers access to the field; researchers depended on the support of practitioners	P	actor composition	practice context	capacity to mobilise social relations
		▪ hierarchies outside TD process were transferred into TD space and distorted group dynamics	P	actor composition	project/process; practice context	capacity to mobilise social relations and status
	Power to	▪ empowerment of practitioners through awareness raised	P	learning processes	project/process; practice context	building capacity to mobilise knowledge and experience
		▪ solutions developed legitimised researchers as experts in the field	R	empowerment	practice context	building capacity to mobilise social status
	Power with	▪ co-production of results, co-creation of management and action plans, visions and scenarios	R; P	joint action	project/process	jointly building knowledge, understandings and experience
		▪ practitioners developed capacities to act jointly despite different standpoints	P	joint action	practice context	capacity to mobilise jointly built understandings and knowledge
DISSEMINATION PHASE	Power over	▪ knowledge compilation by researchers only	R	agenda setting	project/process; academic context	capacity to mobilise experience and knowledge
		▪ funding body and practitioners shaped dissemination and publication requirements	F; P	agenda setting	funding and practice context	capacity to mobilise financial resources and extant norms
	Power to	▪ enhanced capacities to act on the basis of process results	P	empowerment	practice context	building capacity to mobilise knowledge and experience
		▪ researchers were endorsed by practitioners as valuable partners	R	trust building	practice context	building capacity to mobilise social relations
	Power with	▪ co-validation of results	R; P	joint action	project/process	drawing on jointly built knowledge and experience
		▪ joint development of follow-up projects	R; P	joint action	academic and practice context	drawing on jointly built experiences and social relations
		▪ development of networks and partnerships	R; P	trust building	academic and practice context	drawing on jointly built social relations
		▪ implementation of findings, acting upon the knowledge co-produced	P	joint action	practice context	drawing on jointly built knowledge and experiences

10

5. Concluding remarks and outlook

In this article, we set out to provide a platform for debating and confronting power in TD sustainability research. We argued that enquiries into the normative goals of balancing power relations and transforming an unsustainable status quo, which are often implicit in TD sustainability research, are as well needed as an elucidation of power relations within TD processes. In order to arrive at a broad picture of the possible workings of power in TD processes, we adopted a conceptualisation that integrates three dimensions of power: *over, to* and *with*. Guided by this conceptualisation, we drew the contours of a power lens on TD sustainability research and presented empirical questions for tracing power throughout TD processes. On the basis of empirical examples gathered in an expert workshop, we schematically illustrated how the proposed power lens can be applied in future research and reflexive TD practice.

We showed that the proposed power lens has the potential to uncover how depending on the constellation and characteristics of actors, the layout of the process and the configuration of the wider context different forms of power can occur. The examples suggest that in TD projects power works in multiple ways and can be desirable as well as undesirable. The latter implies a normative judgment, which depends on the objectives set as well as the observer's standpoint. From the schematic application of the power lens we conclude that some aspects require particular attention in future analyses of power in TD research:

- *Considering scale:* Different forms of power overlap, and determining which form of power is at work, depends on the scale considered in the analysis and the standpoint taken. What is perceived as *power with* in the frame of the project can entail *power over* in the wider societal context or *power to* from the perspective of an individual actor.
- *Considering situatedness:* Analysing power requires sensitivity to the embeddedness of TD spaces in the wider socio-political context and the predominant science-society relations. Power constellations within TD processes vary according to hierarchies and structures in the practice context as well as the funding and academic context. Likewise, power constellations within TD processes can affect their capacity to shape the wider context.
- *Considering dynamics*: An analysis of power needs to consider how power relations can evolve throughout TD processes and identify possible path-dependencies. Considering dynamics also suggests accounting for histories of research-practice collaborations prior to the project of interest.

Although TD and even more so transformative sustainability research is closely linked to ideas of societal change, enquiries into power within and stemming from these practices are scant. In particular, experiences with power of practitioners are largely absent in the scholarly debate. Yet, understanding their perceptions is critical when it comes to acting upon the TD process and its results. A solid empirical basis on the workings of power will allow TD researchers and practitioners to design and conduct participatory elements in a way that stimulates forms of power which are productive regarding the goals of participation and minimises unproductive ones. The empirical questions proposed allow for rendering power dynamics visible and thus provide a first step towards tackling them. While some mobilisations of power can be restrained by careful design and the choice of adequate methods, others are elusive and require continuous reflection and transparency. By stressing the diverse manifestations of power, we hope to entice sustainability scholars to share their experiences with both productive and repressive forms of power within TD processes, thus contributing to building a practice-related knowledge base on the workings of power in TD research.

References

Allen, A. 1998. Rethinking power. Hypatia 13/1: 21–40.

Arendt, H. 1970. On violence. Boston: Houghton Mifflin Harcourt

Avelino, F. 2017. Power in sustainability transitions: Analysing power and (dis)empowerment in transformative change towards sustainability. Environmental Policy and Governance 27/6: 505-520.

Bachrach, P., Baratz, M. 1962. Two Faces of Power. American Political Science Review 56/4: 947-952.

Bieluch, K. H., Bell, K. P., Teisl, M. F., Lindenfeld, L. A., Leahy, J., Silka, L. 2016. Transdisciplinary research partnerships in sustainability science: An examination of stakeholder participation preferences. Sustainability Science 12/1: 87–104.

Bourdieu, P. 2016. La distinction: critique sociale du jugement. Paris: Minuit.

Bréthaut, C., Gallagher, L., Dalton, J., Allouche, J. 2019. Power dynamics and integration in the water-energy-food nexus: Learning lessons for transdisciplinary research in Cambodia. Environmental Science and Policy 94: 153–162.

Cashmore, M. 2019. Governing radical societal change. In: The Politics of Urban Sustainability Transitions: Knowledge, Power and Governance. Edited by J. Jensen, M. Cashmore, P. Späth. New York: Routledge. 17–32.

Collins, H. M., Evans, R. 2002. The third wave of science studies studies of expertise and experience. Social Studies of Science 32/2: 235–296.

Dahl, R. A. 1957. The concept of power. Behavioral Science 2/3: 201–215.

Defila, R., Di Giulio, A. 2018. Eine Reflexion über Legitimation, Partizipation und Intervention im Kontext transdisziplinärer Forschung. Partizipation und Intervention. Wege der Vermittlung in der transdisziplinären Forschung. In: Interventionsforschung. Wiesbaden: Springer. 85-108.

Digeser, P. 1992. The fourth face of power. Journal of Politics 54/4: 977–1007.

Foucault, M. 1977. Discipline and punish: The birth of the prison. New York: Vintage Books.

Fritz, L., Binder, C. R. 2018. Participation as relational Space: A critical approach to analysing participation in sustainability research. Sustainability 10/8: 2853-2882.

Fritz, L., Meinherz, F. In press. The politics of participatory sustainability assessments: An analysis of power. In: Sustainability Assessment in Urban Systems. Edited by C. R. Binder, E. Massaro, R. Wyss. Cambridge: Cambridge University Press. XX-XX.

Fuchs, D., Glaab, K. 2011. Material power and normative conflict in global and local agrifood governance: The lessons of 'Golden Rice' in India. Food Policy 36/6: 729–735.

Gaventa, J. 2006. Finding the spaces for change: A power analysis. IDS bulletin 37/6: 23–33.

Gaventa, J., Cornwall, A. 2008. Power and knowledge. In: The SAGE handbook of action research: Participative inquiry and practice, Vol. 2. Edited by P. Reason, H. Bradbury. Los Angeles: SAGE. 172–189.

Harding, S. 1992. Rethinking standpoint epistemology: What is "strong objectivity?". The Centennial Review 36/3: 437–470.

Haugaard, M. 2012. Rethinking the four dimensions of power: Domination and empowerment. Journal of Political Power 5/1: 33–54.

Hayward, C. R. 2000. De-facing power. Cambridge: Cambridge University Press.

Kates, R. W. 2016. Sustainability science. In: International Encyclopedia of Geography: People, the Earth, Environment and Technology. Edited by American Association of Geographers. Hoboken: Wiley. 1-4.

Lamine, C. 2018. Transdisciplinarity in research about agrifood systems transitions: A pragmatist approach to processes of attachment. Sustainability 10/4: 1241-1259.

Lukes, S. 1974. Power: A radical view. London: Macmillan.

Marshall, F., Dolley, J., Priya, R. 2018. Transdisciplinary research as transformative space making for sustainability: Enhancing propoor transformative agency in periurban contexts. Ecology and Society 23/3: 8.

McKee, A., Guimaraes, M. H., Pinto-Correia, T. 2015. Social capital accumulation and the role of the researcher: An example of a transdisciplinary visioning process for the future of agriculture in Europe. Environmental Science and Policy 50: 88–99.

Partzsch, L. 2015. Kein Wandel ohne Macht-Nachhaltigkeitsforschung braucht ein mehrdimensionales Machtverständnis. GAIA 24/1: 48–56.

Passoth, J.-H., Rowland, N. J. 2016. Modeling the state: An actor-network approach. In: Knowing Governance: The epistemic construction of political order. Edited by J.-P. Voß, R. Freeman. London: Palgrave Macmillan. 37–61.

Pohl, C., Rist, S., Zimmermann, A., Fry, P., Gurung, G. S., Schneider, F., Speranza, C. I., Kiteme, B., Boillat, S., Serrano, E. 2010. Researchers' roles in knowledge co-production: Experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. Science and Public Policy 37/4: 267–281.

Raymond, C. M., Fazey, I., Reed, M. S., Stringer, L. C., Robinson, G. M., Evely, A. C. 2010. Integrating local and scientific knowledge for environmental management. Journal of Environmental Management 91/8: 1766–1777.

Rosendahl, J., Zanella, M. A., Rist, S., Weigelt, J. 2015. Scientists' situated knowledge: Strong objectivity in transdisciplinarity. Futures 65: 17–27.

Schmidt, L., Neuburger, M. 2017. Trapped between privileges and precariousness: Tracing transdisciplinary research in a postcolonial setting. Futures 93: 54–67.

Schneider, F., Buser, T. 2018. Promising degrees of stakeholder interaction in research for sustainable development. Sustainability Science 13/1: 129–142.

Schneidewind, U., Augenstein, K., Stelzer, F., Wanner, M. 2018. Structure matters: Real-world laboratories as a new type of large-scale research infrastructure: A framework inspired by Giddens' structuration theory. GAIA 27/1: 12–17.

Stauffacher, M., Flüeler, T., Krütli, P., Scholz, R. W. 2008. Analytic and dynamic approach to collaboration: A transdisciplinary case study on sustainable landscape development in a Swiss prealpine region. Systemic Practice and Action Research 21/6: 409–422.

Westberg, L., Polk, M. 2016. The role of learning in transdisciplinary research: Moving from a normative concept to an analytical tool through a practice-based approach. Sustainability Science 11/3: 385–397.

Zingerli, C. 2010. A sociology of international research partnerships for sustainable development. European Journal of Development Research 22/2: 217–233.

13

7 Manuscript VII

Bibliographic details:

Meinherz, F., **Fritz, L.,** Schneider, F., 2020. How values play into sustainability assessments: challenges and a possible way forward. In: Binder, C.R., Massaro, E., Wyss, R. (Eds.): *Sustainability Assessment of Urban Systems.* Cambridge: Cambridge University Press, 65-86.

This manuscript is reproduced with permission of Cambridge University Press through PLSclear.

Contribution of the doctoral candidate:

The doctoral candidate was involved in the overall conceptualisation of the manuscript, the development of the line of argumentation, the identification of relevant literature and the development of recommendations. She provided inputs in particular on the parts referring to participatory approaches and deliberation.

3

How Values Play into Sustainability Assessments: Challenges and a Possible Way Forward

Franziska Meinherz, Livia Fritz, and Flurina Schneider

> No knowledge is "pure" knowledge, and so there are good political
> reasons why certain kinds of research trends develop rather than others.
> *(Mumby and Clair, 1997, p. 185)*

3.1 Introduction

A sustainability assessment has as its objective fostering progress toward sustainability. Empirical observations and scenarios are classified as more or less sustainable (Grunwald, 2004). A sustainability assessment is therefore centered around some notion of sustainability, which serves as the reference (Frame & Brown, 2008). Sustainability is, however, not a concept with one universally agreed-upon definition. There exists a plethora of conceptions of what sustainability means (Kates et al., 2005; Kemp & Martens, 2007; Martens, 2006). Essentially, the notion of sustainability makes reference to a desirable state of the world – it embodies a vision for society and its relationship with its environment. And different definitions of sustainability can be traced back to different such visions (Frame & Brown, 2008; Funtowicz & Ravetz, 1993; McCool & Stankey, 2004). By making reference to sustainability, a sustainability assessment is tied to the values which play into the visions for society and its relationship with the world that are captured in the notion of sustainability. As such, a sustainability assessment is fundamentally normative[1] (Frame & Brown, 2008; Grunwald, 2004; Kates et al., 2005; Kemp & Martens, 2007; Waas et al., 2014; Ziegler & Ott, 2011).

This raises questions with regard to the knowledge that is produced in a sustainability assessment. If a sustainability assessment is, indeed, tied to values, this means that its results or even the very process by which these results are obtained are unlikely to find much support outside the social context in which these values are considered legitimate. No sustainability assessment could then ever be definitive or universally acknowledged (Hirsch Hadorn et al., 2006; Kates et al., 2005; Kemp & Martens, 2007). The core purpose of a sustainability assessment is, however, to provide sound information, based on which decisions regarding sustainability issues can be taken (Kemp & Martens, 2007; Waas et al., 2014). How to produce such information in a context of strong normative positions is a question that remains unanswered, but various authors are working on clarifying it. On a conceptual level, approaches are being developed that distinguish different forms of

65

knowledge and discuss the role these should play in the assessment process (cf. Hirsch Hadorn et al., 2006; Schneidewind 2013, 2015). Other authors focus more on the operational level and are developing approaches by which they hope to bridge the need to produce sound knowledge and the presence of strong normative positions (cf. Ravetz & Funtowicz, 2015; Videira et al., 2010; Waas et al., 2014; and Chapters 6 (Schneider), 7 (Stelzer & Kopfmüller), 8 (Binder et al.), and 9 (Merino-Saum), in this volume).

With this chapter, we aim to contribute to these efforts by looking in more detail at how values actually shape notions of sustainability, how they come into being, and their implications on a knowledge-production process such as a sustainability assessment. Indeed, as van der Hel (2018) noted, while the normative dimension of sustainability is increasingly acknowledged by researchers in the field, a thorough investigation of how different values shape knowledge production for sustainability is still missing. In Section 3.2, we draw on literature from economic philosophy and political ecology to explore how values play into notions of sustainability. With this, we aim to better understand where this normativity of sustainability is located and how it plays out, and the challenges this presents for conducting sustainability assessments. In Section 3.3, we reflect on the implications of the necessity to refer to sustainability values for knowledge-production processes such as sustainability assessments and point to different positions regarding how science should engage with values. We illustrate that these different positions are ultimately expressions of different epistemic values. In Section 3.4, we look at how different values are interrelated with social and material dynamics and how knowledge-production processes are embedded in these interrelations. This allows us to identify further challenges that need to be addressed when conducting a sustainability assessment. Lastly, in Section 3.5, we develop suggestions for how the identified challenges could be addressed. With the discussion which we launch in this chapter, we aim to facilitate a critical reflection on the implications of different configurations of values on knowledge production for sustainability – a reflection which we hope will play into the application of the different approaches for conducting sustainability assessments that are presented in this volume.

3.2 The Value-Loadedness of Sustainability: An Analysis Based on Approaches to Ethics and Ecology

In this section, we flesh out the often-made assertion that different conceptions of sustainability are motivated by different values (cf. Kates et al., 2005) – that sustainability, per se, is a fundamentally normative concept (Frame & Brown, 2008; Grunwald, 2004; Kemp & Martens, 2007; Waas et al., 2014; Ziegler & Ott, 2011). We look at how different definitions of sustainability can be traced back to different underlying values; to ways of seeing the world and one's position in it. For this, we look at what sustainability, as a concept, actually seeks to define.

On the one hand, the concept of sustainability marks a commitment to satisfying the "unmet needs of society" (Hirsch Hadorn et al., 2006, p. 120), to ensuring that "the needs of

the present [are met] without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, p. 8), and to providing "for the fundamental needs of humankind in an equitable way without doing violence to the natural systems of life on earth" (Kemp & Martens, 2007, p. 5). On the other hand, as can already be seen from these quotes, the concept of sustainability describes a vision for the relationship between society and its environment (cf. Rametsteiner et al., 2011).

To illustrate how reflections both on human needs and on the relationship between humankind and its environment tie the sustainability concept to underlying values, we look at how human-made CO_2 emissions are conceptualized in different sustainability discourses. As Hayward (2007) notes, human-made CO_2 emissions can be thought of (1) as something that industries, people or countries have a right to, or (2) as something that industries, people or countries should be held accountable for. Proponents of either position tend to agree that the current level of human-made CO_2 emissions risks fundamentally altering the planetary climate balance, with consequences that are difficult to anticipate. They disagree, however, on the conclusions that should be derived from this. In Section 3.2.1, we show how their disagreement can be traced back to different perspectives on ethics, and in Section 3.2.2 how it reflects differences in how the relationship of society with its environment is conceived. We also touch upon how this affects the domain of sustainability assessments (Section 3.2.3).

3.2.1 CO_2 Emissions as a Means to an End or as Morally Unjust: Consequentialist and Deontological Ethics

Conceiving of human-made CO_2 emissions as something that industries, people, or countries have a right to boils down to seeing them as a means to the end of socioeconomic development. Such a perspective can be traced back to a consequentialist and utilitarian approach to ethics – meaning that an action is judged by the ends it makes it possible to achieve (cf. O'Neill, 2008). In our example, this means that whether any amount of CO_2 emissions is deemed acceptable depends on what they make it possible to achieve in terms of socioeconomic development. Defining sustainability then corresponds to finding the optimal balance between the potential suffering induced by the impact of human-made CO_2 emissions on the planetary climate balance and the socioeconomic benefits they make possible. In this approach to sustainability, well-being is understood as the experience of pleasure in the absence of suffering. Consequently, the best course of action is the one that maximizes pleasure and minimizes suffering over all sentient entities concerned by it (cf. O'Neill, 2008).

The Brundtland Report, which coined one of the most widely used conceptions of sustainability, forms part of this tradition. Its call to manage the current human-made environmental impact in such a way that future generations can still access the same socioeconomic benefits as their predecessors (cf. World Commission on Environment and Development, 1987) represents a guideline for thinking about the negative consequences of human-made environmental impacts alongside the positive outcomes they enable.

In such an approach, a key task for any sustainability assessment is assessing the positive and negative impacts of any course of action for all concerned parties. This is no trivial exercise: well-being is generally thought of as a multidimensional concept, with a plethora of elements playing into it. There is, however, no agreement on what these elements entail – on what the conditions are that need to be met for human well-being to be ensured (Max-Neef, 1991; O'Neill & Uebel, 2015; Rao & Min, 2017). A sustainability assessment based on a consequentialist and utilitarian approach thus needs to answer the difficult question of which elements play into human well-being and how they should be prioritized. Additional complexity arises from the frequent trade-offs between these elements. It might well be that contributions in one domain of well-being entail losses in another domain of well-being (Max-Neef, 1991; O'Neill & Uebel, 2015).

If, on the other hand, human-made CO_2 emissions are to be condemned irrespective of the ends they make it possible to achieve, the difficulty is located elsewhere. If we assume that this condemnation of human-made CO_2 emissions derives from some underlying moral principle – such as, for instance, to refrain from "doing violence to the natural systems of life on earth" (Kemp & Martens, 2007, p. 5) – we are in a deontological approach to ethics. From such a perspective, human well-being is more than the experience of pleasure in the absence of pain. To experience well-being, people must also be able to live in accordance with the fundamental moral principles which define their existence. From a deontological perspective, life has a moral purpose, and to experience well-being, one must be able to fulfill this moral purpose (cf. O'Neill, 2008). For instance, people with the moral belief that natural life systems should not be harmed cannot experience well-being if they are obliged to live in a way that forces them to go against this belief.

Consequently, if this moral purpose involves refraining from harming natural life systems, no amount of human-made CO_2 emissions would ever be justified, regardless of the ends they make it possible to achieve. This greatly limits the potential for trade-offs: violations of such a fundamental principle cannot simply be compensated for by gains in some other domain. In a sustainability assessment, a core task, then, is to determine whether any course of action violates such a moral principle. This, however, presumes that there is agreement on the moral principles that are to be upheld. As Okereke (2010) notes, this is not necessarily the case. Humankind cannot be looked at as one society that shares a common value system – or, in other words, the same fundamental moral principles.[2] And given that fundamental moral principles are the object of disagreement, finding an agreement on how to resolve contradictions between them might not be trivial.

In fact, the very contrast between consequentialist and deontological ethics can be understood as such a disagreement between different underlying moral principles. That the ends justify the means – the basic underlying premise of consequentialism – stands opposed to the premise that the means are to be judged irrespective of the ends they make possible. Agreement between people arguing from either one of these perspectives might thus be difficult to reach. A person who fundamentally disagrees with the premise that CO_2

emissions can be justified in some cases might well refuse to enter in negotiations on how to balance their positive and negative impacts.

3.2.2 Nature as a Resource, Spiritual Entity, or Metabolism: Different Ecologies

After having illustrated how different conceptions of sustainability can be traced back to fundamentally different ethical principles, in this subsection, we make the point that different conceptions of sustainability are furthermore rooted in fundamentally different conceptions of the relationship of society with its environment. To designate these perspectives, we use the terminology used by scholars from political ecology; other fields use different names for the perspectives that we mention in this text.[3]

Approaches to sustainability that conceive of human-made environmental impacts as a means to an end are often rooted in what can be called an anthropocentric worldview. In this view, the planetary system is considered as a resource or input to a production process geared toward the satisfaction of human needs (Imran et al., 2014; Leff, 2002). From an anthropocentric perspective, the planetary system is valuable insofar as it can be exploited by humans for their own purposes. Sustainability, in this view, boils down to managing what are termed "natural resources" in such a way that their current use by humans does not compromise the well-being of future generations of humans. Specifically, this means that society needs to shift from a dependency on non-renewable to renewable natural resources and to a mode of production and consumption that takes into account their capacity for renewal (cf. Costanza & Daly 1992; Daily et al., 2000, 2009). In the case of CO_2 emissions, this would mean that the planetary capacity for absorbing CO_2 is a resource at the disposal of humankind, but that it is limited, and that consequently, in order to be sustainable, societal CO_2 emissions need to be within this capacity. The task of a sustainability assessment, in this perspective, is to assess the degree to which any given course of action allows us to ensure the resource needs of humankind in the long term.

Another perspective, which builds on an anthropocentric perspective, is the view that sustainability can be achieved through the development of technology (cf. O'Neill & Uebel, 2015). In the case of CO_2 emissions, this would involve developing technology that emits less CO_2 or developing technology that increases the global capacity for CO_2 absorption. Some people argue that through technological progress, society can become completely independent of the limits set by ecosystem processes – meaning that there are no natural limits to socioeconomic growth. Others take a precautionary approach, based on the premise that it is uncertain whether such a decoupling of socioeconomic growth from planetary limits can be achieved, especially within the needed time frame (cf. Costanza & Daly, 1992; Martinez-Alier & Muradian, 2015).

This conception of technology as the means by which the planetary system can be exploited for the satisfaction of human needs is rooted in a technocentric perspective. From a technocentric perspective, a nature that follows mechanistic laws stands opposed to intention-driven humans. Humans, gifted with reason, can understand natural processes by

making use of the scientific method and design technologies to utilize them for the satisfaction of their needs. Or, put another way, humans are gifted with the capacity to engineer nature to fit their needs (cf. Brown, 1995; Capra, 1997; Imran et al., 2014; Merchant, 1990). The recent focus on the development of carbon capture and sequestration technology can be read in this sense. Rather than adjusting the mode of production to the planetary limits for CO_2 absorption, those planetary limits are extended to match societal CO_2 emissions. In such a perspective, the task of a sustainability assessment becomes to assess to which degree a given technology is suitable for ensuring that societal resource needs[4] can be met in the long term.

Approaches to sustainability that condemn actions that harm natural life systems on principle are rooted in what is called an ecocentric worldview. From an ecocentric perspective, humankind is just one of the many interconnected and interdependent parts of which the planetary system consists. And all parts of that system have an intrinsic value. Humans, their needs, and their creative potential are not considered any more important or valuable than other parts of the planetary system (cf. Imran et al., 2014; Leff, 2002; Robinson, 2004). Sustainability, in this view, involves humans gaining awareness of their interconnectedness with the planetary system. "What is needed . . . is a new ethic; a new set of values; and a new way of relating to the natural world" (Robinson, 2004, p. 376). There are, however, divergences between different currents of ecocentric thought about what this means.

Some ecocentric perspectives start from the premise that it is not just humans, but all parts of the planetary system that are sentient. In this view, the road to sustainability lies in developing a deep respect for the integrity of this sentient nature and minimizing all human interference in ecosystem processes, since it corresponds to a violation of this integrity (Brown, 1995; Capra, 1997; Imran et al., 2014; Merchant, 1990; Robinson, 2004). Such approaches build on the moral principle that nature's integrity should be protected at all costs. In this view, engineering solutions around planetary limits would constitute a violation of nature's integrity just as much as fundamentally changing the global climate balance through human-made CO_2 emissions that exceed the planetary capacity for CO_2 absorption would. In such a view, the task of a sustainability assessment would be to identify all instances in which humankind interferes with natural processes.[5]

Political ecology offers an ecocentric perspective that looks both at the relationship of humankind with its environment and at humankind itself, i.e., at social organization (cf. Bryant 2015). The planetary system is thought of as one metabolism, with human labor being one of the many processes through which matter and energy are transformed (Foster, 2009; Marx, 1968; Saito, 2016). Human labor, in this sense, is not any different or more valuable or problematical than the transformation processes induced by ecosystem processes (Foster, 2009; Marx, 1968). However, from a political-ecological perspective, these transformation processes need to be analyzed with regard to the power dynamics inherent to them. Political ecology is built on the moral principle that forms of exploitation and oppression are to be condemned and abolished (cf. Marx, 1983; Saito, 2016). From this perspective, in a sustainable future, "that some individuals have a right of ownership over the globe will seem just as absurd as the idea that one human can have a right of ownership

over another human [*translation from German by the authors*]" (Marx, 1983, p. 784). The social order and the relationship of society with its environment are thought of together, and one cannot be in equilibrium without the other. The task of a sustainability assessment would then be to assess to which degree the planetary metabolism is equilibrated and free of oppressive and exploitative power relations.

3.2.3 One Planet, Many Worldviews

In the previous sections, we showed that our underlying values and worldviews radically change not only the goals we want to pursue, but also how we conceive of the road toward them. This has consequences for sustainability assessments: Being able to make reference to shared values has been identified as a conditio sine qua non for agreeing on a frame of evaluation for an argument (Okereke, 2010). Hence, if the parties involved in or concerned by a sustainability assessment[6] cannot refer to shared values, both the validity of the assessment process and its results might be rejected by those parties whose values are not reflected in the process or are violated by it (Frame & Brown, 2008; Grunwald, 2004; McCool & Stankey, 2004). For instance, a sustainability assessment process that aims at finding an optimal trade-off between different aspects will hardly be acknowledged as valid by people whose moral positions make trade-offs between these respective aspects a priori impossible. Disagreements in sustainability assessments can thus persist on different levels: on the one hand, within one set of values and worldviews, and on the other hand, across different sets of values and worldviews. In Table 3.1, we summarize the values and worldviews presented in this section, and highlight how, depending on the underlying values that shape understandings of sustainability, the kind of solutions that are taken into consideration for addressing sustainability issues can change fundamentally.

The presentation of ideal-typical values and worldviews in Table 3.1 points to the kind of disagreements that exist between different approaches to sustainability. For instance, agreement between approaches that are rooted in an anthropocentric and consequentialist perspective and approaches that are rooted in a deontological and political-ecological perspective might be hard to reach. Whereas proponents of anthropocentric and consequentialist approaches to sustainability have concluded that one way of preventing the unsustainable use of planetary resources is to integrate them into the market economy by ascribing a monetary value to their contribution to human well-being (cf. Costanza & Daly, 1992; Daily et al., 2000, 2009), proponents of political-ecological approaches claim that the economization of nature further advances exploitative and oppressive power relations, in that ecosystem processes are marketed as services owned by some humans from whom other humans have to purchase them (cf. Leff, 2002). In this sense, the economization of an increasing number of aspects of the planetary system would correspond to the construction of a "universe in which the domination of nature has remained linked to the domination of man" (Marcuse, 1968, p. 135) – which, in the political-ecological perspective, is a fundamentally unsustainable course of development. What is identified as a promising path toward sustainability based on one perspective thus fundamentally contradicts what is identified as sustainable based on another perspective.

Table 3.1 *A non-exhaustive overview of different ideal-typical worldviews and values and the conceptions of sustainability they imply*

Perspective	Implied worldview	Implied understanding of sustainability	Examples for solution spaces
Technocentric anthropocentrism	"Engineering nature to fit humankind's needs"	Substitutability of ecosystem services; substitutability of technology and ecosystem services; environmental protection/destruction as a means to an end (consequentialist)	Ecological modernization (integration of environmental conservation into the market economy); rent-seeking mechanisms as steering elements
Technosceptic anthropocentrism	"In the face of uncertainty, precaution is better and society should not gamble on future technological progress"	Maximally partial substitutability of ecosystem services; maximally partial substitutability of technology and ecosystem services; environmental protection/destruction as a means to an end (consequentialist)	Ecological modernization (integration of environmental conservation into the market economy); stabilization or reduction of resource and energy demand with unclear consequences for rent-seeking
Essentialist ecocentrism	"Respecting the integrity of Mother Nature"	All human interference in earth system processes is oppressive and to be condemned (deontological)	Rejection of private (corporate) ownership; rejection of rent-seeking; rejection of urbanization; rejection of industrialization
Political ecology	"Equilibrating the planetary metabolism"	Embedding society in the flows of the planetary metabolism and freeing the planetary metabolism of forms of exploitation (deontological)	Rejection of private (corporate) ownership; rejection of rent-seeking; rejection of alienating and exploitative forms of labor; rejection of forms of oppression

It is, however, important to note that the different conceptions of the relationship of society with its environment as we have portrayed them in this section and in Table 3.1 correspond to ideal types, and that positions on sustainability can incorporate elements of different perspectives. For instance, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has recently suggested replacing the notion of ecosystem services with the concept of "nature's contribution to people" (Díaz et al., 2018). This step has been motivated by the desire to demonetize the relationship of society with its environment. The idea is also that, depending on the cultural context, these contributions of nature to people can be perceived differently – that there is not a universal value to a specific aspect of the ecosystem. Although the approach is still people-centered and could thus be deemed an anthropocentric perspective, it explicitly recognizes that both anthropocentric and ecocentric perspectives on the world exist and aims to create reporting categories that account for both perspectives and all the positions that lie in between (cf. Díaz et al., 2018).

3.3 How to Deal with Values in Knowledge Production: Different Epistemologies

Accepting that sustainability is a fundamentally normative concept raises important challenges for conducting sustainability assessments. To select relevant research topics and questions, identify meaningful indicators and thresholds, and interpret the results, sustainability assessments must refer to sustainability values. The intensity and controversy that have characterized the historical debate on the appropriate relationship between science and values illustrates that engaging with values is no trivial task for researchers (e.g., Churchman, 1979; Davydova & Sharrock, 2003; Fleck, 2012; Putnam et al., 2002; Ravetz & Funtowicz, 2015; Ziegler & Ott, 2011). In this section, we explore three ideal-typical positions regarding how science can and should relate to values and show how these positions relate to different ontologies and epistemologies – that is, values regarding what good science is and should be.

The first position is the so-called fact-value split. It argues that researchers should maintain a distance from normative issues (Winckelmann, 1968) and focus on the production of neutral facts. In research, explicit normative statements should be avoided. In this view, politics is the realm within which competing values are negotiated (Pielke & Roger, 2007), whereas science is thought to be free of values. This position is rooted in the ideas of the sociologist Max Weber and represents one of the most dominant epistemological ideals of modern science (Potthast, 2015). Today, this position is held by many natural and social scientists who consider scientific knowledge production to be objective and value-free. Disagreement between different proponents of this perspective persists, however, regarding how science should deal with sustainability values. While some authors argue that sustainability, as a field, is too normative for scientists to engage with, others refrain from acknowledging the values inherent to notions of sustainability and treat sustainability as if it were a purely factual concept. A middle position is taken by those who approach the issue through "what if" clauses.

This first position is underpinned by several ontological and epistemological assumptions: facts and values are thought to be two ontologically different things, which can be separated. Proponents of this position suggest a clear separation of the respective roles of science and society/politics, as well as quality criteria for good scientific work. To justify the fact-value split, its proponents often refer to Hume (2003), who concluded in the eighteenth century that the normative or "what ought to be" cannot be derived directly from "what currently is." What ought to be is defined by personal and societal values, preferences, and worldviews. For instance, whether society should strive for a sustainability vision based on consequentialist or deontological ethics cannot be derived from an empirical or philosophical analysis of the current earth system; it depends on people's values. This claim is supported by most philosophers. However, it is important to understand that the choice to exclude science from value negotiations is in itself a normative claim (Ziegler & Ott, 2011): it draws on epistemological values regarding what good science and the respective roles of science and society should be.

The second position considers facts and values as inseparable and highlights that science cannot and should not be regarded as value-free. This position was brought up by scholars of science studies and philosophy who demonstrated that scientific findings are not neutral facts but reflect the cultures and value systems of their time (e.g., Berger & Luckmann, 2005; Fleck, 2012; Kuhn, 2012). They state that, in practice, the separation between facts and values is very difficult to achieve and that alleged facts often contain a plethora of normative weightings (Kaiser, 2015). This is particularly true in the field of sustainability, where many issues are contested and different perspectives exist on what can be regarded as problematic or desirable developments. In this context, even the selection of the research questions represents a strong normative position, as it defines what comes into the focus of research.

Scholars who consider facts and values as inseparable on an ontological level generally also criticize the epistemological ideal of science as a value-free endeavor, since they claim that this does not reflect the reality of scientific practice. Moreover, they argue that a strict separation of science from values bears the risk of science becoming irrelevant for societal questions such as sustainability. Consequently, they suggest alternative approaches to science or novel forms of collaboration between science and society. The suggested approaches embrace post-normal science (Ravetz & Funtowicz, 2015), Mode2 knowledge production (Nowotny et al., 2001), action research (Bradbury, 2015), and transdisciplinary research (Hirsch Hadorn et al., 2006). What these approaches have in common is that they eschew the separation between science and society and integrate societal actors in the process of knowledge production. From this perspective, doing good science means acknowledging the value dimensions involved in any form of knowledge production, and dealing with it through extending the peer communities and applying rigorous self-reflective approaches.

The third position takes a middle ground between the previous two: it follows the first position in concluding that facts and values belong to two different realms and the second position in acknowledging the impossibility of fully separating the two from each other. A proponent of this position is the philosopher Potthast (2015) who stresses that although facts and values are often merged (particularly in contested situations), analytically they

nevertheless belong to two different realms and should be distinguished. He argues neither for pretending that facts and values should be clearly separated, nor for believing that they are always blurred, which would make all knowledge arbitrary. Rather, he stresses that the presence of moral issues within facts should be acknowledged and unraveled retrospectively in order to make them communicable and open for deliberation. Many proponents of the approaches to knowledge production introduced with the second position might also subscribe to this third one.

These three ideal-typical positions illustrate that the decision on how to deal with sustainability values in sustainability assessments depends to a large degree on the epistemological values – i.e., values that define what is understood by good science – that are held by individual scientists or which prevail in a given discipline. While such epistemological values are generally acknowledged by scientists on a theoretical level, in scientific practice they are often overlooked.

3.4 The Embeddedness of Ways of Knowing and Thinking about the World in Social and Material Orders

In this section, we show that different (epistemological) values and worldviews are historically constructed. They are tied to the socioeconomic, sociotechnological, and socioecological order and one's position in it. We flesh out the point made by Jasanoff: "[S]ociotechnical formations loop back to change the very terms in which we human beings think about ourselves and our positions in the world . . . the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it" (2004, p. 2).

We begin this section with a short historical illustration of this claim, by showing how the anthropocentric worldview and the notion of an objective scientific method have historically emerged in conjunction with industrialization. We show that industrialization marks not only the beginning of a new socioeconomic and sociotechnological order, but that it also changed the ways in which humankind conceives of the planetary system and its own position in it. We then identify two challenges which result from this co-constructedness of socioeconomic, sociotechnological, and socioecological orders and worldviews and values: The first concerns the tendency of this configuration to facilitate the reproduction of hegemonic values and worldviews, and the second concerns the difficulties that arise from the impossibility of disentangling worldviews and values from the socioeconomic, sociotechnological, and socioecological order.

3.4.1 On the Historical Co-constructedness of Values and Worldviews and Social and Material Orders

Merchant (1990) highlights the historical coincidence of socioeconomic, sociotechnological, and socioecological arrangements with worldviews and values which are coherent with

them. She shows how with the technological developments that marked the beginning of industrialization emerged the idea of a mechanistic nature which can be controlled through human ingenuity. Such a vision of the world was much more coherent with how humans experienced the world than the previously prevailing idea of nature as a powerful and uncontrollable force to which humans are subjugated and have to adjust to (Merchant, 1990, 2006).[7] Scientific thought is part of this continuously emerging coherence of how people experience the socioeconomic, sociotechnological, and socioecological order and the worldviews and values they uphold. The idea of an objective scientific method implies a worldview based on the idea of a mechanistic nature which can be understood and controlled by ingenious, reasonable, and creative humans (Merchant, 1990).[8] Correspondingly, in the present day, ecocentric perspectives can be identified as characteristic of non-industrialized societies (Leff, 2002; Merchant, 1990).

To further illustrate how the socioeconomic, sociotechnological, and socioecological order shapes values and worldviews, we again use the example of human-made CO_2 emissions. As we have shown in Section 3.2.1, human-made CO_2 emissions can be thought of either as a means that to some degree can be justified by the ends it makes it possible to achieve, or as something that is to be judged per se, irrespective of the ends it makes it possible to achieve. Hayward (2007) notes, however, that in a carbon-dependent society, human-made CO_2 emissions are, in fact, a necessary means to an end. They are the condition for a number of sociotechnological and socioeconomic activities which are crucial for society. Hence, to reject human-made CO_2 emissions without jeopardizing society as a whole, a different socioeconomic, socioecological, and sociotechnological order – one that is not carbon dependent – is a conditio sine qua non. This illustrates that questions of which moral position can be pursued, which values can be upheld, depend on the socioeconomic, sociotechnological, and socioecological order of society. And at the same time, values, worldviews, and ways of knowing shape this order. By producing categories such as "ecosystem services," knowledge production for sustainability frames how we understand the world and interact with it (Healy et al., 2015; van der Hel, 2018). By shaping how humankind acts on its environment, values, worldviews, and forms of knowledge production contribute to creating a socioeconomic, sociotechnological, and socioecological order with which they are coherent. In short, the socioeconomic, sociotechnological, and socioecological order and worldviews, values, and ways of knowing about the world mutually constitute and reproduce each other (Fletcher et al., 2015; Jasanoff, 2004).

3.4.2 All Values Are Equal, but Some Values Are More Equal than Others: Hegemony

This mutual reproduction of socioeconomic, sociotechnological, and socioecological orders and worldviews and values facilitates the emergence of hegemonic values and worldviews. This can be illustrated by the example of recent trends in sustainability

research and debates. There we can see how approaches to sustainability that originate from specific worldviews and values contribute to reproducing a socioeconomic, sociotechnological, and socioecological order that is coherent with these values.

Scholars from political ecology and ecological economics have noted an increasing emphasis in sustainability discourses on ecological modernization; a concept that is rooted in anthropocentric and technocentric values (cf. Blythe et al., 2018; Fletcher et al., 2015; Healy et al., 2015; Salleh, 2015; van der Hel, 2018). An approach to sustainability that is based on the concept of ecological modernization is based on the premise that the solution to the impending ecological crisis lies in the internalization of nature into the market economy. This has given rise to a conception of nature as a service provider. This trend is notably evident in the emergence of the concept of "ecosystem services." Examples of the commodification of these services include carbon trading schemes and mitigation banking, both concepts that have inspired major international initiatives (Blythe et al., 2018; Fletcher et al., 2015; Salleh, 2015).[9] And such an approach to sustainability reproduces a socioeconomic, sociotechnological, and socioecological order that is coherent with its underlying worldview and values. Ecosystem services – just like other goods, services, and labor – are commodified in monetary terms and traded on the market (cf. Fletcher et al., 2015; O'Neill & Uebel 2015). The purpose of scientific research and technological development increasingly becomes to "objectify, 'design and control' living human and external nature as a resource base for entrepreneurs" (Salleh, 2015, p. 436). Nature is subjugated to the needs of humankind (Salleh, 2015). Consequently, "there is less space for 'nature' to function as its own actant: it is needed for its 'services'" (Fletcher et al., 2015, pp. 365–366). And the growing prevalence of such approaches in science, policy, and civil society increasingly excludes other ways of seeing the world: people or groups whose values, worldviews, and ways of knowing are incoherent with the ones that derive from ecological modernization either are not heard – because they defy the commonly agreed-upon logic and as such might appear irrational or illogical – or exclude themselves from discussion spaces in which they do not feel represented. And this, in turn, leads to a further narrowing of the way in which sustainability is thought of – in science, policy, and civil society (cf. Díaz et al., 2018; Healy et al., 2015; Shove, 2010). For instance, a dominant approach that conceives of human interactions – with other humans and with the non-human environment – entirely in terms of market mechanisms, forecloses approaches that go beyond this logic and which would entail a reflection on how we as a community conceive of our existence and of how we live in interaction with our environment (cf. Fletcher et al., 2015; O'Neill & Uebel, 2015). Thinking of nature as a resource base at the disposal of humankind means that nature is treated as a foreign object. This forecloses the idea of an integrated planetary system of which humankind is one part (cf. Latour, 1997).

This example illustrates how powerful the mechanisms of mutual reproduction of worldviews and values and the socioeconomic, sociotechnological, and socioecological order can be. It also shows how the increasing hegemony of a given set of worldviews and values excludes perspectives that differ from it (Healy et al., 2015).

The argumentation that led the IPBES to abandon the notion of ecosystem services and to replace it with that of nature's contribution to people recognizes the power of the mechanisms by which hegemony is created and can be read as an attempt to break with them. The IPBES states that the framework that comes with thinking of the world in terms of ecosystem services and market relations has complicated and delayed the analysis and valuation of important aspects of the ecosystem – aspects which could not easily be phrased in these terms. Thinking the world in terms of ecosystem services resulted in a socioeconomic, sociotechnological, and socioecological order from which people whose experience of the world is not reflected in the values that underlie this concept were excluded. These people's increasing opposition to notions such as ecosystem services has led the IPBES to promote the adoption of a more inclusive concept – the notion of nature's contribution to people (cf. Díaz et al., 2018).

3.4.3 The Challenge of Achieving Change

An increasing number of actors from different academic disciplines, civil society, and politics agree that the current way in which society interacts with the world is unsustainable and that fundamental change is needed to avoid an impending ecological crisis (cf. EEA, 2015; Fischer-Kowalski, 1998; Haberl et al., 2011; IPCC, 2018; Latour 1991; Merchant, 2006; OECD, 2012; Robinson 2004; Rockström et al., 2009; Spaargaren 2011; WWF, 2016). But as we illustrated in Sections 3.4.1 and 3.4.2, the mutual co-constitution of worldviews, values, and ways of knowing with the socioeconomic, socioecological, and sociotechnological order, and the tendency for hegemony, pose challenges for achieving change. The embeddedness of worldviews and values in socioeconomic, sociotechnological, and socioecological orders and the mutual reproduction of these means that it is difficult to induce changes in one of them without, at the same time, challenging others. Indeed, if we act on worldviews and values that are coherent with the socioeconomic, sociotechnological, and socioecological order in which they are embedded, we might end up reproducing this order.

And there are voices that claim that this is what can currently be observed in the domain of sustainability. Authors from political ecology and also some from science and technology studies claim that the impending ecological crisis is partly the result of the very policies that aim to prevent it – that the increasing hegemony of anthropocentric and neoliberal values in the domain of sustainability gives rise to policies that further aggravate the problems which they aim to solve (cf. Blythe et al., 2018; Brown, 1995; Büscher 2012; Fletcher et al., 2015; Foster, 2009; Healy et al., 2015; Latour, 1997; Leff, 2002; Merchant, 1990; Robinson, 2004; Salleh, 2015); and that these policies stem from the "paradoxical idea that capitalist markets are the answer to their own ecological contradictions" (Büscher, 2012, p. 30). They base this claim notably on the point that current sustainability policies reproduce an unsustainable mode of production and consumption.

Currently, most goods in the market society are positional, meaning that it is not the absolute amount one possesses of them that matters for well-being, but rather how much of them one possesses as compared to other people. This results in a pattern of ever-increasing consumption which violates the limits set by the finite planetary system, resulting in ecological problems (O'Neill, 2008). And shifting toward finding well-being in non-positional goods while remaining in the current socioeconomic order would be difficult, if not impossible: the capitalist socioeconomic order depends on a productivist logic to maintain itself. It depends on a sustained accumulation of capital for the sake of increasing private profits. Consumerism is a fundamental condition to this productivist logic (cf. Fletcher et al., 2015; Kallis, 2011; O'Neill, 2008; Salleh, 2015; Tanuro, 2012).

Instead of challenging this logic, current sustainability policies tend to embrace this very same logic: the conclusions of an increasing number of policy documents and research proposals "have to do with encouraging certain styles of purchasing (in which 'green' is the brand of choice)" (Shove, 2010, p. 1277). Such approaches to sustainability follow a consumerist logic and are in line with the prevailing socioeconomic order (Shove, 2010). Sustainability policies based on this logic thus reflect and reproduce the very problems they aim to solve, and highlight the pertinence of the claim that the solutions to current sustainability issues cannot come from the same structures that have caused them (cf. Farrell, 2011; Funtowicz & Ravetz, 1990; Robinson, 2004). The question of how we can achieve change in a context in which our fundamental worldviews and values are shaped by our experience of the socioeconomic, sociotechnological, and socioecological order and at the same time shape how we interact with the world and thus tend to reproduce this very order is, indeed, not a trivial one.

3.5 Lessons for Sustainability Assessments

In this chapter, we first looked at what makes a sustainability assessment a fundamentally normative exercise. In Section 3.2, we illustrated that different notions of sustainability can be traced back to fundamentally different understandings of ethics and the relationship of humankind with its environment – to different beliefs on how actions should be evaluated and on how we conceive of and value the planetary system. Sustainability – the reference that should guide a sustainability assessment – is thus normative. In Section 3.3, we further showed that not only the reference but also the method of a sustainability assessment is normative – that there are different perspectives on what a good scientific method is that can be traced back to different epistemological values. Second, in Section 3.4, we looked at how different values regarding ethics, the relationship of humankind with its environment, and epistemology are shaped by the socioeconomic, sociotechnological, and socioecological order and at how they simultaneously reproduce this order by shaping how people interact with the world.

From these reflections, we have identified several challenges involved in conducting a sustainability assessment. First, it has been noted that a sustainability assessment might be

rejected by people whose values are not reflected in or are violated by the process or its underlying conception of sustainability. At the same time, given the fundamental differences that can exist between different values, it is difficult to include and respect them all. Second, the fact that values and the socioeconomic, sociotechnological, and socioecological order mutually constitute each other facilitates the emergence of hegemonic values and worldviews. This affects the values and worldviews that are considered in a sustainability assessment, since values that stand in conflict with the hegemonic ones might not be considered legitimate. Third, this mutual reproduction of values and the socioeconomic, sociotechnological, and socioecological order means that knowledge-production processes and policy interventions that are coherent with the prevailing order risk reproducing it. This presents a challenge for sustainability assessments that aim to inform a transition to a different and more sustainable order. In this section, we present some possible options for addressing these challenges.

First, we suggest that the normativity of sustainability assessments should be recognized and that the values that shape the assessment process should be clarified. This requires that both the values that shape the underlying conception of sustainability, as well as the epistemological values that shape the assessment process, need to be rendered explicit. It needs to be clarified how these values shape the different aspects of the sustainability assessment – the research questions and problem definitions, the applied methods, and the interpretation of the results. It is then possible to identify which values and understandings are reproduced in and by the assessment, and consequently also which values and understandings are not considered in the process. We insist that such a process of reflecting on and spelling out the values that guide a sustainability assessment must always take place, regardless of the scope and method of the sustainability assessment, including when the sustainability assessment follows a standardized and seemingly uncontested procedure and when the underlying definition of sustainability is widely accepted. Indeed, that a procedure or definition is uncontested does not mean that it is not normative – it is only a sign that the values that shape this procedure or definition are largely uncontested and have developed a certain hegemony.

Spelling out and reflecting on the values that guide the assessment makes it possible to situate it – to identify which sociocultural understandings or societal discourses it is embedded in, and consequently, how it relates to specific configurations of the socioeconomic, sociotechnological, and socioecological order. Acknowledging and reflecting on the situatedness of the sustainability assessment makes it possible to get a grasp of its underlying assumptions, and hence of the limitations of the assessment. Any sustainability assessment is based on a very specific idea regarding ethics, the relationship of humankind with its environment, and good science, and excludes other conceptions thereof.

Second, we suggest that acknowledging that any sustainability assessment is normative and includes some values at the expense of others is also primordial when it comes to reflecting on the process by which any specific sustainability assessment should be conducted. In some cases, it can be important that the assessment finds support with specific people or groups. In these cases, it is essential that the people or parties whose support for

the assessment is needed can acknowledge the legitimacy or validity of its underlying values. The sustainability assessment process thus needs to be designed in such a way that this can be achieved. This requires an understanding of these people's or parties' values, as well as a process which brings their different values into dialogue and which facilitates finding a consensus between them. This involves not only an openness to other conceptions of sustainability, but also to forms of expertise or knowledge that are not typically considered in scientific knowledge production.

If this is achieved by means of a participatory and deliberative process, it is essential that the deliberation respects the principles of ideal speech laid out by Habermas (1981) – meaning that speech is not strategic or shaped by unequal power relations, and that, consequently, deliberation can take place based on the pertinence of the voiced arguments. Only then is it possible for the different parties involved to reasonably assume that the positions that are being voiced and the narratives of experiences of the socioeconomic, sociotechnological, and socioecological order are genuine – that what is being said is being said to enable a dialogue among equals, rather than to advance one party's interests. The principles of ideal speech are, however, particularly difficult to uphold where power imbalances between different narratives are very strong. Salleh (2015), for instance, noted that in the face of the hegemony of anthropocentric, technocentric, and neoliberal values, these values tend to also frame deliberative exchanges and that this is all the more likely if deliberative processes are formalized under the guidance of institutions that act as cornerstones of the established socioeconomic order (cf. Salleh 2015). Such considerations need to be taken into account when reflecting on how a sustainability assessment process should be designed.[10]

Third, we suggest that the acknowledgment of and reflection on the normativity of sustainability assessments are coupled with a reflection on the implications of the assessment on the socioeconomic, sociotechnological, and socioecological order. This implies two things. First, in the case of a specific assessment, the aftermath of the assessment process must be monitored – information must be gathered on how the produced knowledge is translated into specific ways of interacting with the socioeconomic, sociotechnological, and socioecological order, and on whether the observed developments go in the direction of the goals set during the assessment process. We understand this suggestion as a necessary consequence of the complexity of the issues that sustainability assessments should help clarify. Given the complexity of sustainability issues, we suggest following Frame and Brown (2008) in conceiving of the interaction between knowledge production for sustainability, the design and implementation of political actions, and reflections on values as a complex experimental process with a high learning potential. Second, more research must be conducted on how knowledge production for sustainability is embedded in specific socioeconomic, sociotechnological, and socioecological orders and on how such knowledge production acts as a tool to reinforce or counteract existing dynamics. This means that the values that play into both conceptions of sustainability and of the scientific method, and their embeddedness in the socioeconomic, socioecological, and sociotechnological order must become an object of research.

This chapter provided some first indications on how values shape sustainability assessments and on how values are intertwined with the socioeconomic, sociotechnological, and socioecological order. We hope that if more research is conducted on how these processes play out in specific cases, we will be better equipped to study sustainability issues by "characterising and analysing the emergent qualities and characteristics of different types of sociotechnical configurations" (Shove, 2010, p. 1278). In this way, not only does our analysis of sustainability issues become more complete, but our responses to them can take into account their complexity more holistically. We express the hope that this would allow us to work toward "radical innovations . . . which redefine the rules of the game; which render previously important forms of competence redundant; and which reconfigure interpretations of value and significance" (Shove, 2010, p. 1278) – that is, working toward the radical change which is so desperately needed in order to not jeopardize the planetary balance.

Notes

1. Normativity designates the "value loadedness of human reality" (Rutgers, 2012, p. 11). It makes reference to the subjectivity of the human experience of the world. Values connote something positively or negatively (Kates et al., 2005; Rutgers, 2012). They are essential in the coordination of our actions and provide orientation as to what we should think, do, or say. They provide direction and guide us in the question of who or what we ought to be (Kates et al., 2005; Korsgaard, 1996; Reynaud & Richeb´e, 2009; Rutgers, 2012). Put another way, values refer to how we see the world and our position in it, and guide how we interact with it.
2. Different strands of literature use different words to refer to concepts that we consider synonymous in the context of the discussion in this chapter. A moral principle, like values, shapes how we see the world and our position in it, and guides how we interact with it.
3. The distinction of different approaches to the relationship of humankind with its environment is made in various fields; scholars from different fields, however, use, different terminologies to denominate them. In political ecology, the term "anthropocentrism" is used to refer to a worldview that revolves around the needs of humans, and the term "ecocentrism" is used to refer to a worldview based on an integrated planetary system of which humans are one part (cf. Imran et al., 2014). Coming from economic philosophy, O'Neill and Uebel (2015) distinguish two bodies of literature, one which they call "science-based" and which studies the material and ecological conditions for human well-being, and one which they call "science-sceptical," and which looks at the ecological crisis as being an intrinsic part of the dominant socioeconomic, sociotechnological, and socioecological order. Capra (1997), coming from physics, distinguishes between "shallow ecology," which sees "humans as above or outside of nature, as the source of all value, and ascribes only instrumental, or 'use,' value to nature" (Capra, 1997, p. 7), and "deep ecology," which describes the world "as a network of phenomena that are fundamentally interconnected and interdependent [and] recognizes the intrinsic value of all living beings." (Capra, 1997, p. 7). Merchant (1990), a historian of science, uses the terms "mechanistic" and "organic" to distinguish between a perspective in which nature becomes a kind of "inert, lifeless matter, [that is] passively obeying mechanical laws" (Brown, 1995, p. 191), and one in which nature is seen as an interconnected whole, of which humans are but one part (Merchant, 1990; Brown, 1995).
4. In this context, we understand the planetary capacity for CO_2 absorption as a resource on which humankind depends.
5. Such ecocentric approaches have been criticized on the grounds that they contain an internal contradiction. While they call for nature to be respected as a sentient entity on equal terms with humans, they in fact dehumanize nature completely. It is indeed to humans that the power is given

to define what nature's integrity means, and it is to humans that the responsibility is given to respect it. Humans are thus to speak on nature's behalf and are to take a paternalistic attitude toward it. The internal contradiction inherent to this perspective also emerges from the premise that humans should not interfere in natural processes – this draws a clear boundary between humans and nature and thus goes against the idea that humankind is one part of an integrated system (Brown, 1995; Latour, 1991).

6. For a more extensive discussion of different conceptions of what a "party concerned by a sustainability assessment" is, and of what motivates the involvement of different parties in a sustainability assessment, refer to Chapter 4 (Fritz & Meinherz).

7. Merchant (1990) notes that although, according to Christian dogma, humans were to be the masters of the Creation, this did not correspond to the lived experience of pre-industrial Europeans.

8. As Kaiser (2015) notes, this trend toward an objective scientific method can further be understood as the result of the perceived necessity to de-ideologize knowledge and to clearly distinguish it from value-laden and absolutist ideologies.

9. Carbon trading schemes translate into trading rights to the planetary capacity to absorb CO_2 as a market good. The term "mitigation banking" describes the ambition to compensate for damage done to habitats that fulfill a certain function by creating functionally equivalent habitats elsewhere.

10. For a more extensive discussion of the different forms of power – including discursive power – that can occur in a sustainability assessment and their implications on the assessment process, refer to Chapter 4 (Fritz & Meinherz).

References

Berger, P. L., & Luckmann, T. (2005). *Die gesellschaftliche Konstruktion der Wirklichkeit*. Berlin: Fischer.

Blythe, J., Silver, J., Evans, L., et al. (2018). The dark side of transformation: Latent risks in contemporary sustainability discourse. *Antipode*, 50(5), 1206–1223.

Bradbury, H. (2015). *The Sage Handbook of Action Research*. New York: Sage.

Brown, C. S. (1995). Anthropocentrism and ecocentrism: The quest for a new worldview. *The Midwest Quarterly*, 36(2), 191.

Bryant, R. L. (2015). *The International Handbook of Political Ecology*. Cheltenham: Edgar Elgar.

Büscher, B. (2012). Payments for ecosystem services as neoliberal conservation: (Reinterpreting) evidence from the Maloti-Drakensberg, South Africa. *Conservation and Society*, 10(1), 29–41.

Capra, F. (1997). *The Web of Life: A New Scientific Understanding of Living Systems*. New York: Anchor.

Churchman, C. W. (1979). *The Systems Approach and Its Enemies*. New York: Basic Books.

Costanza R., & Daly, H. E. (1992). Natural capital and sustainable development. *Conservation biology*, 6(1), 37–46.

Daily, G. C., Söderqvist, T., Aniyar, S., et al. (2000). The value of nature and the nature of value. *Science*, 289(5478), 395–396.

Daily, G. C., Polasky, S., Goldstein, J., et al. (2009). Ecosystem services in decision making: time to deliver. *Frontiers in Ecology and the Environment*, 7(1), 21–28.

Davydova I., & Sharrock, W. (2003). The rise and fall of the fact/value distinction. *The Sociological Review*, 51(3), 357–375.

Díaz, S., Pascual, U., Stenseke, M., et al. (2018). Assessing nature's contributions to people. *Science*, 359 (6373), 270–272. DOI:10.1126/science.aap8826.http://science.sciencemag.org/content/359/6373/270.

EEA. (2015). *The European Environment: State and Outlook 2015: Synthesis Report*. Copenhagen: European Environment Agency.

Farrell, K. N. (2011). Snow White and the wicked problems of the west: A look at the lines between empirical description and normative prescription. *Science, Technology, & Human Values*, 36(3), 334–361.

Fischer-Kowalski, M. (1998). Society's metabolism. *Journal of industrial ecology*, 2(1), 61–78.

Fleck, L. (2012). *Genesis and Development of a Scientific Fact*. Chicago: University of Chicago Press.

Fletcher, R., Dressler, W., & Büscher, B. (2015). Nature^{TM} Inc.: Nature as a neoliberal capitalist imaginary. In R. L. Bryant (ed.), *The International Handbook of Political Ecology*. Cheltenham: Edgar Elgar, pp. 359–372.

Foster, J. B. (2009). *The Ecological Revolution: Making Peace with the Planet*. New York: Monthly Review Press.

Frame, B., & Brown, J. (2008). Developing post-normal technologies for sustainability. *Ecological Economics*, 65(2), 225–241.

Funtowicz, S. O., & Ravetz, J. R. (1990). *Uncertainty and Quality in Science for Policy*, vol. 15. New York: Springer Science & Business Media.

Funtowicz, S. O., & Ravetz, J. R. (1993). Science for the post-normal age. *Futures*, 25 (7), 739–755.

Grunwald, A. (2004). Strategic knowledge for sustainable development: the need for reflexivity and learning at the interface between science and society. *International Journal of Foresight and Innovation Policy*, 1(1–2), 150–167.

Haberl, H., Fischer-Kowalski, M., Krausmann, F., Martinez-Alier, J., & Winiwarter, V. (2011). A socio-metabolic transition towards sustainability? Challenges for another great transformation. *Sustainable Development*, 19(1), 1–14.

Habermas, J. (1981). *Theorie des kommunikativen Handelns*., Frankfurt: Suhrkamp.

Hayward, T. (2007). Human rights versus emissions rights: Climate justice and the equitable distribution of ecological space. *Ethics & International Affairs*, 21(4), 431–450.

Healy, H., Martinez-Alier, J., & Kallis, G. (2015). From ecological modernization to socially sustainable economic degrowth: Lessons from ecological economics. In R. L. Bryant (ed.), *The International Handbook of Political Ecology*. Cheltenham: Edgar Elgar, pp. 577–590.

Hirsch Hadorn, G., Bradley, D., Pohl, C., Rist, S., & Wiesmann. U. (2006). Implications of transdisciplinarity for sustainability research. *Ecological economics*, 60(1), 119–128.

Hume, D. (2003). *A Treatise of Human Nature*. North Chelmsforth:Courier Corporation.

Imran, S., Alam, K., & Beaumont, N. (2014). Reinterpreting the definition of sustainable development for a more ecocentric reorientation. *Sustainable Development*, 22 (2), 134–144.

IPCC. (2018). *Global Warming of 1.5 C: An IPCC Special Report on the Impacts of Global Warming of 1.5 C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. Incheon: Intergovernmental Panel on Climate Change.

Jasanoff, S. (2004). The idiom of co-production. In S. Jasanoff (ed.), *States of Knowledge: The Co-production of Science and Social Order*. Abingdon: Routledge.

Kaiser, M. (2015). Ethics of science and a new social contract for knowledge. In S. Meisch, J. Lundershausen, L. Bossert, & M. Rockoff (eds.), *Ethics of Science in the Research for Sustainable Development*. Baden-Baden: Nomos Verlagsgesellschaft, pp. 153–178.

Kallis, G. (2011). In defence of degrowth. *Ecological Economics*, 70(5), 873–880.

Kates, R. W., Parris, T. M., & Leiserowitz, A. A. (2005). What is sustainable development? *Environment*, 47(3), 8.

Kemp, R., & Martens, P. (2007). Sustainable development: How to manage something that is subjective and never can be achieved? *Sustainability: Science, Practice, & Policy*, 3(2).

Korsgaard, C. M. (1996). *The Sources of Normativity*. Cambridge: Cambridge University Press.

Kuhn, T. S. (2012). *The Structure of Scientific Revolutions*. Chicago: University of Chicago press.

Latour, B. (1991). *Nous n'avons jamais été modernes*. Paris: La Découverte.

Latour, B. (1997). *Politiques de la nature: Comment faire entrer les sciences en démocratie*. Paris: La Découverte.

Leff, E. (2002). Die Geopolitik nachhaltiger Entwicklung: Ökonomisierung des Klimas, Rationalisierung der Umwelt und die gesellschaftliche Wiederaneignung der Natur. In C. Görg

and U. Brand (eds.), *Mythen globalen Umweltmanagements: Rio + 10*. Munster: Verlag Westfälisches Dampfboot, pp. 92–117.

Marcuse, H. (2013). *One Dimensional Man: Studies in Ideology of Advanced Industrial Society*. Abingdon: Routledge.

Martens, P. (2006). Sustainability: Science or fiction? *Sustainability: Science, Practice, & Policy*, 2(1).

Martinez-Alier, J., & Muradian, R. (2015). *Handbook of Ecological Economics*. Cheltenham: Edward Elgar Publishing.

Marx, K. (1968). *Das Kapital. Kritik der politischen Ökonomie. Band 1: Der Produktionsprozess des Kapitals*. Berlin: Dietz Verlag.

Marx, K. (1983). *Das Kapital. Kritik der politischen Ökonomie. Band 3: Der Gesamtprozess der kapitalistischen Produktion*. Berlin: Dietz Verlag.

Max-Neef, M. A. (1991). *Human scale development: Conception, application and further reflections*. New York and London: The Apex Press.

McCool, S. F., & Stankey, G. H. (2004). *Environmental management*, 33(3), 294–305.

Merchant, C. (1990). *The Death of Nature: Women, Ecology, and the Scientific Revolution*. New York: Harper Collins.

Merchant, C. (2006). The scientific revolution and *The Death of Nature*. *Isis*, 97(3), 513–533.

Mumby, D. K., & Clair, R. P. (1997). Organizational discourse. In T. A. Van Dijk (ed.), *Discourse as Social Interaction*, vol. 2. Thousand Oaks: Sage, pp. 181–205.

Nowotny, H., Scott, P., Gibbons, M., and Scott, P. B. (2001). *Re-thinking Science: Knowledge and the Public in an Age of Uncertainty*. Cambridge: Polity.

OECD. (2012). *OECD Environmental Outlook to 2050: The Consequences of Inaction*. Paris: Organisation for Economic Co-operation and Development.

Okereke, C. (2010). Climate justice and the international regime. *Wiley Interdisciplinary Reviews: Climate Change*, 1(3), 462–474.

O'Neill, J. (2008). Happiness and the good life. *Environmental Values*, 17(2), 125–144.

O'Neill, J., and Uebel, T. (2015). Analytical philosophy and ecological economics. In *Handbook of Ecological Economics*. Cheltenham: Edward Elgar Publishing. pp. 48–78.

Pielke, J., and Roger, A. (2007). *The Honest Broker: Making Sense of Science in Policy and Politics*. Cambridge: Cambridge University Press.

Potthast, T. (2015). Ethics in the sciences beyond Hume, Moore and Weber: Taking epistemic-moral hybrids seriously. In S. Meisch, J. Lundershausen, L. Bossert, and M. Rockoff (eds.), *Ethics of Science in the Research for Sustainable Development*. Baden-Baden: Nomos Verlagsgesellschaft, pp. 129–152.

Putnam, H., et al. (2002). *The Collapse of the Fact/Value Dichotomy and Other Essays*. Cambridge, MA: Harvard University Press.

Rametsteiner, E., Pülzl, H., Alkan-Olsson, J., and Frederiksen, P. (2011). Sustainability indicator development: Science or political negotiation? *Ecological Indicators*, 11(1), 61–70.

Rao, N. D., and Min, J. (2017). Decent living standards: Material prerequisites for human wellbeing. *Social Indicators Research*, 138(1), 225–244.

Ravetz, J., and Funtowicz, S. (2015). Post-normal science. In S. Meisch, J. Lundershausen, L. Bossert, and M. Rockoff (eds.), *Ethics of Science in the Research for Sustainable Development*. Baden-Baden: Nomos, pp. 101–112.

Reynaud, J.-D., and Richebé, N. (2009). Rules, conventions and values: A plea in favor of ordinary normativity. *Revue Française de Sociologie*, 50(5), 3–35.

Robinson, J. (2004). Squaring the circle? Some thoughts on the idea of sustainable development. *Ecological Economics*, 48(4), 369–384.

Rockström, J., Steffen, W., Noone, K., et al. (2009). Planetary boundaries: Exploring the safe operating space for humanity. *Ecology and Society*, 14(2).

Rutgers, M. R. (2012). A pantheon of public values: A historical and conceptual approach to the normativity of facts and values. *A paper presented at The Public Values Consortium Biennial Workshop, Chicago, IL*. www.narcis.nl/publication/RecordID/oai: uva. nl, volume 376695.

Saito, K. (2016). *Natur gegen Kapital: Marx' Ökologie in seiner unvollendeten Kritik des Kapitalismus*. Frankfurt: Campus Verlag.

Salleh, A. (2015). Neoliberalism, scientism and earth system governance. In R. L. Bryant (ed.), *The International Handbook of Political Ecology*. Cheltenham: Edgar Elgar, pp. 432–446.

Schneidewind, U. (2013). Transformative literacy: Gesellschaftliche ver¨anderungsprozesse verstehen und gestalten. *GAIA-Ecological Perspectives for Science and Society*, 22(2), 82–86.

Schneidewind, U. (2015). Transformative Wissenschaft-Motor fu¨r gute Wissenschaft und lebendige Demokratie. *GAIA-Ecological Perspectives for Science and Society*, 24(2), 88–91.

Shove, E. (2010). Beyond the ABC: Climate change policy and theories of social change. *Environment and Planning A*, 42(6), 1273–1285.

Spaargaren, G. (2011). Theories of practices: Agency, technology, and culture: Exploring the relevance of practice theories for the governance of sustainable consumption practices in the new world-order. *Global Environmental Change*, 21(3), 813–822.

Tanuro, D. (2012). *L'impossible capitalisme vert*. Paris: La Découverte.

van der Hel, S. (2018). Science for change: A survey on the normative and political dimensions of global sustainability research. *Global Environmental Change*, 52: 248–258.

Videira, N., Antunes, P., Santos, R., and Lopes, R. (2010). A participatory modelling approach to support integrated sustainability assessment processes. *Systems Research and Behavioral Science*, 27(4), 446–460.

Waas, T., Hugé, J., Block, T., et al. (2014). Sustainability assessment and indicators: Tools in a decision-making strategy for sustainable development. *Sustainability*, 6(9), 5512–5534.

Winckelmann, J. (1968). *Gesammelte Aufsätze zur Wissenschaftslehre*. Heidelberg: Mohr.

World Commission on Environment and Development. (1987). *Our Common Future*. Oxford: Oxford University Press.

WWF. (2016). *Living Planet Report 2016. Risk and Resilience in a New Era*. Gland, Switzerland: WWF International.

Ziegler, R., and Ott, K. (2011). The quality of sustainability science: A philosophical perspective. *Sustainability: Science, Practice and Policy*, 7(1), 31–44.

8 Manuscript VIII

Bibliographic details:

Meinherz, F., **Fritz, L.,** Schneider, F., 2020. Vom Öffnen und Verschließen von Alternativen: Implikationen der gesellschaftlichen Einbettung nachhaltigkeitsrelevanter Wertvorstellungen. In: Lindner, R; Decker, M.; Ehrensperger, E.; Heyen, N.; Lingner, S.; Scherz, C.; Sotoudeh, M (Eds.): *Gesellschaftliche Transformationen: Gegenstand oder Aufgabe der Technikfolgenabschätzung?* Baden-Baden*:* Edition Sigma/Nomos, in press.

Contribution of the doctoral candidate:

The doctoral candidate was involved in the overall conceptualisation of the manuscript, the development of the line of argumentation, the identification of relevant literature. She provided inputs in particular on the parts referring to participatory approaches and deliberation as well as the formulation of recommendations.

Vom Öffnen und Verschliessen von Alternativen: Implikationen der gesellschaftlichen Einbettung nachhaltigkeitsrelevanter Wertvorstellungen

Franziska Meinherz[a,*], Livia Fritz[a], Flurina Schneider[b]

[a]*Laboratory for Human-Environment Relations in Urban Systems (HERUS), Institut d'ingénierie de l'environnement (IIE), Faculté de l'environnement naturel, architectural et construit (ENAC), Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland*
[b]*Centre for Development and Environment (CDE), University of Bern, Switzerland*
Corresponding author. Address: HERUS-IIE-ENAC-EPFL, Station 2, 1015 Lausanne, Switzerland.
Email address: franziska.meinherz@epfl.ch. Phone: +41 21 693 59 77

1 Einleitung

Die Technikentwicklung ist eng mit Nachhaltigkeit verknüpft und kann Ursprung wie auch Lösung von Nachhaltigkeitsproblemen sein. Angesichts dieses ambivalenten Verhältnisses zwischen Technik und Nachhaltigkeit stellt sich die Frage, wie die Technikentwicklung im Sinne der nachhaltigen Entwicklung zu gestalten ist (Grunwald, 2012). Somit prägt die Idee der Nachhaltigkeit den normativen Bezugsrahmen der Technikfolgenabschätzung (TA) (Dobroć et al. 2018; Kollek 2019; Nierling/Torgersen 2019).

Die Idee der Nachhaltigkeit ist untrennbar mit Wertvorstellungen bezüglich einer wünschenswerten Gesellschaft und der Form ihrer Einbettung in das planetare Ökosystem verbunden. Der Nachhaltigkeitsbegriff wird dementsprechend je nach den ihm zugrundeliegenden Wertvorstellungen anders ausgelegt (Frame/Brown 2008). Und unterschiedliche Auslegungen sehen verschiedene Rollen für die Technik vor. Wenn zum Beispiel die langfristige Erfüllung menschlicher Grundbedürfnisse im Zentrum steht (vgl. WCED 1987), ist es Aufgabe der Technik, Methoden für die langfristige Nutzung natürlicher Ressourcen bereitzustellen. In diesem Sinne ist es vertretbar, natürliche Ressourcen zu erschöpfen, solange gewährleistet wird, dass sie durch technische Substitute ersetzt werden können. Ein solcher Ansatz zur Nachhaltigkeit und zur Rolle der Technik ist jedoch inkompatibel mit Auffassungen des Nachhaltigkeitsbegriffs, welche das Ökosystem unabhängig seiner Nutzbarkeit für die Erfüllung menschlicher Grundbedürfnisse wertschätzen (vgl. Kemp/Martens 2007). Wird ein nachhaltiger Umgang mit dem Ökosystem mit einer minimalen menschlichen Einflussnahme gleichgesetzt (vgl. Imran et al. 2014), ist fast jeglicher technische Fortschritt abzulehnen, da dieser als Werkzeug aufgefasst wird, um die Umwelt für den Menschen nutzbar und ihm gefügig zu machen. Wird Nachhaltigkeit als Zustand verstanden, in welchem das planetare System—inklusive der Gesellschaft—im Gleichgewicht ist (vgl. Salleh 2015), so darf weder die Leistungskraft der Menschen noch diejenige nichtmenschlicher Entitäten ausgebeutet werden. Dies stellt wiederum andere Anforderungen an die Technikentwicklung und -einbettung[1].

Somit sagen Visionen für die Technikentwicklung „etwas über die Art und Weise aus, wie nachhaltige Entwicklung gedacht wird, welche Probleme gesehen werden und welche Prioritäten gesetzt werden" (Grunwald 2012, S. 218). Grunwald (2012) illustriert dies am Beispiel der Landwirtschaft. Konflikte zwischen hochtechnisierten und effizienzmaximierenden und extensiven und ökologischen landwirtschaftlichen Methoden vermitteln einerseits unterschiedliche Visionen für die Technikentwicklung. Andererseits zeigen sie Divergenzen bezüglich der „Vorstellungen vom zukünftigen Verhältnis zwischen Mensch, Technik und Natur" (Grunwald 2012, S. 219) auf. Somit werden durch solche gesellschaftlichen Auseinandersetzungen mit der Zukunft „die Rahmenbedingungen und Möglichkeitsräume der TA erheblich strukturiert" (Dobroć et al. 2018, S. 29).

Die Einsicht, dass die TA von normativen Prämissen geprägt ist, hat sich mittlerweile weitgehend durchgesetzt. Die Frage ist nicht mehr ob, sondern wie sich die TA mit Werten befassen soll (Nierling/Torgersen 2019). Eine vertiefte Auseinandersetzung mit Werten an sich, und somit mit dem normativen Bezugsrahmen der TA, fehlt jedoch weitgehend (Böschen/Dewald 2018; Lucivero et al. 2019;

---

[1] Genauere Ausführungen dieser Erläuterungen finden sich in Meinherz et al. (im Druck).

Torgersen 2018). Insbesondere die Frage, wie nachhaltigkeitsrelevante Wertvorstellungen in Gesellschaftsstrukturen und Machtverhältnisse eingebettet sind, ist bislang kaum beleuchtet (Horcea-Milcu et al. 2019; Jasanoff 2015; Lövbrand et al. 2015; van der Hel 2018). Dieser Frage gehen wir in diesem Beitrag nach. Aufgrund der Vielfalt nachhaltigkeitspolitischer Ansätze ist es uns nicht möglich, das Thema im Rahmen dieses Beitrags umfassend zu behandeln. Vielmehr bearbeiten wir das Thema anhand einer auf groben Tendenzen basierten Analyse.

2 Interpretationen, Umsetzung und Ergebnisse der Nachhaltigkeitspolitik

Umweltanliegen gewannen in den späten Sechzigerjahren an Gewicht. Die „Limits to growth"-Studie (Meadows et al. 1972) und das Buch „Silent Spring" (Carson 1962) wiesen mit grosser Dringlichkeit auf die Kehrseite des ausgedehnten Wirtschaftswachstums der Nachkriegszeit hin. 1972 fand die erste internationale Umweltkonferenz statt, welche in der Gründung einer unabhängigen Kommission resultierte, die ihre Ergebnisse 1987 im sogenannten Brundtland-Bericht veröffentlichte. Dieser brachte eine der meistzitierten Definitionen der nachhaltigen Entwicklung hervor und machte deutlich, dass Umweltfragen nicht losgelöst von sozioökonomischen Fragen betrachtet werden können (WCED 1987). Der Beginn vieler nationaler und internationaler nachhaltigkeitspolitischer Programme fällt in die Folgezeit der Veröffentlichung dieses Berichts (Kates et al. 2005).

2.1 Unterschiedliche Positionen, aber mehrheitlich einheitliche Praxis

Es besteht eine grosse Vielfalt an teils widersprüchlichen Auffassungen, welchen Prinzipien Nachhaltigkeitspolitik folgen und wie diese umgesetzt werden sollen. Einige dieser Divergenzen können auf unterschiedliche Auslegungen des Gerechtigkeitsbegriffs zurückgeführt werden. So argumentieren manche AkteurInnengruppen, dass Nachhaltigkeitspolitik Prinzipien der ausgleichenden Gerechtigkeit und der Verteilungsgerechtigkeit folgen soll. Dementsprechend sollen sich Bemühungen zur Reduktion umweltschädlicher Aktivitäten primär auf jene Teile der Gesellschaft konzentrieren, deren Aktivitäten historisch betrachtet hauptsächlich zu den gegenwärtigen Umweltproblemen geführt haben. Damit soll dem Umstand Rechnung getragen werden, dass tendenziell diejenigen Bevölkerungsschichten, welche historisch betrachtet wenig zu Umweltproblemen beigetragen haben, aufgrund ihrer prekären Lebensbedingungen diesen stärker ausgesetzt sind, und sichergestellt werden, dass nachhaltigkeitspolitische Massnahmen der notwendigen Verbesserung ihrer Lebensbedingungen Rechnung tragen (Okereke 2010; Salleh 2015). Andere AkteurInnengruppen vertreten die Position, dass es ungerecht sei, sich in der Berechnung von Emissionsreduktionsquoten auf Aktivitäten in der Vergangenheit zu beziehen, da damals deren Folgewirkungen noch nicht bekannt gewesen seien. Sie plädieren dafür, dass sich Nachhaltigkeitspolitik an der Gegenwart orientieren solle (Okereke 2010).

Auch bezüglich der für die Umsetzung nachhaltigkeitspolitischer Ziele geeigneten Instrumente bestehen divergierende Auffassungen. So kann grob zwischen markt- und technikfokussierten und markt- und technikkritischen oder -skeptischen Ansätzen unterschieden werden, wobei sich diese oft überschneiden und selten in der einen oder anderen Reinform auftreten. In einem marktbasierten Ansatz wird davon ausgegangen, dass eine Eingliederung der Umweltproblematik in die Dynamik des freien Marktes eine optimale Ressourcenverteilung und -nutzung und grösstmögliche Effizienz garantiert. Die so entstehenden Preismechanismen würden zu einer Transition weg von einer erdöl- und kohlebasierten und hin zu einer grünen Wirtschaft führen (Salleh 2015). Oftmals überschneidet sich ein solcher Ansatz mit technikfokussierten Ansätzen. Diese gehen davon aus, dass technische Lösungen für die Erschliessung erneuerbarer Ressourcen und das Ersetzen begrenzter Rohstoffe existieren oder entwickelt werden können (O'Neill/Uebel 2015). Solchen Ansätzen liegen oft Auffassungen des Nachhaltigkeitsbegriffs zugrunde, welche die Erfüllung menschlicher Grundbedürfnisse ins Zentrum stellen und dementsprechend auf anthropozentrischen Wertvorstellungen beruhen (Meinherz et al. im Druck). Techniskeptische Ansätze hinterfragen die Annahme, dass Technikentwicklung ein rohstoff- und energieunabhängiges Wirtschaftswachstums ermöglichen kann, und verfechten eine Abkehr von wirtschaftswachstumsbasierten Ansätzen (Kallis 2011; Martinez-Alier/Muradian 2015). Obschon sich solche Ansätze nicht zwingend an Interpretationen des Nachhaltigkeitsbegriffs orientieren, welche das Ökosystem unabhängig von seiner

Nutzbarkeit für die Erfüllung menschlicher Grundbedürfnisse wertschätzen, verfechten sie aus Gründen der Vorsicht ebenfalls eine Bewahrung und Wertschätzung des Ökosystems und überschneiden sich somit mit Ansätzen, die in ökozentrischen Wertvorstellungen gründen (Meinherz et al. im Druck). Marktkritische Ansätze bemängeln, dass die Vermarktung der Umwelt bestehende Ungleichheiten verschärft, indem sich gewisse AkteurInnen zuvor als Allgemeingut geltende Elemente der Umwelt aneignen und diese gewinnbringend an andere AkteurInnen verkaufen (Leff 2002; Salleh 2015) und merken an, dass eine profit- und somit wachstumsorientierte Nachhaltigkeitspolitik lediglich zu einer Problemverlagerung auf andere Rohstoffe oder Umweltprozesse führt (Healy et al. 2015; Kallis 2011). Damit stützen sich solche Ansätze auf Wertvorstellungen, welche sowohl die Ausbeutung menschlicher Arbeit wie auch des Ökosystems ablehnen (Meinherz et al. im Druck).

Trotz dieser Vielfalt an Auffassungen lässt sich in den nationalen und internationalen nachhaltigkeitspolitischen Ansätzen, welche auf die Veröffentlichung des Brundtland-Berichts folgten, eine Verengung auf Ansätze feststellen, welche eine klare Grenze zwischen Gesellschaft und Umwelt ziehen und Letztere primär als Mittel zum Zweck der Befriedigung menschlicher Grundbedürfnisse sehen (Lövbrand et al. 2015). Diese Ansätze folgen oft einer marktfokussierten Logik, in welcher Umweltprobleme als Marktversagen aufgefasst werden. Dabei wird davon ausgegangen, dass nur wertgeschätzt wird, was einen Preis hat. Um Umweltprobleme zu lösen, müssen daher entsprechende Märkte geschaffen werden (vgl. Costanza/Daly 1992). Zusätzlich zu natürlichen Ressourcen wird nun auch ihr Erhalt und jener der Umwelt zu einem auf dem Markt gehandelten Produkt. Dies resultiert in einer Ausweitung des Privateigentums auf bislang als Allgemeingüter wahrgenommene Elemente des Ökosystems. Beispiele hierfür sind der Handel mit Emissionszertifikaten oder Flächenkompensationen über Ökokonten (Blythe et al. 2018; Salleh 2015). Dementsprechend werden Nachhaltigkeitsthemen zunehmend positiv konnotiert: In ihnen liegt ein Innovationspotential; sie stellen Marktlücken und Investitionsmöglichkeiten dar. Damit einhergehend werden Unternehmen und KonsumentInnen zu den HauptakteurInnen der nachhaltigen Entwicklung. Die Rolle politischer und ökonomischer Institutionen rückt in den Hintergrund. Es stehen weniger gesamtgesellschaftliche Zusammenhänge als vielmehr die Handlungsparadigmen individueller AkteurInnen im Zentrum. Die nachhaltige Entwicklung wird nicht als politisches, sondern als individuelles Problem wahrgenommen (McCarthy 2012; Shove 2010). Und für die Bewältigung von Nachhaltigkeitsproblemen wird hauptsächlich auf technische Innovation gesetzt, während gesellschaftsorientierte Lösungsansätze, welche die sozialen und ethischen Grundsätze des Handelns hinterfragen, kaum in Erwägung gezogen werden (Dobroć et al. 2018). Solche normativen Vorentscheide prägen auch die TA (Dobroć et al. 2018; Kollek 2019). In diesem Sinne beschränkt sich dann die Rolle der TA auf die Förderung der Entwicklung von Technik für eine bessere Gesellschaft (vgl. Schot/Rip 1996). Dadurch „kann [es] passieren, dass TA ungewollt zu einem Technologie-Hype beiträgt." (Kastenhofer et al. 2019, S. 37).

2.2 Eine Nachhaltigkeitspolitik, die ihre Ziele verfehlt

Diese nachhaltigkeitspolitischen Ansätze scheinen jedoch nicht nur ihre umweltpolitischen, sondern auch die sich in vielen Nachhaltigkeitszielen niederschlagenden sozioökonomischen Ziele zu verfehlen. Obschon in einigen Bereichen die relativen Emissionswerte oder der relative Material- und Energieverbrauch gesenkt werden konnten, nehmen der Gesamtmaterial- und -energieverbrauch und die Gesamtemissionen weiter zu. Auch der Rückgang der Biodiversität und der Verlust fruchtbarer Böden schreiten fort (Healy et al. 2015; WWF 2016). Insbesondere im Energiebereich werden ausgeprägte Rebound-Effekte beobachtet, da in vielen Bereichen Effizienzgewinne durch eine Zunahme des Verbrauchs überkompensiert werden (Antal/van den Bergh 2014). Zudem hat die technikfokussierte Nachhaltigkeitspolitik zur Verschärfung der sozialen Ungleichheiten beigetragen. Sie kommt primär jenen Bevölkerungsschichten zugute, deren Lebensstil techniklastig ist. Dies betrifft nur eine kleine globale Elite. Und selbst in vermögensstarken Ländern ist einem signifikanten Teil der Bevölkerung der Zugang zu grünen Technologien aus finanziellen Gründen verwehrt. Zudem reiht sich die Herstellung solcher Technologien in das bestehende Muster ein, dass sich Rohstoffförderung und Produktionsstätten in den globalen Süden verlagern, und somit auch die damit verbundenen Emissionen und Umweltprobleme, während die Gewinne dieser Produktion im globalen Norden angesiedelten Unternehmen zukommen (Salleh 2015).

3

Obschon vermehrt Berichte und wissenschaftliche Arbeiten veröffentlicht werden, die auf dieses Versagen und die Notwendigkeit eines raschen politischen Wandels hin zu radikal anderen Strategien hinweisen (Abson et al. 2016; EEA 2015; IPCC 2018; OECD 2012; Rockström et al. 2009; WWF 2016), und Forschung in Bereichen wie der politischen Ökologie, der Umweltsoziologie oder der ökologischen Ökonomie Einsichten in die Ursachen des Versagens markt- und technikfokussierter Ansätze generiert (Kallis 2011; Martínez-Alier/Muradian 2015; Shove 2010), überwiegen diese weiterhin (Dobroć et al. 2018; McCarthy 2012; Shove 2010).

2.3 Das Verschliessen von Alternativen: Institutionalisierung und Hegemonie

Die Siebzigerjahre waren eine Zeit, in welcher nicht nur Nachhaltigkeitsthemen an Dringlichkeit und Einfluss gewannen, sondern die auch tiefgreifende wirtschaftliche Veränderungen mit sich brachte. Das in vielen Ländern stabile und ausgeprägte Wirtschaftswachstum der Nachkriegsjahre brach ein und verschiedenste Länder sahen sich mit Finanzkrisen konfrontiert. In der Folgezeit wurde die in den Nachkriegsjahren vorherrschende sozialdemokratische Wirtschaftspolitik, welche sich durch eine starke antizyklische staatliche Beteiligung an der Wirtschaft und kontrollierte internationale Währungsmärkte auszeichnete, in vielen Ländern durch liberale Wirtschaftsprogramme ersetzt. Damit sollten neue Absatzmärkte und Investitionsmöglichkeiten geschaffen und der Wirtschaft aus der Stagflation geholfen werden. Dies förderte unter anderem die Entstehung monopol- und oligopolistischer transnationaler Unternehmen, deren wirtschaftliche Grösse teils jene der Staaten, in denen ihre Produktionstätigkeit angesiedelt war, übertraf (Harvey 2007; McCarthy 2012). In diesem Kontext überrascht es wenig, dass sich nachhaltigkeitspolitische Ansätze durchsetzten, welche der stagnierenden Wirtschaft neue Märkte und Investitionsmöglichkeiten erschlossen (Blythe et al. 2018; Salleh 2015).

Die Entwicklung hin zu marktliberalen Ansätzen in diversen Bereichen des öffentlichen und privaten Sektors und die Ausweitung des Letzteren auf Kosten des Ersteren führten dazu, dass die marktliberale Logik immer mehr Teil politischer, juristischer und gesellschaftlicher Institutionen wurde. Indem zwischenmenschliche Interaktionen und Mensch-Umwelt-Verhältnisse zunehmend in Marktmechanismen integriert wurden, wurden entsprechende Institutionen, Gesetzesrahmen und Gesellschaftsnormen geschaffen. Wertvorstellungen, welche den Menschen und seine Bedürfnisse ins Zentrum stellen, und welche davon ausgehen, dass es dem rationalen Menschen möglich ist, sich die Umwelt durch Wissenschaft und Technik zu eigen zu machen, erhielten so eine institutionelle Form und wurden von dieser reproduziert. Dies erschwerte es, politische Ansätze zu verfolgen, die mit dieser Logik brachen (McCarthy 2012; O'Neill/Uebel 2015; Salleh 2015).

Bourdieu (2012, S. 187) beschreibt diesen Prozess der Institutionalisierung als eine „fermeture des possibles"—als ein „Verschliessen von Möglichkeiten". Ein ursprünglich willkürlicher Ansatz wird zu einer allgemein anerkannten Realität, einer unhinterfragten Tatsache (Bourdieu 2012). Anschauungen oder Ansätze, welche mit der vorherrschenden Logik im Widerspruch stehen, werden entweder nicht gehört, weniger stark gewichtet oder nicht zum Ausdruck gebracht, weil sie unlogisch oder irrational erscheinen. Dadurch wird eine Verengung auf eine Denkweise und die ihr entsprechenden politischen Ansätze begünstigt (Healy et al. 2015; Meinherz et al. im Druck; Shove 2010). Umweltprobleme als Marktversagen zu definieren und für ihre Lösung auf wirtschaftsliberale und technikfokussierte Ansätze zu setzen wird durch die Normalisierung dieser Wertvorstellungen von einer Möglichkeit unter vielen zu einer absoluten Realität und nicht mehr hinterfragt. Die Frage nach alternativen Gesellschaftsmodellen wird marginalisiert (Dobroć et al. 2019; Jasanoff 2015; Latour 1997; O'Neill/Uebel 2015; Salleh 2015).

Dieser Prozess des Verschliessens kann als Ursache des Beharrens auf marktliberalen und technikfokussierten Ansätzen in der Nachhaltigkeitspolitik verstanden werden. Es setzen sich nachhaltigkeitspolitische Ansätze durch, die sich auf Wertvorstellungen beziehen, welche mit aktuellen Gesellschaftsstrukturen und Institutionen kohärent sind. Gleichzeitig werden so die Wertvorstellungen, welche diesen Institutionen und Gesellschaftsstrukturen zugrunde liegen, weiter institutionalisiert und normalisiert. Dementsprechend wird in der Nachhaltigkeitspolitik weitgehend auf Ansätze gesetzt, welche die Lösung von Nachhaltigkeitsproblemen in denselben Institutionen und Gesellschaftsstrukturen suchen, welche zu den Problemen geführt haben, denen sie begegnen will (Lövbrand et al. 2015). Forschende aus

4

verschiedenen Bereichen betonen jedoch zunehmend, dass die Lösungen von Nachhaltigkeitsproblemen nicht von denselben Institutionen und Gesellschaftsstrukturen kommen können, welche sie verursacht haben (Abson et al. 2016, Funtowicz/Ravetz 1990, Lövbrand 2015).

3 Das Öffnen von Alternativen: Schlussfolgerungen für die nachhaltigkeitsorientierte Technikfolgenabschätzung

Diese Einsichten sind von Relevanz für die nachhaltigkeitsorientierte TA. Es ist einerseits Aufgabe der TA, die gesellschaftlichen Wirkungen soziotechnischer Zukunftsvisionen zu erforschen. Andererseits soll sie auch aufzeigen, inwiefern diese Visionen Ausdruck bestimmter Gesellschaftsstrukturen sind, bestehende Machtverhältnisse reproduzieren und das Ergebnis diskursiver Schliessungsprozesse sind (Dobroć et al. 2019; Grunwald 2012; Lösch et al. 2016; Lucivero et al. 2019). Die TA soll normative Prämissen offenlegen und argumentativ begründen, um so ihre Neutralität und Glaubwürdigkeit zu gewährleisten (Kollek 2019; Nierling/Torgersen 2019). Um dies zu erreichen, wird vermehrt auf partizipative Ansätze gesetzt. Durch den Einbezug von AkteurInnengruppen mit unterschiedlichen Interessen soll die unbewusste Selektion von Prioritäten und Wertvorstellungen vermieden werden. Des Weiteren trägt die TA durch diesen Fokus auf Partizipation einem von demokratischen Werten geprägten prozeduralen Ideal Rechnung (Kollek 2019; Lucivero et al. 2019; Nierling/Torgersen 2019).

Es wurde jedoch festgestellt, dass in partizipativen Aushandlungsprozessen gewisse Wertvorstellungen mitunter vernachlässigt werden. Und grundsätzliche Fragen bezüglich der moralischen Ausrichtung und der Definition eines guten Lebens werden kaum gestellt (Dobroć et al. 2018; Lucivero et al. 2019; Sclove 2010). Als Ursache hierfür wurde die Tendenz partizipativer TA identifiziert, den Machtdynamiken zwischen Diskursen und AkteurInnengruppen und somit dem soziopolitischen Kontext, in dem AkteurInnengruppen miteinander interagieren, zu wenig Aufmerksamkeit zu schenken. Dadurch wird der Einfluss von Wertvorstellungen, die dem dominanten gesellschaftlichen Selbstverständnis entstammen und sich auf allgemein akzeptierte soziale Normen beziehen, ausgeblendet (Lucivero et al. 2019; Torgersen 2018). So beziehen sich zum Beispiel Nachhaltigkeitsanalysen oft auf relativ rasch formalisierte Indikatorensysteme und übernehmen die darin implizit verankerten Wertvorstellungen, ohne dass die ihnen vorhergehenden diskursiven Schliessungsprozesse untersucht werden (Böschen et al. 2019). Weiterhin wurde festgestellt, dass die TA dazu tendiert, die Wertvorstellungen markt- und technikfokussierter nachhaltigkeitspolitischer Ansätze unhinterfragt zu übernehmen (Dobroć et al. 2019; Hack 2004).

Diese Beobachtungen weisen auf das Risko hin, dass die nachhaltigkeitsorientierte TA in den in diesem Beitrag beschriebenen Prozess der Institutionalisierung spezifischer Wertvorstellungen und des Verschliessens von Alternativen eingebunden ist. Wir schliessen uns deshalb der Forderung an, dass sich die TA vermehrt auf ihren Anspruch besinnen sollte, diskursive Schliessungsprozesse kritisch zu hinterfragen (vgl. Dobroć et al. 2019). Um dies zu erreichen, schlagen wir vor, dass die nachhaltigkeitsorientierte TA i) hegemoniale Wertvorstellungen in Technikzukünften explizit macht, ii) Machtdynamiken aufzeigt und iii) untersucht, inwiefern die Gesellschaftsstrukturen, welche durch spezifische Technikzukünfte reproduziert werden, Nachhaltigkeitsprobleme verschärfen oder lösen.

1. Hegemoniale Wertvorstellungen explizit machen: Dieser Schritt ist notwendig, damit hegemoniale Wertvorstellungen und Ansätze überhaupt erst zum Diskussionsgegenstand werden können (Dobroć et al. 2018; Bourdieu 1972). Folgt man der Theorie zu diskursiven Praktiken, können hegemoniale Diskurse und Ansätze dann durchbrochen werden, wenn alternative Diskurse die etablierte Wahrheit infrage stellen, oder wenn sie in Widerspruch mit der gelebten Realität stehen und somit ein Erklärungsnotstand besteht (Bourdieu 1972; Fairclough 1992; Jørgensen/Phillips, 2002). Es hat sich jedoch gezeigt, dass das Gegenüberstellen kontrastierender Diskurse nicht unbedingt ausreicht, um Hegemonien aufzubrechen (Lucivero et al. 2019). Dass auch Widersprüche mit der gelebten Realität nicht zwingend genügen, wird aus dem Fortbestehen der vorherrschenden nachhaltigkeitspolitischen Ansätze trotz ihres Versagens deutlich. Unseres Erachtens sollte die nachhaltigkeitsorientierte TA daher aufzeigen, in welche Gesellschaftsstrukturen die den verschiedenen Technikzukünften zugrundeliegenden Wertvorstellungen eingebettet sind. Eine solche Genese und gesellschaftshistorische Kontextualisierung der Wertvorstellungen, die Studien in der

5

nachhaltigkeitsorientierten TA zugrunde liegen, erlaubt es, deren historische Konstruktion offenzulegen und sie so zum Diskussionsgegenstand werden zu lassen (Torgersen 2018).

2. Machtdynamiken aufzeigen und beachten: In Nachhaltigkeitsanalysen und in der TA wird zunehmend versucht, durch partizipative Formate eine Pluralität von Wertvorstellungen und Ansätzen zu berücksichtigen. Solche Formate können jedoch die Machtstrukturen, in welche sie eingebettet sind, reproduzieren. Dies ist dann umso wahrscheinlicher, wenn die Rahmenbedingungen des Dialogs von Institutionen geschaffen werden, die Teil der etablierten Gesellschaftsordnung sind (Fritz/Meinherz im Druck; Lucivero et al. 2019; Salleh 2015). Es muss also besser verstanden werden, welche Machtdynamiken die normativen Verhandlungen prägen, aus welchen nachhaltigkeitsorientierte Technikvisionen entstehen—welche Wertvorstellungen Eingang finden und welche ausgeschlossen werden. Auf dieser Grundlage können Strategien entwickelt werden, um Machtdynamiken zu bestärken, welche dem Aufbrechen unnachhaltiger hegemonialer Ansätze oder Praktiken förderlich sind, und Strukturen zu schwächen, welche diese reproduzieren. In Fritz/Meinherz (eingereicht) präsentieren wir einen Ansatz, mit dem dies systematisch und projektbezogen untersucht werden kann.

3. Nachhaltigkeitsrelevante gesellschaftliche Auswirkungen von Technikzukünften untersuchen: Dies ist per se die Aufgabe der nachhaltigkeitsorientierten TA (Grunwald 2012; Lösch et al. 2016). Dieses Unterfangen wird durch die Komplexität und Vielschichtigkeit der Wechselwirkung zwischen gesellschaftlichen und ökologischen Prozessen, nachhaltigkeitsorientierter Wissensproduktion und der Ausarbeitung und Umsetzung politischer Aktionspläne erschwert. In Bezug auf Nachhaltigkeitsbewertungen schlagen Frame/Brown (2008) vor, Nachhaltigkeitspolitik und das Erstellen von Nachhaltigkeitsindikatoren als ein komplexes Experiment mit hohem Lernpotential zu verstehen. Ein solcher Ansatz scheint uns auch für die nachhaltigkeitsorientierte TA geeignet.

Wir hoffen, dass eine nachhaltigkeitsorientierte TA so der Einbettung der Nachhaltigkeitspolitik in Gesellschaftsstrukturen und den daraus resultierenden Herausforderungen Rechnung tragen und die Schaffung jener radikalen Innovationen fördern kann „which redefine the rules of the game; which render previously important forms of competence redundant; and which reconfigure interpretations of value and significance" (Shove 2010, S. 1278).

Literatur

Abson, D.; Fischer, J.; Newig, J.; Schomerus, T., Vilsmaier, U.; von Wehrden, H.; Abernethy, P.; Ives, C. D.; Jager, N. W.; Lang, D. J. (2016): Leverage points for sustainability transformations. In: Ambio 46(1), S. 30-39

Antal, M.; van den Bergh, J. C. J. M. (2014): Re-spending rebound: a macro-level assessment for OECD countries and emerging economies. In: Energy Policy 68, S. 585-590

Blythe, J.; Silver, J.; Evans, L; Armitage, D; Bennett, N. J.; Moore, M.-L.; Morrison, T. H.; Brown, K. (2018): The dark side of transformation: Latent risks in contemporary sustainability discourse. In: Antipode 0(0)

Böschen, S.; Dewald, U. (2018): TA als Kontextualisierungsexpertise. Zwischen einfachem und reflexivem Modus. In: TATuP 27(1), S. 34-39

Böschen, S.; Sotoudeh, M.; Stelzer, V. (2019): Indikatorenarbeit. Kontextneutralisierende und kontextoffene Strategien in der Analyse komplexer Probleme. In: TATuP 28(1), S. 45-51

Bourdieu, P. (1972): Esquisse d'une théorie de la pratique: précédé de trois études d'ethnologie kabyle. Editions du Seuil

Bourdieu, P. (2012): Sur l'état. Cours au collège de France 1989–1992. Éditions raisons d'agir/Éditions du seuil

Carson, R. (1962): Silent spring. Houghton Mifflin

Costanza, R.; Daly, H. E. (1992): Natural capital and sustainable development. In: Conservation biology 6(1), S. 37–46

Dobroć, P.; Krings, B.-J.; Schneider, C.; Wulf, N. (2018): Alternativen als Programm: Plädoyer für einen Perspektivenwechsel in der Technikfolgenabschätzung. In: TATuP 27(1), S. 28-33

EEA (2015): The European environment — state and outlook 2015: synthesis report. European Environment Agency, Copenhagen

Fairclough, N. (1992): Discourse and social change. Polity press, Cambridge

Frame, B.; Brown, J. (2008): Developing post-normal technologies for sustainability. In: Ecological Economics 65(2), S. 225-241

Fritz, L.; Meinherz, F. (eingereicht): Tracing power in transdisciplinary sustainability research: an exploration. In: GAIA-Ecological Perspectives for Science and Society

Fritz, L.; Meinherz, F. (im Druck): The Politics of Participatory Sustainability Assessments : an Analysis of Power. In: Binder, C. R.; Massaro, E.; Wyss, R. (Hg.) (im Druck): Sustainability Assessment in Urban Systems. Cambridge University Press

Funtowicz, S. O.; Ravetz, J. R. (1990): Uncertainty and quality in science for policy. Springer Science & Business Media

Grunwald, A. (2012): Technikzukünfte als Medium von Zukunftsdebatten und Technikgestaltung. KIT Scientific Publishing

Hack, L. (2004): Reichweiten. Theoriegeleitete Technikforschung und TA. In: Bechmann, G.; Petermann, T. (Hg.) (2004): Interdisziplinäre Technikforschung. Genese, Folgen, Diskurs. Campus

Harvey, D. (2007): A brief history of neoliberalism. Oxford University Press

Healy, H.; Martinez-Alier, J.; Kallis, G. (2015): From ecological modernization to socially sustainable economic degrowth: lessons from ecological economics. In: Bryant, R. L. (Hg.) (2015): The international handbook of political ecology. Edgar Elgar, S. 577–590

Horcea-Milcu, A.-J.; Abson, D. J.; Apetrei, C. I.; Duse, I. A.; Freeth, R.; Riechers, M.; Lam, D. P. M.; Dorninger, C.; Lang, D. J. (2019): Values in transformational sustainability science: four perspectives for change. In: Sustainability Science

Imran, S.; Alam, K.; Beaumont, N. (2014): Reinterpreting the definition of sustainable development for a more ecocentric reorientation. In: Sustainable Development 22(2), S134–144

IPCC (2018): Global warming of 1.5°C: An IPCC special report. Intergovernmental Panel on Climate Change, Incheon

7

Jasanoff, S. (2015): Future imperfect: Science, technology, and the imaginations of modernity. In: Jasanoff, S.; Kim, S.-H. (Hg.) (2015): Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power. University of Chicago Press, S. 1-33

Jørgensen, M. W.; Phillips, L. J. (2002): Discourse analysis as theory and method. Sage

Kallis, G. (2011): In defence of degrowth. In: Ecological Economics 70(5), S. 873–880

Kastenhofer, K.; Capari, L.; Fuchs, D.; Peissl, W. (2019): "Wes Brot ich ess, des Lied ich sing"? Technikfolgenabschätzung und ihre Auftraggeber. In: TATuP 28(1), S. 33-38

Kates, R. W.; Parris, T. M.; Leiserowitz, A. A. (2005): What is sustainable development? In: Environment 47(3)

Kemp, R.; Martens, P. (2007): Sustainable development: how to manage something that is subjective and never can be achieved? In: Sustainability: Science, Practice, & Policy, 3(2)

Kollek, R. (2019): Implizite Wertbezüge in der Technikfolgenabschätzung. Plädoyer für eine Praxis der reflexiven Normativität. In: TATuP 28(1), S. 15-20

Latour, B. (1997): Politiques de la nature: Comment faire entrer les sciences en démocratie. La Découverte

Leff, E. (2002): Die Geopolitik nachhaltiger Entwicklung: Ökonomisierung des Klimas, Rationalisierung der Umwelt und die gesellschaftliche Wiederaneignung der Natur. In: Görg, C.; Brand, U. (Hg.) (2002): Mythen globalen Umweltmanagements: Rio+10. Verlag Westfälisches Dampfboot, Münster

Lösch, A.; Böhle, K.; Coenen, C.; Dobroc, P.; Ferrari, A.; Heil, R.; Hommrich, D.; Sand, M.; Grunwald, A.; Dickel, S. (2016): Technikfolgenabschätzung von soziotechnischen Zukünften. Institut für Technikzukünfte

Lövbrand, E.; Beck, S.; Chilvers, J.; Forsyth, T.; Hedrén, J.; Hulme, M.; Lidskog, R.; Vasileiadou, E. (2015): Who speaks for the future of earth? how critical social science can extend the conversation on the anthropocene. In: Global Environmental Change 32, S. 211–218

Lucivero, F.; Delvenne, P.; van Oudheusden, M. (2019): Making the invisible visible. Normativities *in* and *of* technology assessment. In: TATuP 28(1), S. 21-26

Mader, C.; Hilty, L. M.; Som, C.; Wäger, P. (2019): Transparenz normativer Orientierungen in partizipativen TA-Projekten. In: TATuP 28(1), S. 58-64

Martinez-Alier, J.; Muradian, R. (2015): Handbook of Ecological Economics. Edward Elgar Publishing

McCarthy, J. (2012): The financial crisis and environmental governance „after" neoliberalism. In: Tijdschrift voor economische en sociale geografie 103(2), S. 180–195

Meadows, D. H.; Meadows, D. L.; Randers, J.; Behrens, W. W. (1972) The limits to growth: A report for the Club of Rome's project on the predicament of mankind. Universe Books

Meinherz, F.; Fritz, L.; Schneider, F. (im Druck): How values play into sustainability assessments: Challenges and a possible way forward. In: Binder, C. R.; Massaro, E.; Wyss, R. (im Druck): Sustainability Assessment of Urban Systems. Cambridge University Press

Nierling, L.; Torgersen, H. (2019): Normativität in der Technikfolgenabschätzung. Einleitung in das TATuP-Thema. In: TATuP 28(1), S. 11-14

OECD (2012): OECD environmental outlook to 2050: The consequences of inaction. Organisation for economic co-operation and development

Okereke, C. (2010): Climate justice and the international regime. In: Climate Change 1(3), S. 462–474

O'Neill, J.; Uebel, T. (2015): Analytical philosophy and ecological economics. In: Martínez-Alier, J.; Muradian, R. (Hg.) (2015): Handbook of Ecological Economics. Edward Elgar, Cheltenham, S. 48-78

Rockström, J., Steffen, W.; Noone, K.; Persson, A.; Chapin F. S.; Lambin, E.; Lenton, T.; Scheffer, M.; Folke, C.; Schellnhuber, H. J. (2009): Planetary boundaries: exploring the safe operating space for humanity. In: Ecology and society 14(2)

Salleh, A. (2015): Neoliberalism, scientism and earth system governance. In: Bryant, R. L. (Hg.) (2015): The international handbook of political ecology. Edgar Elgar, S. 432-446

Schot, J.; Rip, A. (1996): The past and future of constructive technology assessment. In: Technological forecasting and social change 54, S. 251-268

Sclove, R. (2010): Reinventing technology assessment. A 21st century model. Woodrow Wilson International Center for Scholars

Shove, E. (2010): Beyond the ABC: climate change policy and theories of social change. In: Environment and planning A 42(6), S. 1273–1285

Torgersen, H. (2018): Die verborgene vierte Dimension. Normative Reflexion als Erweiterung der Theorie der Technikfolgenabschätzung. In: TATuP 27(1), S. 21-27

van der Hel, S. (2018): Science for change: A survey on the normative and political dimensions of global sustainability research. In: Global Environmental Change 52, S. 248–258

WCED (1987): Our Common Future. Oxford University Press

WWF (2016): Living Planet Report 2016. Risk and resilience in a new era. WWF International, Gland

9

9 Manuscript IX

Bibliographic details:

Binder, C.R.; **Fritz, L**; Andreas Balthasar; Ralph Hansmann; Zilla, Roose (submitted). Increasing the relevance of science for practice and practice for science: quantitative empirical insights. Submitted to *Science and Public Policy*.

Contribution of the doctoral candidate:

The doctoral candidate provided inputs on participation and transdisciplinarity, developed hypotheses and survey questions during the data collection process. She contributed to the conceptualisation of the article and the analytical foci chosen, provided feedback on the manuscript, co-wrote the introduction and discussion sections.

Increasing the relevance of science for practice and practice for science: Quantitative empirical insights

Claudia R. Binder[1]*, Livia Fritz[1], Ralph Hansmann[1,2], Andreas Balthasaar[2], Zilla Roose[2]

1: Claudia R. Binder
Laboratory for Human Environment Relations in Urban Systems (HERUS)
Swiss Mobiliar Chair in Urban Ecology and Sustainable Living
École Polytechnique Fédérale de Lausanne (EPFL)
CH-1015 Lausanne, Switzerland
Claudia.binder@epfl.ch

1: Livia Fritz
Laboratory for Human Environment Relations in Urban Systems (HERUS)
École Polytechnique Fédérale de Lausanne (EPFL)
CH-1015 Lausanne, Switzerland

Ralph Hansmann
1: Laboratory for Human Environment Relations in Urban Systems (HERUS)
Swiss Mobiliar Chair in Urban Ecology and Sustainable Living
École Polytechnique Fédérale de Lausanne (EPFL)
CH-1015 Lausanne, Switzerland

2: Transdisciplinarity Lab (TdLab)
Department of Environmental Systems Science (D-USYS)
ETH Zurich
CH-8092 Zürich, Switzerland

3: Andreas Balthasar & Zilla Roose
Department of Political Science
University of Lucerne
6002 Lucerne, Switzerland

Abstract

We present results of a survey conducted with researchers and practitioners involved in a Swiss national research programme on steering energy consumption. We analyse what motivates practitioners and researchers to engage in a collaborative research project, their perception of the collaboration intensity in different project phases, and to which extent the research project provided useful results for practitioners. Our analyses demonstrate that the intensity of collaboration is a key driver of successful collaboration as it fosters trust between researchers and practitioners. Thereby, it increases the usefulness of the research project for practitioners and their perceived contribution to the success of the research project. Research programmes should thus (i) foster trust through fostering collaboration between research and practice; (ii) facilitate the development of a shared understanding of researchers' and practitioners' respective roles; and (iii) support the inclusion of practitioners in the project development phase through financial support during the proposal-writing phase

1. Introduction

In the face of complex sustainability problems, science policy and research funding programmes increasingly ask researchers to co-create knowledge with policymakers, businesses or civil society actors – i.e. with practitioners. This generally rests on the assumption that the participation of practitioners results in societally relevant and robust knowledge that is more likely to contribute to societal transformations. The call for involving practitioners has become an integral part of the

1

sustainability discourse in research policy and funding schemes (Cundill et al. 2015; Hessels et al. 2018; Schmidt & Pröpper 2017; Schneider et al. 2019; Spangenberg 2011; Van der Hel 2016).

At the regional and international levels, this call for the inclusion of diverse societal actors in knowledge production is reflected for instance in the "Science with and for Society" stream of the European Commission's Horizon 2020 programme (2019) or in global initiatives such as Future Earth (Future Earth 2019). At the national level, both public funding agencies and private donors have introduced funding schemes which call for the integration of different actor groups into research processes. In the European context these include the German funding priority programme "Socio-Ecological Research" (SöF) by the Federal Ministry for Science and Education (BMBF), the Austrian "Cultural Landscape Research Programme" (KLE, "Kulturlandschaftsforschung") by the Federal Ministry of Science and Research (AUT), or the National Research Programmes by the Swiss National Science Fund (CH), to name but a few.

This growing concern with policy relevance and the public expenditures it entails show the need for systematic assessments of transdisciplinarity (TD)-related research practices and their added value. This concerns in particular the relation between different forms and features of TD processes and the practical relevance and usefulness of the outputs which they produce (Newig et al. 2019).

Several studies have analysed individual or small sets of TD projects (Binder et al. 2015; Fritz et al. 2019; Hansson & Polk 2018; Wiek et al. 2014) and, more recently, funding programmes (Hessels et al. 2018; de Jong et al. 2016) with regard to the links between collaboration processes and their effects. These studies suggest that the forms and features of the collaborative research process involving researchers and practitioners affect its potential for producing relevant results and contributing to societal impact. Process features that are discussed in this regard include the intensity of researcher-practitioner interactions (Schneider & Buser 2018; Walter et al. 2007; Wiek et al. 2014), the timing of practitioner involvement, e.g. early involvement is considered important for joint understanding of the problem, ownership and the relevance of research results for practitioners (Lux et al. 2019), the methods of knowledge integration used (Newig et al. 2019), as well as process dynamics such as the development of mutual trust (Fritz et al. 2019).

For a long time, practitioners' perspectives on participation processes constituted blind spots in TD scholarship (Bracken et al. 2015; Fritz & Binder 2018; Schmidt & Pröpper 2017; Zscheischler et al. 2018). It is only recently that they have been receiving increasing interest. Qualitative studies have begun to capture the expectations and goals, experiences and perceptions of practitioners regarding the TD process and its (desired) outcomes (e.g. Binder et al. 2015; Bracken et al. 2015; Di Giulio et al. 2016; Fritz et al. 2019; Schmidt & Neuburger 2017; Schmidt & Pröpper 2017). Insights gained in these qualitative studies, often based on a single case study, point in similar directions: practitioners' motivations and expectations regarding participation in and the effects of TD projects are likely to differ from those of the researchers. A recent study on impact pathways, for instance, has shown that researchers and practitioners perceive different pathways to societal effects (Fritz et al. 2019). Also, the few quantitative studies of both researchers' and practitioners' motivations and perceptions of successful collaborations point in these directions (Thompson et al. 2017; Zscheischler et al. 2018). Greater knowledge of practitioners' perceptions, thus, contributes to better understanding of TD processes and some of the challenges encountered in them.

In summary, despite this growing concern with policy relevance, larger-scale systematic analyses of the real-world practice of TD at the level of funding programmes have been scant. So far, most reflections on TD practices are single case studies, with little more aggregated evidence of how forms and perceived qualities of the collaboration process relate to the perceived practical and scientific relevance of its results. Empirical investigations into how different interrelated process features (such as timing, form and intensity of practitioner involvement) link to the perceived practical usefulness and societal relevance of results are largely missing. Furthermore, there is a need for

2

greater empirical insights into the interrelations between effects, process features and qualities (Lux et al. 2019), and the dynamics of participation processes (Hansson & Polk 2018).

In this article, on the basis of a quantitative survey with researchers and practitioners who participated in projects funded by a major Swiss National Research Programme, we investigate how features (e.g. motivation, intensity and form, factors) of participation as perceived by researchers and practitioners relate to the perceived relevance and usefulness of the research project and its results. In so doing, we aim to (i) understand the differences between researchers and practitioners regarding expectations of and motivation for participation; (ii) elicit the perceived intensities and forms of interaction; (iii) assess which factors are perceived to shape the participation process itself; and (iv) understand how the perceived participation process features are linked to the perceived benefit of the project (practical and scientific). Finally, we reflect on the role research programme structures and funding instruments can play and how they could contribute to fostering societally relevant and useful research.

2. The National Research Program 71 (NRP71)

The National Research Programs (NRPs) are among the foundational mechanisms of the Swiss National Science Foundation. The research carried out by NRPs consists of targeted research that contributes to solving contemporary problems of national importance. Therefore, NRPs attach great importance to cooperation between scientific research and practitioners from business, society and public administration. NRPs are distinguished by the following characteristics: they are solution-oriented and close to the practical realm; they are interdisciplinary and transdisciplinary; the research projects of an NRP jointly pursue an overall goal; knowledge transfer and the communication of results are valued highly.[1] A team of consultants supports the transfer of knowledge and technology into practice. Each NRP has a steering group of experts from the relevant scientific fields which is responsible for the selection and supervision of projects, as well as for the integration and consolidation of the findings. Submissions for NRP projects can only be made in response to a public call for proposals by the Swiss National Science Foundation (SNSF).

The NRP 71 'Managing Energy Consumption' focuses on socioeconomic questions related to energy consumption. It aims to develop basic scientific knowledge and practice-oriented approaches that facilitate regulatory decisions and help set the course of Swiss energy policy. Special attention is given to areas with a high savings potential, like commercial and private electricity consumption, residual heat in residential buildings, and private transport. The call for NRP 71 was announced in 2013. International scientific experts reviewed the proposals. The main reviewing criteria were: scientific quality and originality; concordance with the goals of NRP 71 and relevance for the Swiss 'Energy Strategy 2050'; clear application, transfer and utilisation strategy; and adequate personnel and infrastructure. Out of more than 100 proposals, the steering committee decided to recommend that the National Research Council approve 19 projects. Most of the projects started in 2014 and ended in mid-2018.

3. Methods

The basis of this article is an online survey conducted in spring 2018. The aim was to study the cooperation between researchers and their partners from practice in NRP 71. We wanted to understand how the collaboration was assessed by the respective actor groups and which factors were perceived to be relevant for a successful cooperation. The online survey was structured along three main themes:

---

[1] http://www.snf.ch/en/funding/programmes/national-research-programmes-nrp/Pages/default.aspx#Details

1. **Structure of the cooperation between researchers and practitioners**: This concerns aspects relating to the form of practitioners' participation in the research project and the intensity of the exchange.
2. **Results of the cooperation**: This part relates the assessments of both groups regarding awareness, relevance, applicability and usefulness of the results. It also includes questions concerning the fulfilment of expectations regarding the cooperation and the benefit that the cooperation has created for the research project and practitioners.
3. **Success factors for the cooperation**: This theme deals with factors that researchers and practitioners consider important in order to achieve a fruitful cooperation.

Several of the questions built on the state of the art of TD and on key concepts in TD scholarship: three process phases of TD projects (Bergmann et al. 2005; Jahn et al. 2012; Lang et al. 2012; Pohl et al. 2007; Schneider & Buser 2018) and intensities of involvement (Schneider & Buser 2018; Stauffacher et al. 2008). Additionally, they were derived from the findings of a systematic qualitative literature review on factors shaping participation processes in knowledge production (Fritz and Binder, 2018).

A separate questionnaire was developed for researchers and practitioners. Members of the steering committee, in cooperation with representatives of the SNSF and a member of the knowledge and technology transfer team of the programme, developed the questionnaires in a multi-stage procedure. The questionnaire for the researchers was available in German and English, the questionnaire for the practitioners in German and French.

The questionnaire was made available to all researchers and practitioners who were involved in projects under NRP 71. The knowledge and technology transfer team had a list of addresses of researchers and practitioners involved in the respective research projects. The project leaders were informed about the survey and the practitioners (related to their projects) to whom the survey would be administered. They were invited to check and complete the list of practitioners.

The survey was programmed using the Qualtrics online tool. An individual link to the survey was sent to researchers and practitioners via e-mail. Persons who had worked on more than one project were contacted only once. They were asked to refer to the most important project for them. Table 1 shows how many researchers and practitioners were contacted and how many took part in the online survey. 72 of the 99 researchers contacted (72 percent) and 61 of the 120 partners from practice contacted (51 percent) participated in the survey. For the analysis of the data, the SPSS statistics program was used.

Table 1: Dispatch and response of the online survey

	Researchers	Practitioners
Cleaned lists	100	124
Invalid addresses	5	12
Additional addresses received	4	12
Persons included twice	1	4
Total valid addresses	**99**	**120**
Return (absolute)	72	61
Return (relative)	**72%**	**51%**

3.1 Description of the sample

Researchers and practitioners from all 19 projects were contacted. Of the 72 researchers who took part in the online survey, more than half were affiliated to a university and a further 11% were at a university of applied sciences. 67 (93%) of the participants had direct contact with practitioners within

4

the framework of the research project. They represented 17 out of 19 projects. 3 of the participating researchers participated in more than one project within the framework of NRP 71.

61 practitioners took part in the online survey. 12 of them worked for private companies, 11 for the federal government, 10 for industry associations, 9 for municipalities, 6 for cantonal authorities and 6 for energy service providers. The remaining 6 persons worked for an NGO, association or society. Around 40 % of the practitioners were located in the German-speaking part of Switzerland. A further 40 % were active in the whole of Switzerland. Between 3 and 6 % worked in the French-speaking or Italian-speaking part of Switzerland or abroad.

36 of 61 practitioners (59%) who answered the questionnaire knew that they were listed as partners on a research project. They were partners in 13 of the 19 projects. Three practitioners collaborated with more than one project under NRP 71. 14 practitioners had been involved in previous NRPs. 25 practitioners (41%) and five researchers (7%) did not know that they were listed as a partner or as having a partner from practice. These persons were asked only the introductory and final questions. They were not further included in the sample.

3.2 Structure of the survey

The survey asked how practitioners had cooperated with researchers, using the same set of participation formats (e.g. financial participation with cash contribution, provision of data, provision of equipment and/or software) in both questionnaires. Motivations were elicited using actor-adapted sets of possible sources of motivation for researchers (e.g. to secure the practical relevance of our project; to enhance the credibility of the results; to enhance the applicability of the results) and practitioners (e.g. to develop a concrete product or process; staying on top of research; finding solutions to a specific problem; supporting researchers).

The frequency of contact between researchers and practitioners was assessed separately for the three phases of the (i) development of the research question, (ii) processing of the research question and (iii) dissemination of results, using the levels 1 = no contact, 2 = very little contact (1–2 times), 3 = occasional contact (3–5 times), and 4 = frequent contact (more than 5 times) with the additional possible response 'I do not know'. An integrative measure for the overall frequency of partner contacts was computed based on the sum score of the three separate measures (three levels: 1 = very little contact (sum < 6), 2 = moderate contact frequency (sum score 5 to 9), 3 = frequent contact (sum > 9)).

After these questions, both the researchers and practitioners had to rank different participation factors according to their importance for the success of cooperation between research and practice (1 = most important reason, 2 = second most important reason, etc. to 5 = least important). The five participation factors which were derived from the literature considered here were a) researchers have sufficient time, b) practitioners have sufficient time, c) practitioners have sufficient financial resources d) there is a consistent perception of the problem to be addressed, and e) there is geographic proximity to the partners.

Various aspects of the actual process of cooperation were addressed thereafter in the questionnaires. Researchers were asked for example, 'whether the role of the partners in the project was always clear', and whether they incorporated practitioners' input into the project (four-point response scale: no, rather no, rather yes, yes; with the additional response option 'I do not know'). Practitioners were asked for example whether 'There were moments when I didn't realize what my role in the project was', whether their 'knowledge and expertise found appreciation in the project', and whether they 'were able to establish a trustful relationship with the researchers'. An additional open question asked researchers and practitioners which 'other factors favored or hampered their exchanges with their partners (practitioners or researchers)'.

To assess the usefulness of the research project for practice from the perspective of the

5

practitioners, a composite usefulness indicator was computed as an average from their valid responses to the four items 'Are these results relevant to your work?', 'We can apply the results directly', 'The project will influence our work' and 'The results give legitimacy to our work'. The resulting scale of this usefulness indicator accordingly ranged from 1 (= low usefulness) to 4 (= high usefulness). The perceptions of the researchers in relation to the usefulness of the research-practice cooperation for practice were assessed by the responses of the researchers to the single item 'Do you think the results are of relevance for the activities of your partners?' (response options: 'No', 'To some extent', 'Yes', and 'I do not know').

To investigate the contribution of practitioners to the research project, they were asked whether they think that they contributed to the success of the research project (response scale from 1 = no to 4 = yes; with the additional response option 'I do not know'). With the same aim, the researchers were asked how well the processing of the research questions of the project would have progressed in their view *without* collaboration with the practitioners (response options: 1 = better, 2 = as well, 3 = worse; with the additional response option 'I do not know').

The researchers were furthermore asked whether their expectations of collaborating with partners were met in overall terms (four-point scale: no, rather no, rather yes, yes with additional response option 'I don't know') and practitioners were asked in a similar way 'whether their expectations for the research project have been fulfilled so far'. The final questions on the survey asked for the type of research institution and for the type of organization where the practitioners were based, as previously described, and both practitioners and researchers were asked whether they had additional comments.

4. Results

4.1 Motivation of researchers and practitioners to collaborate

Figure 1 shows the researchers' answers to the question regarding their motivation for involving practitioners in their research projects. The two most frequently named motives were (i) to ensure the practical relevance of the project, and (ii) that the results should be applicable. Further important reasons included (iii) to validate the research performed; (iv) positive experiences with cooperation in the past; (v) to increase the legitimacy of the research; and (vi) to enhance the credibility of the findings. About 12% of the researchers stated that they had not themselves decided to pursue cooperation with practitioners and that the involvement of practitioners had been a requirement of the programme management. Eleven researchers (16.4%) specified other motives that were not eligible in the questionnaire; four of these researchers explained that cooperation with practitioners was an integral part of the research or that the project would not have been feasible without the involvement of practitioners. Two researchers mentioned access to data as an important reason for involving practitioners.
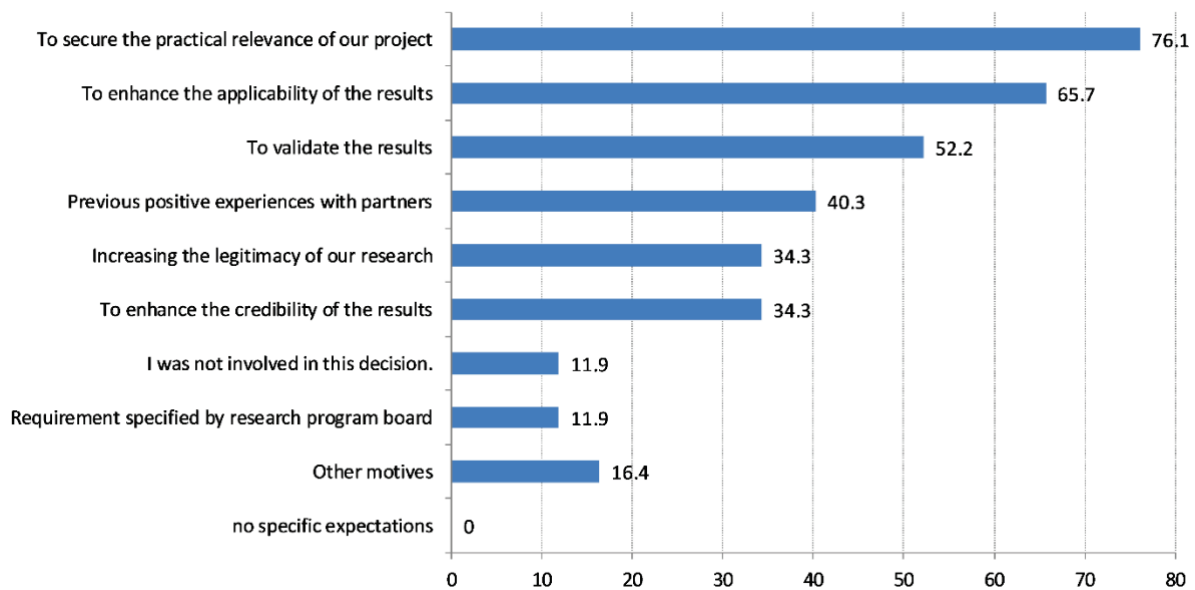
6

Figure 1: Researchers' motivations for involving practitioners in the research project (percentages of n = 67; more than one option could be selected). Data source: Balthasar et al. (2018)
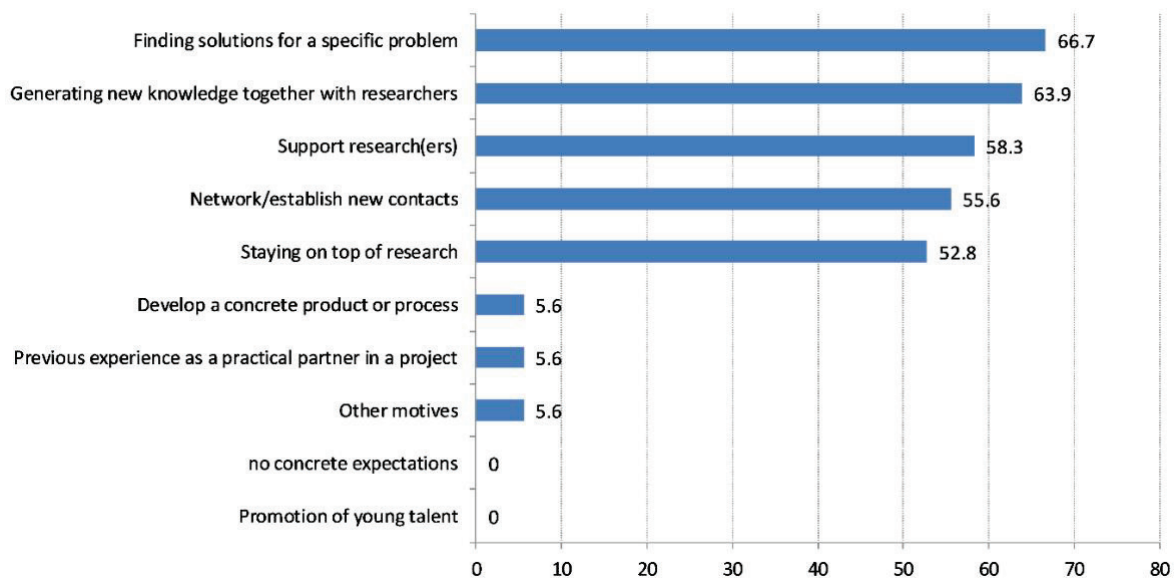

Figure 2: Practitioners' motivations for participating in the research project (percentages of n = 36; more than one option could be selected). Data source: Balthasar et al. (2018)

Regarding practitioners' motivations, the five most frequently named reasons for participating in the research project were (i) the development of a solution for a concrete problem; (ii) an interest in generating new knowledge together with researchers; (iii) to support researchers; (iv) to establish a network and contacts and (v) to keep up with research. These five reasons were named by majorities in the range of 53% and 67%, showing their importance. Only two practitioners each selected the 'development of a concrete product or process' and 'previous experience as a practitioner in a project', and two other practitioners specified other reasons, namely to 'receive fundamental knowledge' and to 'get an evaluation of a planned intervention at low cost'.

The main motivations of researchers are similar to the main motivations of practitioners to participate in the research project. Researchers want either to secure the practical relevance of the

7

project or the applicability and validity of the project results. Similarly, practitioners aim at finding solutions to a specific problem and generating new knowledge together with researchers. This indicates the importance of the practical relevance of the research topic as a motivation for researchers and practitioners to collaborate with each other. Interestingly, researchers frequently mentioned positive experiences with practitioners in earlier research projects as an important motivation for including practitioners, whereas this aspect was mentioned as motivation by only two practitioners in the sample. Practitioners mentioned the relevance of establishing a network or new contacts, which was not highlighted by the researchers. This could be relevant for structuring the forms of interaction within the project and also at the programme level.

4.2 Perceived forms and intensities of cooperation

When looking at the ways in which cooperation took place, researchers mentioned the participation of practitioners in workshops most frequently (59%), closely followed by their assistance in access to information (e.g. data, clients, stakeholders, role as door opener) (58%), the direct provisioning and transferring of data (55%), participating in interviews (55%) and participating in accompanying groups (e.g. steering or advisory) (52%). Researchers also stated that practitioners provided support in the communication of the results (45%). Financial support in the form of cash contributions (23%) or as internal contributions (e.g. of services, or analyses from practitioner partners) (15%) was mentioned rather rarely by the researchers and provisioning of software and equipment was not mentioned at all. Other forms of cooperation described by the researchers included the cooperative design of interventions.

Practitioners perceived their involvement in the research projects as follows. They considered their participation in accompanying groups (67%) and workshops (64%) as the most frequently used forms of collaboration, followed by their availability for interviews and assistance in access to information (role as door opener, e.g. for access to data, clients, participants) both with 39%. Provisioning of data and support in the communication of results were both mentioned by 28% of the practitioners.

The relative frequencies of the different categories named by researchers and practitioners were compared using a Chi-square test. By and large practitioners and researchers perceived the forms in which they collaborated in similar ways. The largest difference between their perceptions was found for the provisioning of data, which was acknowledged much more often by the researchers than by the practitioners (54%; $\chi2 = 6.38$, df = 1, p = 0.012). This was also the only significant difference between the two perspectives in relation to the frequency of a certain collaboration format (at the level of p<0.01). In addition, there were three forms of cooperation where the differences were actually non-significant but where a substantial difference was observed (.05 < p < .1). These three forms of cooperation, namely (i) provision of access to information or stakeholders (role as door opener), (ii) financial participation with contribution in kind, and (iii) support in communicating results were all perceived substantially more often by the researchers than by the practitioners. A reason for these differences could be that the perceptions of practitioners might be related primarily to regular forms of participation, while researchers also remember, weight and mention one-shot services, such as the transfer of data.
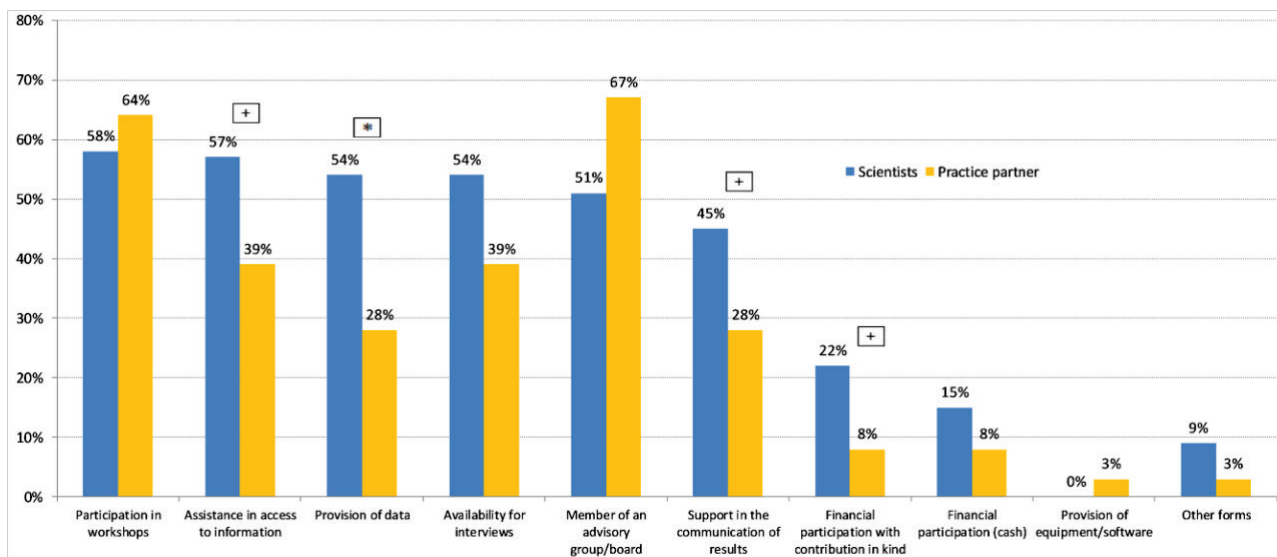
Figure 3: Percentage of researchers and practitioners who have selected different forms of cooperation (n = 66 researchers, n = 36 practitioners, multiple answers possible Percentages of n = 36; more than one option could be selected). *p < .05; +non-significant tendency with p < .1 (Chi-square tests); Data source: Balthasar et al. (2018)

4.3 Perceived frequency of participation in the three phases

Another key aspect investigated relates to the perceived frequency of interactions between research and practice for the three phases of the research project: (i) the definition of the research questions; (ii) the scientific working phase aiming to answer the research questions; and (iii) the phase of communicating the findings. The distribution of the respective responses from researchers and practitioners is displayed in Figure 4. In all three phases practitioners perceived the frequency of contact to be less intensive than researchers.

For statistical comparisons with significance tests, the responses were considered as a rank scale from 1 to 4 to compare responses of researchers and practitioners (via Mann-Whitney U-tests) and to compare the three phases (via Wilcoxon tests). Three non-parametric Mann-Whitney U-tests showed that the perceived higher contact frequency reported by the researchers compared to the practitioners was significant for the design phase ($M_{research}$ = 2.3; $M_{practice}$ = 1.5, p < .001), the active research phase ($M_{research}$ = 3. $M_{practice}$ = 2.6, p =.034) as well as for the dissemination phase ($M_{research}$ = 2.8, $M_{practice}$ = 2.1, p=.002). Apparently, researchers perceive the research–practice collaboration to be more intense than the practitioners involved (Figure 4).

There were also significant differences among the three phases. According to the ratings by the researchers, the contact during the phase of developing the research question was significantly less intense than during both the phase of work on the research question (Wilcoxon test, p < .001) and the phase of communicating the findings (p = .004). A similar picture emerged from the analysis of the practitioners' responses. They perceived the contact during the phase of developing the research question as significantly less intense than during the work on the research question (p < .001) and for the communication of the findings (p = .006). In addition, the practitioners also perceived the cooperation during the work on the research question as more intense than during the communication of the findings (p = .037).
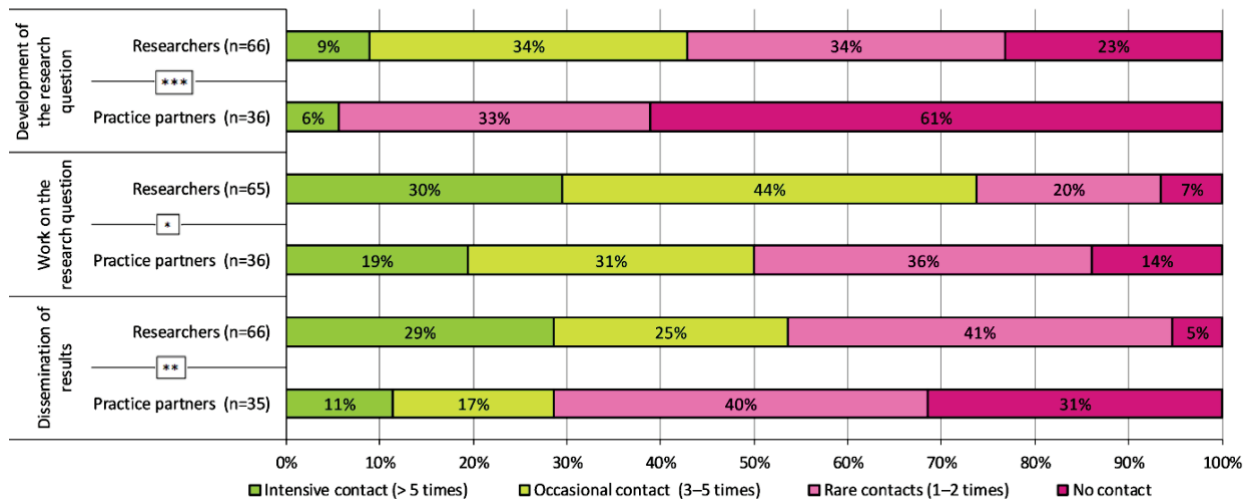
9

Figure 4: Ratings of the frequency of the contact between researchers and practitioners in the phases of (i) the definition of the research questions, (ii) the scientific working phase aiming to answer the research questions and the (iii) the communication of the findings.
*p < .05; **p < .01; ***p < .001 (Mann-Whitney U-tests); Data source: Balthasar et al. (2018)

4.4 Perceived relevance of participation factors for a successful cooperation

The analysis of the participation factors, which the literature states should support a successful collaboration, shows that both researchers and practitioners share the same perception regarding the relevance of the five participation factors selected. Both researchers and practitioners consider the common perception of the problem to be solved to be the most important factor for a successful cooperation. The second most important factor, according to the researchers, is that practitioners have enough time and, conversely, for practitioners that researchers commit to spending time on the collaboration. Both groups consider sufficient time on their own side to be the third most important factor. Furthermore, both groups consider sufficient financial resources for the practitioners to be the fourth most important factor. Finally, geographical proximity to each other is rated by both groups as the least important factor.

Subsequently, researchers and practitioners were asked about other beneficial and hindering factors. The researchers mentioned that it was beneficial for the success of collaboration if the practitioners had already been involved in research projects in the past or if they were genuinely interested in research or scientific thinking. Furthermore, they stated that it was important to agree on the questions and procedures. This is supported by regular exchange and cooperation with an already known person. One hindering factor was the difficulty of finding time for joint appointments (Balthasar & Roose 2018).

In addition, practitioners also considered it beneficial if the persons already knew each other and had shared interests or spoke a 'common language'. Five practitioners mentioned that it was more difficult to cooperate if researchers themselves had little or no experience in the market sector.

Table 2: Assessment of the importance of different factors for successful cooperation between research and practice (perspective of researchers and practitioners).

Perception of researchers		Perception of practitioners	
Rank	Factors	Rank	Factors

10

1.	Shared perception of the problem to be solved	1.	Shared perception of the problem to be solved
2.	Practitioners have sufficient time	2.	Researchers have sufficient time
3.	Researchers have sufficient time	3.	Practitioners have sufficient time
4.	Practitioners have sufficient financial resources	4.	Practitioners have sufficient financial resources
5.	Geographical proximity to practitioners	5.	Geographical proximity to researchers

Legend: Ranking on the basis of the total number of points = sum of the awarded points across all interviewed researchers or practitioners; scoring: most important reason = 5 points; second most important reason = 4 points; third most important reason = 3 points; fourth most important reason = 2 points; fifth most important reason = 1 point. Data source: Balthasar et al. (2018)

4.5 Perceived usefulness of the research project

Usefulness of the research project for practice: practitioners' perspective
The practitioners' responses show that they consider the results of the research as quite useful for them. The mean value of the corresponding composite usefulness score which assessed the usefulness of the research project for practice from the point of view of practitioners was, with M = 2.7 (SD = 0.6), in the upper half (> 2.5) of the four-point scale (from 1 = low usefulness to 4 = high usefulness). Table 3 shows the aspects that were significantly related to the usefulness of the research project for the practitioners. A successful and trustful relationship with researchers (r=.474**), a higher frequency of the contact with the researchers (r= .398**) and the perception that their own knowledge and expertise were highly valued by researchers (r= .356*) were significantly correlated with the perceived usefulness of the research project for the practitioners. Interestingly, in addition to the correlations found (Table 3), the trustful relationship with researchers is highly correlated with the frequency of the contact between practitioners and researchers (r=0.536**), so that the two most important factors for the usefulness of the research for practitioners are themselves correlated with each other.

Table 3: Significant correlations between aspects of cooperation as perceived by the practitioners and the 'usefulness of the research for practice' (composite score)

Variable	R_2	Significance p	n
Trustful relationship with researchers	.474**	.005	33
Frequency of contact	.398**	.018	35
Perceived estimation of knowledge and expertise	.356*	.042	33

Data source: Balthasar et al. (2018)

Usefulness of the research project for practice: researchers' perspective
Five researchers responded to the question 'Do you think the results are of relevance for the activities of your partners?' with 'I do not know'. They were thus excluded from the following analysis. Of the remaining 62 researchers 43.5% responded with 'Yes' and 56.5% with 'To some extent'. No one responded with 'No'. As a consequence, the indicator of usefulness for practice resulted in a dichotomous variable with only two levels due to the restricted response range of the participants. Therefore, instead of correlations, Mann-Whitney U-tests were used to investigate the relationships between various aspects of the research cooperation and relevance of the project results for the practitioners as perceived by the researchers.

The significant findings emerging from these analyses are shown in Table 4. Similarly to the aspects mentioned by practitioners, those researchers who perceived a high relevance of the research findings for practitioners ('yes' group) (i) had a significantly higher contact frequency with the practitioners involved, (ii) perceived the role of the practitioners in their project to be more clear, and

11

(iii) incorporated inputs from their partners more often into their projects, compared to researchers who were less sure about the relevance of the research findings to their partners ("to some extent" group).

Table 4: Significant differences (according to Mann-Whitney U-tests) in responses of the researchers perceiving a high relevance of the research findings for the practitioners involved ('yes' response) and researchers perceiving it only 'to some extent' in relation to important aspects of the cooperation. Data source: Balthasar et al. (2018)

Cooperation aspects (items)	n	M_{scale}	M_{ranks}	Sign. p
Frequency of contact with practice partners [a]	26	$M_{yes} = 2.3$	34.4	0.032
	32	$M_{partly} = 1.8$	25.5	
At times, the role of the partners in the project was unclear to me. [b]	27	$M_{yes} = 3.7$	36.2	0.044
	35	$M_{partly} = 3.3$	27.9	
Have you incorporated inputs from your partners into the project? [c]	26	$M_{yes} = 1.2$	25.8	0.018
	35	$M_{partly} = 1.5$	34.9	

[a] Low frequency = 1, moderate = 2, high = 3
[b] Yes = 1, rather yes = 2, rather no = 3, no = 4
[c] Yes = 1, rather yes = 2, rather no = 3, no = 4; 'I do not know' = excluded from the analysis

4.6 Perceived contributions of the practitioners to the success of the research project

Practitioners' perspective

Of the practitioners 80% stated that they perceived having contributed ('yes' or 'rather yes') to the success of the research project. The average rating of practitioners on the corresponding four-point agreement scale was M = 2.8 (SD = 0.6). Most of them (94%) also stated that they could bring in their experience into the project ('yes' or 'rather yes'). Practitioners perceived having a higher contribution to the success of the research project if (i) they were able to build up a trustful relationship with the researchers (r= 0.484**); (ii) it was clear to them what their role in the project was (r=0.371*); (iii) they had frequent contact with the researchers (r=0.579**); and (iv) they perceived the research project to be useful (r=0.377*, see Table 5). In addition, considering different forms of cooperation, practitioners assisting in providing access to information, data or participants (acting as door opener) perceived a significantly higher contribution to the success of the research project (M = 3.1) compared to practitioners who stated not having acted as door opener (M = 2.7, see Table 6).

Table 5: Practitioners' view on the factors affecting the 'perceived contributions to the success of the research project' (bivariate correlations between contribution ratings and perceived cooperation aspects)

Cooperation aspects (Spearman rank correlations)	R2	Significance p	n
Successful trustful relationship with researchers	0.484**	0.004	33
There were moments in which it was not clear what my role in the project is	-0.371*	0.031	34
Frequency of contact	0.579**	<0.001	35
Usefulness of research for practitioners (composite score)	0.377*	0.026	35

Table 6: Significant differences (according to Mann-Whitney U-tests) in practitioners' assessment of how the research project would have developed without their participation - depending on the form of cooperation.

12

Form of cooperation (items)	n	M_{scale}[a]	M_{ranks}	Sign. p
Assistance in access to information (e.g. data, clients, stakeholders) /role as door opener: Yes	14	$M_{yes} = 3.1$	20.2	0.039
No	21	$M_{no} = 2.7$	14.6	

[a] Item/ scale: Responses of practitioners to the question whether they think that they have 'contributed to the success of the research project?' (response scale from 1 = no to 4 = yes; without consideration of the additional response option 'I do not know'). Data source: Balthasar et al. (2018)

Researchers' perspective

Researchers were also asked how the research project would have progressed without the participation of the practitioners (response scale: 'better' = 1, 'the same' = 2, 'worse' = 3; additional option 'I do not know'). Five researchers responded 'I do not know' and one did not respond at all.

Of the remaining 61 researchers 14.8% selected 'better', 13.1% 'the same' and a clear majority of 72.1% responded with 'worse', indicating that the research benefited substantially from the practice cooperation in by far the majority of the projects (M = 2.6, SD = 0.7). It was further investigated whether researchers' judgement of the various aspects of the collaboration correlated significantly with the perceived usefulness of the input of practitioners for the research project. However, no significant relationships emerged. Still, considering different forms of cooperation, it turned out that researchers evaluated practitioners' contribution to the success of the research process significantly higher if their partners assisted in access to information (e.g. data, clients, stakeholders) and/or acted as door opener (M = 2.7 vs. M = 2.4 if not; see Table 7).

Table 7: Significant differences (according to Mann-Whitney U-tests) in researchers' assessment of how the processing of the research question would have progressed without the participation of the practitioners depending on the form of cooperation.

Form of cooperation (items)	n	M_{scale}[a]	M_{ranks}	Sign. p
Assistance in access to information (e.g. data, clients, stakeholders) /role as door opener: Yes	35	$M_{yes} = 2.7$	34.1	0.046
No	26	$M_{no} = 2.4$	26.9	

[a] Item/ scale: How would the research project have progressed without the participation of the practitioners? (response scale: "better" = 1, "the same" = 2, "worse" = 3; n = 61 as the response option "I do not know" was excluded from the analysis). Data source: Balthasar et al. (2018)

4.7 Fulfilment of the expectation of the collaboration

Of the researchers, 90% stated that their expectations had been fulfilled or partially fulfilled, 5% said that their expectations had (rather) not been met, and 5% had chosen the option 'I don't know'. Disaggregated findings for different types of practitioners and researchers respectively show that the researchers at universities of applied sciences stated particularly often that their expectations had been fulfilled (75%) or rather fulfilled (25%). The situation is similar for researchers working for private companies. They also stated that their expectations were met (69%) or rather fulfilled (31%). The perspectives of the university researchers are less enthusiastic: only 33% stated that their expectations were met and 61% that they were rather met. For around 5% of researchers at universities their expectations were not met at all. A Kruskal-Wallis test showed that the difference between the fulfilment of the expectations of researchers from universities, universities of applied sciences and private companies was significant (df = 2, p = 0.014; excluding 'I don't know' responses).

13

The higher the frequency of the contact with practitioners was, the more likely was it that the expectations of the researchers for the cooperation were fulfilled. The corresponding rank-correlation between the two variables was with r = .33 clearly significant (p = .011).

Practitioners' assessment of the fulfilment of the expectations of the cooperation resembles the one of the researchers: 54% of the practitioners stated that their expectations had been fulfilled. For 40%, their expectations were partly fulfilled and for 6% they were not fulfilled. Here the findings likewise indicate that the frequency of contact with the researchers plays a crucial role for the fulfilment of the expectations of the practitioners, even though the correlation slightly missed the 5% significance level (r = 0.31, p = .067). These results show that researchers and practitioners are no monolithic entities and that there is a need to study them as diverse and heterogeneous entities.

5. Discussion

This paper presented an analysis of the motivation of practitioners and researchers for engaging in a collaborative research project, the forms of their cooperation, their perceptions of the intensity of the collaboration, and their perceptions on how practitioners contribute to the research project and their assessment of the extent to which the research project provides useful results for practitioners. The results are derived from a survey with researchers and their partners from practice from a National Research Program on energy research in Switzerland (Balthasar & Roose 2018). It is one of only a few quantitative studies analysing the perceptions of both researchers and practitioners who participated in such a programme.

We discuss the results obtained in this study along three main lines: first, the aspects and factors affecting the utility of the collaboration between researchers and practitioners for research and practice; second, the role of the perceived intensity of collaboration; and third, we derive policy recommendations for large funding programmes that seek to have a societal impact.

5.1 Determinants affecting the usefulness of collaboration for practitioners and researchers

One central claim of TD approaches is that the participation of practitioners should improve the implementation and applicability of the results obtained in the research project (Gross & Hoffmann-Riem 2005; Hansson & Polk 2018; de Jong et al. 2016). Figure 5 summarizes the significant determinants of the usefulness of the research project for practice, bringing together the analysis of both the practitioners' and the researchers' perspectives. To achieve comparable indicators for both perspectives, we use biserial rank correlation coefficients as measures of the strength of influence of the aspects, according to the perspective of the researchers (instead of comparing the differences in means).

Determinants affecting the usefulness of the research project for practitioners

For both, practitioners and researchers, the perceived frequency of contact is a significant determinant of an increase in the usefulness of the research project for practitioners. In the case of practitioners, the frequency of contact is also related to establishing a trustful relationship with researchers, thus confirming that this is a key factor for a successful TD project (Elzinga 2008; Renner et al. 2013; Shdaimah & Stahl 2012).
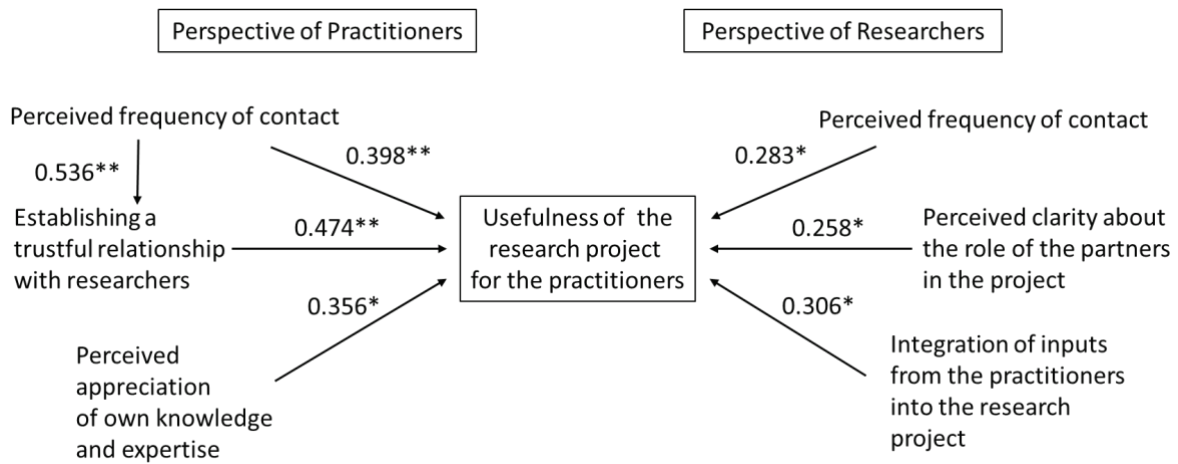
Figure 5: Significant aspects related to the usefulness of the research project for practitioners, according to the analysis of the responses of both researchers and practitioners. *p < .05, **p < .01 significant correlation coefficients.

The second determinant (Figure 5) is similar for practitioners and researchers: 'perceived appreciation of their own knowledge and expertise' (practitioners) and 'level of integration of practitioners' input into the research project' (researchers). This determinant suggests that the better the practitioners' inputs can be integrated into the research project, the higher the perceived appreciation of their knowledge and expertise is likely to be – leading to an increasing usefulness of the research project for practitioners. This second determinant could potentially be linked with the perceived frequency of contact between researchers and practitioners in the different project phases. According to the TD literature, the integration of practitioners' input is related to their involvement in the early phases of the project (Lang et al. 2012; Wuelser & Pohl 2016). Our results show that in our case the perceived frequency of contact between researchers and practitioners was lowest in the phase where the research question was developed. There was also a significant difference between researchers and practitioners, with practitioners perceiving their degree of involvement in this early phase as being significantly lower than researchers. This is somehow in contrast with the view expressed by both researchers and practitioners that a shared understanding of the problem is the most important success factor for the collaboration. One might assume that this joint understanding, however, is usually reached in the first research phase, i.e. the problem-framing phase.

Four explanations might elucidate this seemingly inconsistent observation: The first is that the current problems related to the energy transition might be clear for both researchers and practitioners, since it has been a prevalent issue during recent years. Thus, there might be less need to obtain a common understanding than in a less popular topic. Second, the motivations both for researchers to include practitioners and for practitioners to participate in research projects are similar. Both aim at contributing to solving a real-world problem by performing and contributing to research. Third, we consider that practitioners' involvement in the form of workshop participation and participation in steering boards gives them sufficient possibilities to bring forward their views and thus contribute to a common understanding of the research project. Thus, one should further investigate to what extent these forms of involvement (e.g. workshops, steering boards) might be related to the perception of practitioners that their own ideas and comments feed into the research project. Fourth, researchers perceived the interaction with practitioners to be most beneficial for their research when they functioned as gatekeepers providing data and access to the field. Thus, they also integrate the knowledge of practitioners (e.g. data) into their research. Both of these activities were found to be

15

correlated with their perception of the usefulness of the results.

The third determinant differs between researchers and practitioners (Figure 5). For researchers, the clarity of the role of practitioners in the project is a key aspect for ensuring the practical usefulness of the research project. For practitioners, the results indicate that a trustful relationship is a key determinant for the practical usefulness of the results of the research project. The fact that the frequency of contact was also correlated with a trustful relationship between researchers and practitioners suggests a connection between these three factors. One could envision a dynamic relationship like the one postulated by Ostrom (1998 p. 13), who states: 'If initial levels of cooperation are moderately high, then individuals may learn to trust one another, and more may adopt reciprocity norms. When more individuals use reciprocity norms, gaining a reputation for being trustworthy is a better investment. Thus, levels of trust, reciprocity, and reputations for being trustworthy are positively reinforcing.' This indicates that a perceived higher intensity of collaboration increases trust, which, in turn, leads to a higher usefulness of the research for practice and finally, also to a higher perceived contribution of practitioners to the success of the research project (see Figure 6).

Determinants of practitioners' contributions to the success of the research project.

Researchers and practitioners agree only on one determinant which (statistically significantly) affects the perceived contribution of practitioners to the success of the research project. This is the assistance of practitioners in providing access to information for researchers, as well as in opening the door to the practice field for researchers. This is perceived as being essential for the success of the research project. From the perspective of practitioners, furthermore, the perceived frequency of contact, a trustful relationship with researchers, the perceived clarity of their own role within the project, and the usefulness of the research for themselves were relevant aspects for their perceived contribution to the research. This is well in agreement with their motivations for participating in the research project. Practitioners want to contribute to solving a problem, generating knowledge together with the researchers as well as supporting them. This suggests that it is essential to elicit and discuss the motivations of both researchers and practitioners for getting involved in a research project. This would make it possible to clarify the role of the practitioners in the project and also how and when they should and would like to be involved (see also Fritz et al. 2019; Fritz & Binder forthcoming). At the programme level this information allows for providing support regarding the type and intensity of interaction between researchers and practitioners. We consider that at programme level, one should also take into account the motivation of practitioners for increased networking among themselves and researchers.
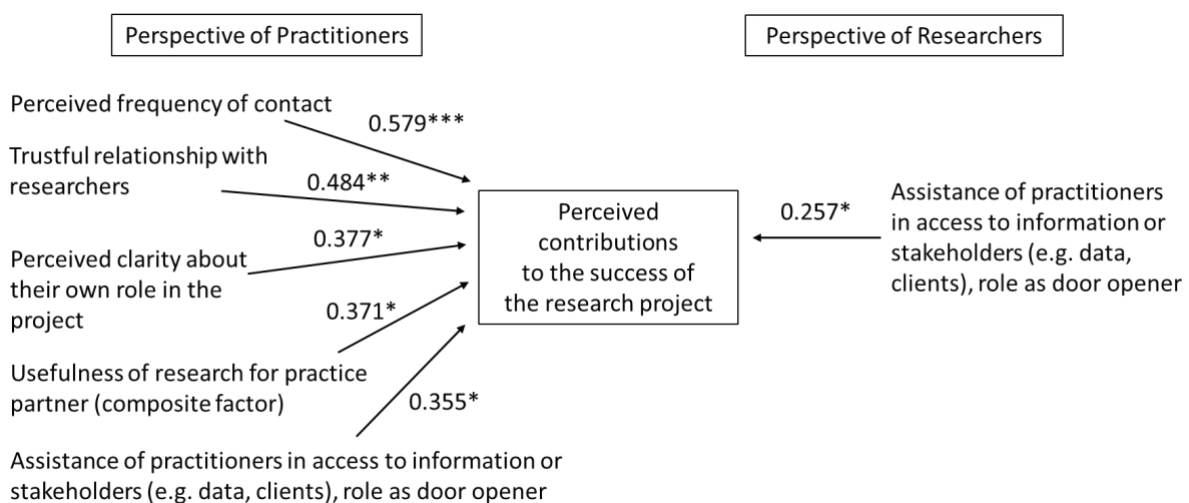

Figure 6: Significant aspects related to the 'perceived contributions to the success of the research project',

according to the analysis of both researchers' and practitioners' responses. *p < .05, **p < .01 significant correlation coefficients

5.2 Frequency of contacts as crucial variable

Our findings suggest that the perceived intensity of collaboration is a key variable for (i) ensuring the usefulness of the research project for practitioners; (ii) having a higher perceived contribution to the success of the research project (practitioners), (iii) fostering trust between researchers and practitioners; and (iv) for ensuring the relevance of the results for practice. The intensity of the collaboration has been put forward as an essential factor for, and a useful indicator of, a successful participation by scholars of TD and participation (Stauffacher et al., 2008; Schneider and Buser, 2018). Our findings confirm the pertinence of the intensity of collaboration as an indicator of a fruitful collaboration, but add a word of caution to interpreting them. The perceptions of intensity were found to largely diverge, with researchers assessing intensities higher than practitioners. Thus, using intensities as an indicator for fruitful collaboration requires due consideration of both researchers' and practitioners' assessments.

Indeed, our results show that researchers and practitioners perceived the intensity of their collaboration significantly differently. This holds true for all three research phases. The difference in the perception of the intensity between researchers and practitioners might be related to the perceived form of collaboration, where practitioners perceive themselves to be mostly involved in workshops and steering boards. For specific activities, such as assistance to access in information ($p<.05$), provision of data ($p<.01$), support in communication of results ($p<.05$) and financial contribution ($p<.05$), researchers perceived a significantly higher form of interaction than practitioners. These forms of interaction are, however, not defined as collaboration, but rather as either one-way transfers of information or services (Stauffacher et al., 2008). The chosen type of collaboration might be related to the character of the funding instrument, in which only researchers are funded and marginal funding is available for practitioners (in the form of remuneration for assistance in workshops and steering boards). In contrast, even though not statistically significant, practitioners perceived their involvement to be mainly in the form of participation in steering groups and workshops, which can be related to 'real' collaboration according to Stauffacher et al., (2008).

Another key aspect is that both researchers and practitioners consider the common understanding of the problem as the most important factor for a successful collaboration. As presented above, typically this common understanding is reached in the first phase of the research, i.e. the development of the research question. In this phase, the perceived intensity of collaboration was significantly lower than in the other two phases. Our results corroborate similar studies on TD in practice, which found that often initial project ideas originate in an academic context, with researchers then approaching practitioners whom they consider relevant to be involved. The latter are frequently only taken on board after the funding proposals have been submitted and accepted (Felt et al. 2012, 2013; Lang et al. 2012; Wuelser & Pohl 2016). Some scholars have explained this phenomenon with the incompatibility of co-design of project ideas and proposal-based research funding mechanisms (Schmidt & Pröpper 2017; Talwar et al. 2011; Whitman et al. 2015). A number of scholars argue that whoever initially formulates the problem owns the process (Webber & Ison 1995). In this perspective, the lack of practitioners' involvement in the initial phases of a project leads to an unbalanced problem ownership (Lang et al. 2012 p. 36; Ober 2016 p. 11; Röckmann et al. 2015; Siew et al. 2016; Stauffacher et al. 2008; Talwar et al. 2011; Webber & Ison 1995 p. 110). Early involvement is associated with the increased legitimacy and relevance of the research project (Robinson & Tansey 2006) and higher chances of its results being implemented (Renner et al. 2013 p. 243).

Finally, the relationship between the intensity of collaboration and trust should be further elucidated. Our results suggest that trust is a key factor for the perceived practical usefulness of the

17

research project, as well as for the perceived contribution of practitioners to the success of the research project. The centrality of trust found in this study corroborates previous qualitative findings on the role of trust in participatory and collaborative research projects (Elzinga 2008; Renner et al. 2013; Shdaimah & Stahl 2012). Furthermore, other scholars have found that, if individuals have had positive earlier experiences in collaboration with practice or science, they bring their positive experience into the setup of the new collaboration, thus potentially arriving faster at the trustful relationship (Fritz et al., 2019, Binder et al., 2015).

5.3 Policy implications: the role of funding programmes

The findings presented here point to some key issues to be considered when developing funding programmes which ask applying projects to involve practitioners and to contribute to/achieve societal impact.

Fostering trust through intensity of collaboration. The role of trust was seen as one of the key determinants for increasing the usefulness of the results for practice and the relevance of the input of practitioners for research. In the literature, it has been found that prior collaborations and building on existing relationships are seen as one way of ensuring trust amongst participants (Maclure & Bassey 1990; McKee et al. 2015). A second way of ensuring trust discussed in the participation literature, which is confirmed by our findings, is through the project and joint activities within it (Dewulf et al. 2005; Maclure & Bassey 1990). Additionally, if the collaboration has been successful, practitioners have stated that they are prepared for a collaboration with scientists and are likely to engage in future research collaborations (Binder et al. 2015). Our results complement these findings by adding the component of the intensity of the interaction between practitioners and researchers. Hence, at the programme level the interaction between researchers and practitioners can be actively promoted. This is confirmed as 12% of the researchers stated that if they had not been asked to interact with practitioners as a programme requirement they would not have done so. Thus, funding programmes might want to foster the intensity of collaboration by having programme meetings to which practitioners are invited or explicitly ask for meetings between researchers and practitioners in the proposal. In this way, according to our results, trust between researchers and practitioners could be enhanced.

Including practitioners in early phases of the research project. The participation factor stated as the most important one by researchers and practitioners alike was a shared perception of the problem and the agreement on the research question. This common agreement is usually obtained in the beginning of the research project. However, both researchers and practitioners state that in this phase, the perceived intensity of the interaction between researchers and practitioners was the lowest. Thus, it should be further explored when the early involvement of practitioners in the first design phase is necessary. Our results suggest that by including practitioners in workshops early on to critically reflect together on the problem to be addressed might lead to a common understanding of the research question. Second, the sharing of data and access to information, and the role of door opener, require a good understanding of the research aims themselves.

Invest in a common understanding on what is meant by 'partner from practice'. One important result of the study is that researchers and practitioners did not always share the same understanding of their role in the cooperation. However, a common interest and understanding of the other side's point of view are important prerequisites for the success of cooperation between science and practice. For this reason, roles must be clarified at an early stage so that mutual expectations coincide.

6. Conclusions

This paper presented the results of a survey with researchers and practitioners of a large Swiss national research programme on steering energy consumption. We analysed the motivation of practitioners and researchers for engaging in a collaborative research project, their perception of the intensity of the collaboration in the different project phases, and their perception of how practitioners contributed to the research project and to what extent the research project provided useful results for practitioners. Our analyses show that in this programme the main motivation for both researchers and practitioners is to develop and provide research which addresses a real-world problem and which can later be implemented. One key finding is that the intensity of collaboration constitutes an important driver for a successful collaboration. The perceived intensity of collaboration fosters trust between researchers and practitioners and increases the usefulness of the research project for practitioners and the perceived contribution of practitioners to the success of the research project. Research programmes should thus (i) foster the trust relationship through developing mechanisms of exchange between research and practice; (ii) make sure that researchers and practitioners share the same understanding of their respective role in the cooperation; and (iii) support the inclusion of practitioners already in the development phase of the project through providing seed money during the proposal-writing phase.

References

Balthasar, A., & Roose, Z. (2018). 'Befragung der Forschenden und Praxispartner/-innen des Nationalen Forschungsprogramms 71 «Steuerung des Energieverbrauchs» zum Nutzen ihrer Zusammenarbeit.

Balthasar, A., Roose, Z., Binder, C. R., & Fritz, L. (2018). *Datensatz der Befragung der Forschenden und Praxispartner/-innen des Nationalen Forschungsprogramm 71 «Steuerung des Energieverbrauchs » zum Nutzen ihrer Zusammenarbeit*. Luzern, Lausanne.

Bergmann, M., Brohmann, B., Hoffmann, E., Loibl, M. C., Rehaag, R., Schramm, E., & Voß, J.-P. (2005). *Qualitätskriterien transdisziplinärer Forschung* (No. 13). ISOE Studientexte.

Binder, C. R., Absenger-Helmli, I., & Schilling, T. (2015). 'The reality of transdisciplinarity: a framework-based self-reflection from science and practice leaders', *Sustainability Science*, 10/4: 545–62. DOI: 10.1007/s11625-015-0328-2

Bracken, L. J., Bulkeley, H. A., & Whitman, G. (2015). 'Transdisciplinary research: understanding the stakeholder perspective', *Journal of Environmental Planning and Management*, 58/7: 1291–308. DOI: 10.1080/09640568.2014.921596

Cundill, G., Roux, D. J., & Parker, J. N. (2015). 'Nurturing communities of practice for transdisciplinary research', *Ecology and Society*, 20/2: 22.

Dewulf, A., Craps, M., Bouwen, R., Abril, F., & Zhingri, M. (2005). 'How indigenous farmers and university engineers create actionable knowledge for sustainable irrigation', *Action research*, 3/2: 175–192. DOI: 10.1177/1476750305052141

Di Giulio, A., Defila, R., & Brückmann, T. (2016). '"Das ist halt das eine … Praxis, das andere ist Theorie"-Prinzipien transdisziplinärer Zusammenarbeit im Forschungsalltag'. Defila R. & Di Giulio A. (eds) *Transdisziplinär forschen-zwischen Ideal und gelebter Praxis: Hotspots, Geschichten, Wirkungen*. Campus Verlag.

Elzinga, A. (2008). 'Participation'. *Handbook of transdisciplinary research*, pp. 345–59. Springer.

European Commission. (2019). 'Horizon 2020 - Work Programme 2018-2020. Science with and for Society', *Decision C(2019)1849 of 18 March 2019*. DOI: http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-swfs_en.pdf

Felt, U., Igelsböck, J., Schikowitz, A., & Völker, T. (2012). 'Challenging participation in sustainability research', *The Journal of Deliberative Mechanisms in Science*, 1/1: 4–34. DOI: 10.4471/demesci.2012.01

——. (2013). 'Growing into what? The (un-) disciplined socialisation of early stage researchers in transdisciplinary research', *Higher education*, 65/4: 511–24. DOI: 10.1007/s10734-012-9560-1

Fritz, L., & Binder, C. (forthcoming). 'Whose knowledge, whose values? An empirical analysis of power in transdisciplinary sustainability research', *European Journal of Futures Research*.

Fritz, L., & Binder, C. R. (2018). 'Participation as Relational Space: A Critical Approach to Analysing Participation in Sustainability Research', *Sustainability*, 10/8: 2853. DOI: 10.3390/su10082853

Fritz, L., Schilling, T., & Binder, C. R. (2019). 'Participation-effect pathways in transdisciplinary sustainability research: An empirical analysis of researchers' and practitioners' perceptions using a systems approach', *Environmental Science & Policy*, 102: 65–77. DOI: 10.1016/j.envsci.2019.08.010

Future Earth. (2019). 'Initiatives'. *FutureEarth*. Retrieved October 6, 2019, from <https://futureearth.org/initiatives/>

Gross, M., & Hoffmann-Riem, H. (2005). 'Ecological restoration as a real-world experiment: designing robust implementation strategies in an urban environment', *Public Understanding of Science*, 14/3: 269–284. DOI: 10.1177/0963662505050791

Hansson, S., & Polk, M. (2018). 'Assessing the impact of transdisciplinary research: The usefulness of relevance, credibility, and legitimacy for understanding the link between process and impact', *Research Evaluation*, 27/2: 132–144. DOI: https://doi.org/10.1093/reseval/rvy004

Hessels, L. K., de Jong, S. P. L., & Brouwer, S. (2018). 'Collaboration between Heterogeneous Practitioners in Sustainability Research: A Comparative Analysis of Three Transdisciplinary Programmes', *Sustainability*, 10/12: 4760. DOI: 10.3390/su10124760

Jahn, T., Bergmann, M., & Keil, F. (2012). 'Transdisciplinarity: Between mainstreaming and marginalization', *Ecological Economics*, 79: 1–10.

de Jong, S. P., Wardenaar, T., & Horlings, E. (2016). 'Exploring the promises of transdisciplinary research: A quantitative study of two climate research programmes', *Research Policy*, 45/7: 1397–1409.

Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., et al. (2012). 'Transdisciplinary research in sustainability science: practice, principles, and challenges', *Sustainability science*, 7/1: 25–43.

Lux, A., Schäfer, M., Bergmann, M., Jahn, T., Marg, O., Nagy, E., Ransiek, A.-C., et al. (2019). 'Societal effects of transdisciplinary sustainability research—How can they be strengthened during the research process?', *Environmental Science & Policy*, 101: 183–191. DOI: 10.1016/j.envsci.2019.08.012

Maclure, R., & Bassey, M. (1990). 'Participatory action research in Togo: An inquiry into maize storage systems'. *Participatory research*. Sage Publications, Newbury Park, GB.

20

McKee, A., Guimaraes, M. H., & Pinto-Correia, T. (2015). 'Social capital accumulation and the role of the researcher: An example of a transdisciplinary visioning process for the future of agriculture in Europe', *Environmental Science & Policy*, 50: 88–99. DOI: 10.1016/j.envsci.2015.02.006

Newig, J., Jahn, S., Lang, D. J., Kahle, J., & Bergmann, M. (2019). 'Linking modes of research to their scientific and societal outcomes. Evidence from 81 sustainability-oriented research projects', *Environmental Science & Policy*, 101: 147–155.

Ober, S. (2016). 'Demokratie und Wissenschaft. Eine Beziehung voller Widersprüche', *Forum Wissenschaft*, 4/15.

Ostrom, E. (1998). 'A behavioral approach to the rational choice theory of collective action: Presidential address, American Political Science Association, 1997', *American political science review*, 92/1: 1–22.

Pohl, C., Hadorn, G. H., & Zimmermann, A. B. (2007). *Principles for designing transdisciplinary research*. oekom Munich.

Renner, R., Schneider, F., Hohenwallner, D., Kopeinig, C., Kruse, S., Lienert, J., Link, S., et al. (2013). 'Meeting the challenges of transdisciplinary knowledge production for sustainable water governance', *Mountain Research and Development*, 33/3: 234–247. DOI: 10.1659/MRD-JOURNAL-D-13-00002.1

Robinson, J., & Tansey, J. (2006). 'Co-production, emergent properties and strong interactive social research: the Georgia Basin Futures Project', *Science and Public Policy*, 33/2: 151–160.

Röckmann, C., van Leeuwen, J., Goldsborough, D., Kraan, M., & Piet, G. (2015). 'The interaction triangle as a tool for understanding stakeholder interactions in marine ecosystem based management', *Marine Policy*, 52: 155–62. DOI: 10.1016/j.marpol.2014.10.019

Schmidt, L., & Neuburger, M. (2017). 'Trapped between privileges and precariousness: Tracing transdisciplinary research in a postcolonial setting', *Futures*, 93: 54–67. DOI: 10.1016/j.futures.2017.07.005

Schmidt, L., & Pröpper, M. (2017). 'Transdisciplinarity as a real-world challenge: a case study on a North–South collaboration', *Sustainability Science*, 12/3: 365–379. DOI: 10.1007/s11625-017-0430-8

Schneider, F., & Buser, T. (2018). 'Promising degrees of stakeholder interaction in research for sustainable development', *Sustainability Science*, 13/1: 129–142. DOI: 10.1007/s11625-017-0507-4

Schneider, F., Buser, T., Keller, R., Tribaldos, T., & Rist, S. (2019). 'Research funding programmes aiming for societal transformations: ten key stages', *Science and Public Policy*, 46/3: 463–478. DOI: 10.1093/scipol/scy074

Shdaimah, C., & Stahl, R. (2012). 'Power and conflict in collaborative research'. *Real Social Science: Applied Phronesis*, Cambridge University Press., pp. 122–37. Flyvbjerg, Bent; Landman, Todd; Schram, Sanford: Cambridge.

Siew, T. F., Aenis, T., Spangenberg, J. H., Nauditt, A., Döll, P., Frank, S. K., Ribbe, L., et al. (2016). 'Transdisciplinary research in support of land and water management in China and Southeast Asia: evaluation of four research projects', *Sustainability Science*, 813–29. DOI: 10.1007/s11625-016-0378-0

Spangenberg, J. H. (2011). 'Sustainability science: a review, an analysis and some empirical lessons', *Environmental Conservation*, 38/3: 275–287. DOI: 10.1017/S0376892911000270

Stauffacher, M., Flüeler, T., Krütli, P., & Scholz, R. W. (2008). 'Analytic and dynamic approach to collaboration: a transdisciplinary case study on sustainable landscape development in a Swiss prealpine region', *Systemic Practice and Action Research*, 21/6: 409–22.

Talwar, S., Wiek, A., & Robinson, J. (2011). 'User engagement in sustainability research', *Science and Public Policy*, 38/5: 379–90.

Thompson, M. A., Owen, S., Lindsay, J. M., Leonard, G. S., & Cronin, S. J. (2017). 'Scientist and stakeholder perspectives of transdisciplinary research: Early attitudes, expectations, and tensions', *Environmental Science & Policy*, 74: 30–9. DOI: 10.1016/j.envsci.2017.04.006

21

Van der Hel, S. (2016). 'New science for global sustainability? The institutionalisation of knowledge co-production in Future Earth', *Environmental Science & Policy*, 61: 165–175. DOI: 10.1016/j.envsci.2016.03.012

Walter, A. I., Helgenberger, S., Wiek, A., & Scholz, R. W. (2007). 'Measuring societal effects of transdisciplinary research projects: design and application of an evaluation method', *Evaluation and program planning*, 30/4: 325–38. DOI: 10.1016/j.evalprogplan.2007.08.002

Webber, L. M., & Ison, R. (1995). 'Participatory rural appraisal design: conceptual and process issues', *Agricultural systems*, 47/1: 107–31. DOI: 10.1016/0308-521X(94)P3278-3

Whitman, G. P., Pain, R., & Milledge, D. G. (2015). 'Going with the flow? Using participatory action research in physical geography', *Progress in Physical Geography*, 39/5: 622–639. DOI: 10.1177/0309133315589707

Wiek, A., Talwar, S., O'Shea, M., & Robinson, J. (2014). 'Toward a methodological scheme for capturing societal effects of participatory sustainability research', *Research Evaluation*, 23/2: 117–32.

Wuelser, G., & Pohl, C. (2016). 'How researchers frame scientific contributions to sustainable development: a typology based on grounded theory', *Sustainability Science*, 11/5: 789–800. DOI: 10.1007/s11625-016-0363-7

Zscheischler, J., Rogga, S., & Lange, A. (2018). 'The success of transdisciplinary research for sustainable land use: individual perceptions and assessments', *Sustainability Science*, 1–14. DOI: 10.1007/s11625-018-0556-3

22

PART III: APPENDIX

A Supplementary Material Literature Review

A.1 Table. Overview of articles included in literature review

Type of articles	SR	DR	STS
Main approaches	Transdisciplinary research;	Participatory rural appraisal (PRA), participatory action research (PAR); transdisciplinary research;	Participatory risk assessment, participatory technology assessment; public engagement;
Review articles	7 Brandt et al.2013, Reed 2008, Zscheischler and Rogga 2014, Cvitanovic et al. 2015, Brinkmann et al. 2015, Röckmann et a. 2015, Popa et a. 2015	/	1 Hessels and van Lente 2008
Case study-based articles (incl. self-reflections)	28 Stauffacher et al. 2008, Newig et al. 2008, Angelstam et al. 2013, Pohl et al. 2010, Renner et al. 2013, McKee et al. 2015, Munoz-Erickson 2014, Wiek et al. 2012, Thompson et al. 2017, Vilsmaier 2015, Hegger et al. 2012, Cornell et al. 2013, Elzinga 2008, Rosendahl et al. 2016, Raymond et al. 2010, Binder et al. 2016, Schneider et al. 2008 and 2014, Boon et al 2014, Mattor et al. 2014; Harris et al. 2013 Stokols 2006 Hanschitz et al. 2009 Polk and Knuttson 2008, Westberg and Polk 2016, Polk 2014, Talwar et al. 2011, Robinson et al. 2006	12 Holmes 2001, Podesta et al. 2012, Michener 1998, Maclure et al. 1991, Steelman et al.2015, Siew et al. 2016, Schmidt and Pröpper 2017, Neef and Neubert 2010, Habermann et al. 2013, Dewulf et al. 2005, Kesby 2007, Webber and Ison 1994	7 Chilvers and Longhurst 2016, Chilvers and Burgess 2008, Bister et al. 2008, Linnerooth-Bayer et al. 2015, Bond et al. 2004, Petts 1997, Felt et al. 2012
Other empirical articles	9 Mielke et al. 2016, Bieluch et al. 2016, Schmid et al. 2016 ,Fazey et al. 2012, Blackstock et al. 2007, Defila and Di Giulio 2016, Wuelser and Pohl 2016, Wittmayer et al. 2014,	3 Schmid and Luger, 2015, Witjes et al. 2012, Bayissa 2015	1 Chilvers 2008
Additional	1 Ober 2016	7 Cornwall 2004, Cornwall and Coehlo 2007, Williams 2004 Hickey and Mohan, Kothari and Cooke2001, Lacroix et al. 2011	3 Pellizzoni 2003, Renn and Schweitzer2009, Stirling 2008

B   Supplementary Material Interviews

B.1   Table. Anonymised list of interviewees

Project	Type of Interviewee	Date of Interview
A	Professor	16/6/17
A	Professor	28/1/16
A	1 Project coordinator and 1 project collaborator/PhD	13/6/17
A	Project collaborator/PostDoc	24/10/17
A	Practitioner, public service sector	19/12/17
A	Practitioner, NGO/Association	20/3/18
B	Professor	29/1/16
B	Project collaborator/PostDoc	12/12/17
B	Project collaborator/PhD	12/12/17
B	Practitioner, public sector /policy-maker	14/6/17
B	2 Practitioners, public sector	21/6/17
C	Professor	14/6/17
C	Professor	27/1/16
C	Practitioner, private sector	21/3/18
D	Professor	15/6/17
D	Professor	26/2/16
D	Practitioner, public sector/administration	20/3/18
E	Professor	2/16
E	Project collaborator/PostDoc	25/5/18
E	Practitioner, NGO/Association	25/6/18
F	Professor	13/6/17
F	Professor	15/6/17
F	Professor	1/16
F	Project collaborator/PhD	15/6/17
F	Practitioner, NGO/Association	23/10/17
F	Practitioner, NGO/Association	18/12/17
F	Practitioner, public sector/administration	23/3/18
G	Professor	13/6/17
G	Professor	15/6/18
G	Project coordinator	16/6/17
G	Practitioner, private sector	19/6/17
G	Practitioner, private sector	24/5/18
G	Practitioner, private sector	4/5/18

B.2 Table. Interview guide, exploratory round with project leaders

Generischer Leitfaden für die Interviews Projektleitende 2015* [Stand: 25.01.2016]

*Anpassung je nach Projekt

INTRO – VORSTELLUNG

Zunächst einmal möchte ich mich herzlich bei Ihnen bedanken, dass Sie sich die Zeit nehmen, mit mir dieses Gespräch zu führen. Das Interview wird in etwa eine Stunde dauern und wird von mir aufgezeichnet, sofern Sie damit einverstanden sind. Die Auswertung des Interviews erfolgt so, dass keine Rückschlüsse auf einzelne Personen oder Projekte möglich sind. Wie wir bereits angekündigt haben, sollen im Rahmen des Projektes „Zivilgesellschaft und Forschung für nachhaltige Entwicklung" zwei Dissertationen entstehen, die sich schwerpunktmäßig mit partizipativen Formen der Wissensproduktion und den transformativen Wirkungen von Forschungsprojekten befassen. Wie für die gesamte Begleitforschung im Rahmen von ZiFoNE, besteht unser Ziel in keiner Weise in der Evaluierung Ihres Projektes. Vielmehr möchten wir mit Ihnen über strukturelle, methodische und inhaltliche Aspekte Ihres Projektes sprechen. Uns interessieren die Erfahrungen, die Sie während der Planung und der Anfangsphase des Projekts gemacht haben und Ihre Erwartungen an den weiteren Verlauf.

3 Blöcke, aufgebaut entlang der Projektchronologie:

I. Entstehung (d.h. wie es zum Projekt kam - Inhalt und Akteure)

II. Architektur (d.h. wie die Zusammenarbeit gestaltet werden soll - geplante Interaktion, Erwartungen an Partizipation, imaginierte Herausforderungen).

III. Intention (d.h. zu was das Projekt führen soll - Ergebnisse ('Outputs'), Wirkungen und Wirkungsfaktoren)

1. ENTSTEHUNGSPROZESS DER PROJEKTIDEE
Mich würde zunächst einmal interessieren, wie es zu Ihrem Projekt kam.
1. Woraus entstand die ursprüngliche Idee zu Ihrem Projekt? Wie hat sich diese Idee dann weiterentwickelt bis zum eingereichten Projekt?
Nachfrage: Welche Impulse gab es 'unterwegs', die zur Weiterentwicklung der Idee geführt haben, und woher kamen diese?
Oft ist es ja so, dass es eine Kerngruppe von Personen gibt, die zusammen die Idee für ein Projekt entwickelt und dass sich daraus dann nach und nach die Gruppe bildet, die zusammen die Forschungsfragen schärft, das Projektdesign ausarbeitet und den Antrag einreicht. In diesem Prozess kann es natürlich sein, dass einzelne Personen wegfallen und neue dazu stoßen. Und dasselbe geschieht zu Projektbeginn oft nochmals.
2. Wie war das bei Ihnen? Wer war die Kerngruppe, wie hat diese zusammengefunden und wie hat sie sich dann weiterentwickelt?
Nachfrage: Gab es außerhalb dieser Kerngruppe, weitere Personen oder Institutionen, die die Projektgenese beeinflusst haben? Falls nötig nachfragen: warum gerade diese?
[Solange nachfragen, bis klar ist, wer, wann, warum dazukam oder wegging]
[Frage 1 und 2 überlappen sich teilweise, bei 1. soll Inhalt, bei 2. Akteure im Vordergrund stehen]
Nachfrage zu oben:
3. Wenn Sie an die bevorstehenden Phasen Ihres Projektes denken, ist es für Sie bereits absehbar, welche weiteren Personen oder Organisationen im Laufe des Projektes noch dazu stoßen werden – also entweder zum Team im engeren Sinn oder in Form von punktuellem Austausch und Interaktionen in bestimmten Projektphasen?
Nachfrage: Warum gerade diese oder jene Person/Organisation?
[Falls nötig eventuell nachhaken: Welche Akteure aus der Praxis oder der Zivilgesellschaft werden im Laufe des Projektes einbezogen?]
2. <ARCHITEKTUR DES PROJEKTES>
Geplante Interaktionen
Mich interessiert besonders wie Ihr Projekt strukturiert ist, jetzt nicht die thematische, sondern in erster Linie die formale Struktur.
4. Welche Organe wie z.B. Beiräte, Steuergruppen, Vollversammlungen u.Ä. gibt es in Ihrer Projektstruktur? Welche Entscheidungen sollen in welchen dieser Organe getroffen werden?
Nachfrage: Wer hat Entscheidungsbefugnisse? Wer ist in diesen vertreten? Sind das entscheidenden oder beratenden Gremien?

[z.B. auch von Interesse, ob das zentralisierte oder dezentrale Strukturen sind]
5. Wie planen Sie die Zusammenarbeit in Ihrem Projekt in Bezug auf Vernetzung, Austausch, Synthese – sowohl zwischen den Forschenden als auch zwischen Forschenden und Praxisakteuren (Personen/Organisationen aus der Praxis)? [Reihenfolge von Frage 4. und 5. kann je nach Gesprächssituation getauscht werden] *Wenn nötig nachhaken: hinsichtlich Vernetzung? Austausch? Synthese?* *Wozu dienen die einzelnen Gefäße – wissen Sie schon welche Themen, in welchen Formaten diskutiert werden sollen? [eher niedrige Priorität]* [gemeint ist: welche Gefäße gibt es für Austausch – wer trifft sich wann, wie oft, in welchen Rahmen? Wird es formalisierte Strukturen geben oder auf ad hoc Basis, etc.]
Erwartungen
[! nur an jene Personen stellen, die partizipative Elemente haben] 6. Was erwarten Sie sich davon, dass Sie Praxisakteure einbinden? Hegen Sie spezifische Erwartungen an bestimmte, vielleicht besonders wichtige, Praxisakteure? [zweite Frage bei denen, die von vielen Praxisakteuren sprechen] *Wenn es sich ergibt, nachfragen: (bei 6, 7, oder 8): Wir hatten jetzt ja die Projektperspektive inne. Wenn wir mal die Perspektive wechseln, was würden Sie sagen, worin besteht denn der Nutzen für die genannten Personen/Organisationen aus der Praxis, die sich an Ihrem Projekt zu beteiligen?* [nach Möglichkeit Bezug nehmen auf die bereits erwähnten Interaktionen mit Personen/Organisation aus dem jeweiligen Praxisfeld und sagen, dass somit ja partizipative Elemente vorgesehen sind] 7. Welche Voraussetzungen könnten sich besonders positiv oder negativ auf die partizipativen Komponenten in Ihrem Projekt auswirken? [Frage 7 und 8 überlappen sich möglicherweise]
Imaginierte Herausforderungen
[! nur an jene Personen stellen, die partizipative Elemente haben] 8. Worin sehen Sie die zentralen Herausforderungen in der Planung und Umsetzung der partizipativen Elemente Ihres Projekts? Wie planen Sie diesen Herausforderungen zu begegnen?

337

3. <INTENTION>

Intendierte Wirkungen und Produkte

Einleitende Worte: Mir ist selbstverständlich bewusst, dass das Projekt sich noch in der Anfangsphase befindet, evtl. haben Sie aber durchaus schon gewisse Vorstellungen von den Zielen, Wirkungen oder bestimmten Produkten Ihres Projekts.

[Grundsätzlich alle genannten Produkte und Wirkungen im Fragenblock „Intendierte Wirkungen und Produkte" stichpunktartig notieren und genannte Verknüpfungen mit Pfeilen einzeichnen]

[Einleitungsfrage, die zu bestimmten Produkten oder Wirkungen überleiten soll. Je nach Antwort sollte dann flexibel nachgefragt werden]

9. Was sind aus heutiger Sicht die übergeordneten Ziele Ihres Projekts?

Formuliert als Nachfrage zu den Zielen des Projekts:

[Falls Ziele im Sinne von Erkenntniszielen oder in einer sonstigen Form definiert werden, die keine direkten Wirkungen darstellt]

10. Was sind die wichtigsten Wirkungen, Effekte oder Veränderungen, die Sie mit Ihrem Projekt erreichen möchten, auch außerhalb der Wissenschaft?

[Falls bereits Wirkungen bei den Zielen genannt wurden → Bei Bedarf um Konkretisierung bitten]

Mögliche Nachfragen:

Wo, also in welchen Bereichen erhoffen Sie sich Wirkungen?

In welchem zeitlichen Rahmen (nur ganz ungefähr → kurzfristig, mittelfristig, langfristig)?

Formuliert als Nachfrage zu den Zielen des Projekts:

11. Gibt es bereits konkrete Pläne für Produkte – und damit meine ich nicht nur Publikationen, sondern beispielsweise auch Konzepte, Modelle, Szenarien, Verfahren, Plattformen, Leitfäden etc., mit denen Sie die genannten Ziele/Wirkungen *[abh. von bisherigen Aussagen]* erreichen wollen?

[Falls bisher nur über Ziele gesprochen wurde]:

Welche Wirkungen, Effekte oder Veränderungen erhoffen Sie sich von diesen Produkten, auch außerhalb der Wissenschaft?

[Nachfragen:]

Sind Personen oder Organisationen aus der Praxis in die Erstellung dieser Produkte eingebunden?

[Versuchen über Nachfragen auf das systemische Verständnis, also auf die Verknüpfungen zwischen den Produkten und Wirkungen der Projektleitenden zu kommen]

Wirkungsfaktoren

12. Wir haben nun ja schon von Wirkungen gesprochen, die Sie mit Ihrem Projekt erzielen wollen. Haben Sie bereits eine Vorstellung darüber, was einen Einfluss auf diese Wirkungen haben könnte, also z.B. darauf, ob oder wie stark diese eintreten?

[Gemeinsam mit Interviewpartner die notierten Wirkungen und Produkte aufzeigen und anhand derer die Faktoren bestimmen, um Zusammenhänge nachvollziehbar zu machen. Welcher Faktor ist für welche Wirkung relevant und wie stark ist der Einfluss (nur ganz ungefähr)]

[Die genannten Faktoren stichpunktartig notieren]

[Zur weiteren Erläuterung]:

Konkretes Beispiel (projektintern):

[Falls der Interviewpartner bereits bei den Erwartungen an Partizipation implizit oder explizit von Wirkungen gesprochen hat, kann dies als Beispiel verwendet werden, sonst: siehe unten]

Nehmen wir ein beliebiges Beispielprojekt, in dem eine Vision entwickelt wird, die im Anschluss an das Projekt in einer Region implementiert werden soll (Das wäre dann die erhoffte Wirkung). Dadurch, dass ausgewählte Personen oder Organisationen aus der Praxis bereits in die Entwicklung der Vision eingebunden werden, erhofft man sich eine höhere Akzeptanz, bessere Implementierungschancen und damit eine größere Wirkung. Hier wäre nun das Einbeziehen ausgewählter Personen oder Organisationen in die Entwicklung der Vision der Einflussfaktor

Solche Einflussfaktoren innerhalb Ihres Projekts könnten also z.B. bestimmte Aspekte des Projektdesigns sein.

Konkretes Beispiel (projektextern)

Nehmen wir dasselbe fiktive Projekt wie oben. Die Chancen auf die Implementierung der Vision könnten außerdem von verschiedenen politischen Entwicklungen abhängen. Nehmen wir an, die Vision behandelt die zukünftige Energieversorgung der Region und setzt auf erneuerbare Energien. Nun wird allerdings auf nationaler Ebene beschlossen, die Förderung für erneuerbare Energien zurückzufahren, was einen direkten negativen Einfluss auf die Wirtschaftlichkeit der Vision und damit auf ihre Implementierung hat.

Solche externen Einflüsse könnten dann Teil des Kontextes Ihres Projekts sein, z.B. gegebene Rahmenbedingungen, bestimmte Entwicklungen, die einen Einfluss auf die Wirkung des Projekts haben könnten.

[Nachfrage für interne Faktoren]:

Gibt es zusätzlich Einflüsse innerhalb Ihres Projekts, z.B. bezogen auf das Projektdesign, die aus Ihrer Sicht einen Einfluss auf die Wirkungen haben?

[Nachfrage für externe Faktoren]:

Gibt es zusätzlich Einflüsse außerhalb Ihres Projekts, z.B. bestimmte Gegebenheiten, Rahmenbedingungen, Voraussetzungen oder Entwicklungen, die aus Ihrer Sicht einen Einfluss auf die Wirkungen haben?

[Nachfragen oder weglassen, falls schon erläutert]

339

[Auf Basis der Liste der Faktoren, die notiert wurden]

Welche dieser Faktoren können oder werden Sie innerhalb Ihres Projekts direkt beeinflussen und auf welche Weise werden Sie das tun?

[Auf externe/nicht beeinflussbare hinweisen und fragen oder weglassen, falls schon erläutert]:

Was bedeuten diese Faktoren *[individuell anpassen]* für Ihr Projekt?

[Nur, wenn es aus dem Kontext heraus Sinn ergibt]:

13. Woher wissen Sie um diese Dinge?

[Ein wenig auflockernd einleiten]:

14. Abschließend möchte ich gerne noch auf mögliche 'Risiken und Nebenwirkungen' Ihres Projekts zu sprechen kommen. Können Sie sich vorstellen, dass Ihr Projekt auch 'Risiken und Nebenwirkungen' verursachen kann? Welche könnten das sein?

SCHLUSS

15. Haben wir im Laufe des Interviews Aspekte ausgelassen, die Sie sich vielleicht schon im Vorfeld überlegt haben oder die Ihnen gerade noch durch den Kopf gehen?

BEDANKEN!

Damit sind wir am Ende des Interviews. Vielen herzlichen Dank noch einmal, dass Sie sich die Zeit dafür genommen haben! Evtl. kommen wir noch einmal auf Sie zu, falls sich während der Auswertung noch Nachfragen ergeben.

Für 2014ner Projekte [Frage wird vor Frage 14 eingeschoben]:
Wenn Sie sich nun einmal an den Anfang Ihres Projekts zurückversetzen und sich den bisherigen Verlauf vor Augen führen:
Welche Anpassungen, Konkretisierungen oder Änderungen gab es bisher, die für die Ziele, Produkte oder Wirkungen des Projekts relevant sind?
[Falls ja, nachfragen:]
Wie kam es dazu?

B.3   Table. Interview guide, in-depth round with researchers

Erhebungen im Rahmen des Projektes „Zivilgesellschaft und Forschung für Nachhaltige Entwicklung" (ZiFoNE)

Semi-strukturierte Interviews mit Forschenden und Praxisakteuren aus ausgewählten Projekten des Förderprogramms „Wissenschaft für Nachhaltige Entwicklung", Anm.: Generischer Leitfaden, der an das jeweilige Projekt sowie die Projektphase angepasst wird

Ziel und Zweck des Interviews

- Wahrnehmungen der Zusammenarbeit und Interaktionen zwischen wissenschaftlichen Akteuren und Akteuren aus der Praxis erfassen
- Verstehen, wodurch diese Prozesse der Zusammenarbeit geformt werden (von Individuen bis zu institutionellem Kontext)

Anmerkungen zu den Interviews

Zunächst einmal möchte ich mich herzlich bei Ihnen bedanken, dass Sie sich die Zeit nehmen, mit mir dieses Gespräch zu führen. Das Interview wird in etwa eine Stunde dauern und wird von mir aufgezeichnet, sofern Sie damit einverstanden sind. Die Auswertung des Interviews erfolgt so, dass keine Rückschlüsse auf einzelne Personen oder Projekte möglich sind. Wie für die gesamte Begleitforschung im Rahmen von ZiFoNE, besteht unser Ziel in keiner Weise in der Evaluierung Ihres Projektes. Mich interessieren viel mehr die Erfahrungen, die Sie in der Zusammenarbeit und dem Austausch mit F/P. Im bisherigen Projektverlauf gemacht haben.

Aufbau des Leitfadens

I. Einbettung des Projektes

- Rolle des Projektes in der Organisation und der sonstigen Tätigkeiten des Akteurs
- Wie kam es dazu Praxisakteure einzubinden bzw. wie kam es zum Engagement im Projekt
- Erwartungen an Zusammenarbeit mit Forschenden bzw. Praxisakteuren

II. Akteure und Funktionsweisen der Zusammenarbeit

- Wer sind die wichtigsten Akteure?
- Wie tauschen sich diese aus? Wie interagieren diese?
- Wie kam es dazu?

III. Zwischenbilanz der bisherigen Zusammenarbeit

- Erste Zwischenbilanz in Bezug auf Zusammenarbeit/Austausch mit Forschenden bzw. Praxisakteuren
- Bedingungen im Projekt und Rahmenbedingungen, die Zusammenarbeit begünstigen/erschweren/formen

Forschende (F)
EINBETTUNG DES PROJEKTES
1. Wie kam es dazu, dass Sie Praxisakteure in dieses Projekt involviert haben?
Nachfragen:
• *Haben Sie schon öfter Praxisakteure in Ihre Forschung einbezogen? //*
• *Ist es in ihrer Institution Standard, dass man solche Projekte macht? Ist das was Spezielles, dass man mit der Praxis arbeitet?*
• *Wie hängt Ihre Arbeit im Projekt X und der Austausch mit Praxisakteuren mit Ihren anderen Forschungs- und mögl. Lehrtätigkeiten zusammen?*
Nachfragen zu Erwartungen:
• *Was erwarten Sie sich vom Einbezug der Praxisakteure in Ihr Projekt?*
• *Worin sehen Sie die Bedeutung des Einbezugs Ihrer Praxisakteure für die Erreichung des intendierten Beitrages zu nachhaltiger Entwicklung?*
• *Warum sind gerade die ausgewählten P. relevant in Bezug auf diesen Wandel?*
AKTEURE UND DEREN INTERAKTIONEN
2. *Mir geht es ja in erster Linie um die Zusammenarbeit von Forschenden und Praxisakteuren (Schnittstelle):*
In Bezug auf diese Zusammenarbeit, wer sind nach Ihrem Kenntnisstand die wichtigsten Akteure (Akteursgruppen) im Projekt X, sowohl auf Seite der Forschenden als auch der Praxis?
[InterviewpartnerInnen bitten die zentralen Akteure/Akteursgruppen im Projekt auf Kärtchen zu schreiben, anzuordnen und Beziehungen zu beschreiben]
Charakterisierung der Akteure
[Mehrere Fragen anhand der Akteursdarstellung diskutieren:]

- Welche Funktionen nehmen Sie / die jeweiligen Personen im Projekt ein?
- Welche Expertisen bringen die jeweiligen Personen in das Projekt ein? In welchem Zusammenhang stehen diese zur Entwicklung nachhaltiger Problemlösungen?

Formen und Intensitäten der Interaktionen

- Wer tauscht sich mit wem aus? [direkte Verbindungslinien einzeichnen]
- Was wird ausgetauscht?
- Wie findet Austausch statt? [potentiell nachfragen zu Formaten e.g. Treffen und wer diese festlegt]
- Wie intensiv ist der Austausch? Woran zeigt sich die Intensität?
- Wenn Sie die Intensität des Austausches mit den Akteuren aus der Praxis verorten müssten, welche dieser Bezeichnungen trifft die Zusammenarbeit am besten: Information (Praxisakteure werden informiert), Konsultation (Praxispartner nehmen Stellung), Kooperation (zweiseitige Kommunikation, aber ein eine Akteursgruppe gibt Struktur vor), Zusammenarbeit (es wird gemeinsam etwas erarbeitet, zweiseitige)? Gibt es mehrere, die zutreffen (wann welche?)? Was heißt das konkret? Falls mehrere: welche behagt Ihnen (weshalb) am besten?

[könnten Sie bitte die jeweilige Beziehung in den Farben markieren]

- Haben die Intensitäten der Zusammenarbeit mit verschiedenen Akteursgruppen im bisherigen Projektverlauf variiert?

Entscheidungen und zusätzliche Akteure

- Wer trifft wichtige Entscheidungen im Projekt also z.B in Bezug auf den Fortlauf u.ä.? Gab es Anregungen aus der Praxis, die zu Anpassungen im Projekt führten? Wenn ja, wie läuft so ein Entscheidungsprozess ab? wer entscheidet darüber?
- Gibt es andere zentrale Akteure in Bezug auf Entscheidungen im Projekt, die wir bisher nicht besprochen haben?

Gewichtung (Einfluss)

- Ich würde Sie bitten nun die zentralen Akteure in Bezug auf deren Wichtigkeit für die Erreichung der Projektziele zu gewichten. Sie können auch Akteure hinzufügen und auch gleiche Gewichtungen vergeben. (1 Punkt wenig wichtig, 3 sehr wichtig)
- Mit Blick auf die Akteure aus der Praxis, fehlt ein wichtiger Akteur? Hätten Sie gerne noch weitere Akteure an Bord gehabt, die aber nicht teilnehmen konnten/wollten?

Am Schluss eine Retrospektive:

- Wenn Sie zurück denken an den Beginn des Projektes, das Formulieren der Projektidee und die Einreichung des Antrages, welche Personen stehen dann im Zentrum?

343

ZWISCHENBILANZ

Wir haben nun viel über Ihren Austausch und Ihre Zusammenarbeit mit F. und P. gesprochen. Mich würde jetzt ganz besonders interessieren, wie Sie diese Zusammenarbeit bisher empfunden haben.

3. Wenn Sie nun einen Schritt zurücktreten und auf die bisher erfolgte Zusammenarbeit zurückblicken, welche Zwischenbilanz ziehen Sie hinsichtlich des Einbezugs von und der Zusammenarbeit mit Praxisakteuren?

Nachfragen:

- Was waren Highlights? Warum liefen diese Dinge besonders gut?
- Was war besonders herausforderungsreich? Warum?
- Gab es Dinge, dich sich anders entwickelt haben als gedacht?
- Gab es Momente/Orte, an denen Sie Unterschiede im Zugang von F. und P. besonders manifestierten?
- Gab es Momente, in denen Sie Sorge um die Wissenschaftlichkeit des Projektes trugen / dass Ihre wissenschaftliche Arbeit zu kurz kommt?
- … befürchteten durch den Einbezug ausgewählter Praxisakteure die Interessen bestimmter Gruppen zu privilegieren?

RAHMENBEDINGUNGEN

[zurück zu den aufgezeichneten Akteuren:]

Wenn wir uns Ihre Verbindungen zu den anderen Personen nochmal ansehen:

4. Welche Rahmenbedingungen begünstigen oder erschweren die Zusammenarbeit / den Austausch zwischen Ihnen und den Akteuren aus der Praxis?

[falls nicht im Verlauf des Gesprächs angesprochen, direkt auf diese potentiellen Faktoren ansprechen]

Fragen 5-8:

Entweder auf Karten schreiben und jeweils nach Rolle im Projekt fragen. Am Schluss nach einer Reihung in Bezug auf deren Wichtigkeit in der Ausgestaltung von Zusammenarbeit fragen ODER AHP und dann fragen warum und was fehlt?

5. In Bezug auf die Zusammenarbeit von F und P ist oft von der Herausforderung die Rede, ein Umfeld zu schaffen, in dem, alle Akteure gleichermaßen das Gefühl haben, sich offen ausdrücken zu können und ihr jeweiliges Wissen einzubringen. Was denken Sie darüber? Haben Sie im Projekt X diesbezüglich Erfahrungen gemacht?

6. Vertrauen, z.B. in die Expertisen der Anderen, aber auch in die Bereitschaft über einen längeren Zeitraum mitzuwirken, wird häufig als zentrales Element von Zusammenarbeit beschrieben. Wie sehen Sie das? Welche Erfahrungen haben Sie diesbezüglich im Projekt X gemacht?

7. Es wird häufig von unterschiedlichen Erwartungshaltungen von Seiten der Forschenden und der Praxisakteure berichtet. Was denken Sie darüber? Spielt das in Ihrer Zusammenarbeit eine Rolle?

   Also z.B. Erwartungen an Ergebnisse oder auch an die Intensität und Dauer des Prozesses

8. Man hört oft, dass die Verfügbarkeit von Ressourcen, insbesondere auch für Akteure aus der Praxis die Zusammenarbeit formen. Was denken Sie dazu? Spielt das in Ihrem Projekt eine Rolle? Wie äußert sich dies im Projekt X?

   Nachfrage:

   - *Es ist öfters von der Sorge die Rede, die Praxisakteure zeitlich zu sehr zu belasten. Welche Rolle spielt der Faktor Zeit in der Zusammenarbeit mit F/P.?*
   - *Was wäre anders, wenn im Rahmen des Programmes WFNE eine Finanzierung für Praxisakteure explizit vorgesehen wäre?*
   - *... Ungleicher Zugang zu Ressourcen, ökonomische und Zeitressourcen aber auch Ressourcen im Sinne von Kompetenzen, politische Ressource etc. ...*

9. Das Projekt X ist ja in das Themenfeld „Nachhaltige Entwicklung" eingebettet. Es ist immer wieder von der Herausforderung die Rede, unterschiedliche Vorstellung von Nachhaltigkeit in Einklang zu bringen. Inwiefern spielt das in Ihrer Zusammenarbeit mit verschiedenen Akteuren aus F/P eine Rolle?

10. Was würden Sie in der Zusammenarbeit mit den Praxisakteuren anders machen, wenn Sie dieses Projekt nochmals planen könnten?
In Bezug auf Forschungs-Praxis Interaktionen, haben wir im Laufe des Interviews Aspekte ausgelassen, die Sie sich vielleicht schon im Vorfeld überlegt haben oder die Ihnen gerade noch durch den Kopf gehen?

B.4   Table. Interview guide, in-depth round with practitioners

Erhebungen im Rahmen des Projektes „Zivilgesellschaft und Forschung für Nachhaltige Entwicklung" (ZiFoNE)

Semi-strukturierte Interviews mit Forschenden und Praxisakteuren aus ausgewählten Projekten des Förderprogramms „Wissenschaft für Nachhaltige Entwicklung"; Anm.: Generischer Leitfaden, der an das jeweilige Projekt sowie die Projektphase angepasst wird

Ziel und Zweck des Interviews

- Wahrnehmungen der Zusammenarbeit und Interaktionen zwischen wissenschaftlichen Akteuren und Akteuren aus der Praxis erfassen
- Verstehen, wodurch diese Prozesse der Zusammenarbeit geformt werden (von Individuen bis zu institutionellem Kontext)

Anmerkungen zu den Interviews

Zunächst einmal möchte ich mich herzlich bei Ihnen bedanken, dass Sie sich die Zeit nehmen, mit mir dieses Gespräch zu führen. Das Interview wird in etwa eine Stunde dauern und wird von mir aufgezeichnet, sofern Sie damit einverstanden sind. Die Auswertung des Interviews erfolgt so, dass keine Rückschlüsse auf einzelne Personen oder Projekte möglich sind. Wie für die gesamte Begleitforschung im Rahmen von ZiFoNE, besteht unser Ziel in keiner Weise in der Evaluierung Ihres Projektes. Mich interessieren viel mehr die Erfahrungen, die Sie in der Zusammenarbeit und dem Austausch mit F./P. im bisherigen Projektverlauf gemacht haben.

Aufbau des Leitfadens

IV. Einbettung des Projektes

- Rolle des Projektes in der Organisation und der sonstigen Tätigkeiten des Akteurs
- Wie kam es dazu Praxisakteure einzubinden bzw. wie kam es zum Engagement im Projekt
- Erwartungen an Zusammenarbeit mit Forschenden bzw. Praxisakteuren

V. Akteure und Funktionsweisen der Zusammenarbeit

- Wer sind die wichtigsten Akteure?
- Wie tauschen sich diese aus? Wie interagieren diese?
- Wie kam es dazu?

VI. Zwischenbilanz der bisherigen Zusammenarbeit

- Erste Zwischenbilanz in Bezug auf Zusammenarbeit/Austausch mit Forschenden bzw. Praxisakteuren
- Bedingungen im Projekt und Rahmenbedingungen, die Zusammenarbeit begünstigen/erschweren/formen

346

Praxisakteure (P)

EINBETTUNG DES PROJEKTES

1. Wie kam es zu ihrem Engagement in diesem Projekt?

Nachfragen:

- Haben Sie schon öfter gemeinsam mit Forschenden Projekte durchgeführt?
- Wie fügt sich Ihr Mitwirken in dem Forschungsprojekt in das Tätigkeitsfeld Ihrer Organisation ein? (//:in Ihr übriges Aufgabenprofil bei X [Organisation] bzw. Ihre berufliche Praxis ein?)

Nachfragen zu Erwartungen:

- Was erwarten Sie sich von Ihrem Engagement in dem Projekt?
- Worin sehen Sie die Bedeutung Ihres Austausches mit den Forschenden für Veränderungsprozesse im Bereich x?
- Worin sehen Sie die Kernkompetenzen der ForscherInnen, die zu Verbesserungen in Ihrem Tätigkeitsbereich beitragen
- // Warum mit Blick auf NE im Bereich X wichtig mit Forschenden zu kooperieren?

AKTEURE UND DEREN INTERAKTIONEN

2. *Mir geht es ja in erster Linie um die Zusammenarbeit von Akteuren aus der Praxis und Forschenden (Schnittstelle):* **In Bezug auf diese Zusammenarbeit, wer sind nach Ihrem Kenntnisstand die wichtigsten Akteure (Akteursgruppen) im Projekt X, sowohl auf Seite der Praxis als auch der Forschenden?**

[InterviewpartnerInnen bitten die zentralen Akteure/Akteursgruppen im Projekt auf Kärtchen zu schreiben, anzuordnen und Beziehungen zu beschreiben]

A → B ← N

[Mehrere Fragen anhand der Akteursdarstellung diskutieren:]

Charakterisierung der Akteure

- Welche Funktionen nehmen Sie / die jeweiligen Personen im Projekt ein?
- Welche Expertisen bringen die jeweiligen Personen in das Projekt ein? In welchem Zusammenhang stehen diese zur Entwicklung nachhaltiger Problemlösungen?

Formen und Intensitäten der Interaktionen

- Wer tauscht sich mit wem aus? [direkte Verbindungslinien einzeichnen]
- Was wird ausgetauscht?
- Wie findet Austausch statt? [potentiell nachfragen zu Formaten e.g. Treffen und wer diese festlegt]
- Wie intensiv ist der Austausch? Woran zeigt sich die Intensität?
- Wenn Sie die Intensität des Austausches mit diesen Akteuren verorten müssten, welche dieser Bezeichnungen trifft die Zusammenarbeit am besten: Information (Sie werden informiert), Zusammenarbeit (zweiseitige Kommunikation; Sie erarbeiten gemeinsam mit den Forschenden etwas) oder Konsultation (Sie nehmen Stellung), Kooperation (zweiseitige Kommunikation, aber ein eine Akteursgruppe gibt Struktur vor)? [könnten Sie bitte die jeweilige Beziehung in den Farben markieren]; Gibt es mehrere, die zutreffen (wann welche?)? Was heißt das konkret? Falls mehrere: welche behagt Ihnen (weshalb) am besten?
- Haben die Intensitäten Ihrer Zusammenarbeit mit den Akteuren XX bisher variiert?

Entscheidungen und zusätzliche Akteure

- Treffen Sie Entscheidungen in diesem Projekt und wenn ja: welche? Falls ja: weshalb treffen sie gerade diese Entscheidungen? Und ist das formell geregelt oder hat es sich so ergeben?
- Nach Ihrem Wissensstand, wie werden Entscheidungen getroffen im Projekt?
- Haben Sie im bisherigen Verlauf Anregungen zur Änderungen von Aspekten im Projekt gegeben, z.B. Ablauf von Workshops, zum Design etc. Wenn ja, wie sind Sie da vorgegangen?
- Gibt es andere zentrale Akteure in Bezug auf Entscheidungen im Projekt, die wir bisher nicht besprochen haben?

Gewichtung (Einfluss)

- Ich würde Sie bitten nun die zentralen Akteure in Bezug auf deren Wichtigkeit für die Erreichung der Projektziele zu gewichten. Sie können auch Akteure hinzufügen und auch gleiche Gewichtungen vergeben. (1 Punkt wenig wichtig, 3 sehr wichtig)
- Fehlt ein wichtiger Akteur? Weshalb wäre dieser wichtig?

ZWISCHENBILANZ

Wir haben nun viel über Ihren Austausch und Ihre Zusammenarbeit mit F. und P. gesprochen. Mich würde jetzt ganz besonders interessieren, wie Sie diese Zusammenarbeit bisher empfunden haben.

3. Wenn Sie nun einen Schritt zurücktreten und auf die bisher erfolgte Zusammenarbeit zurückblicken, welche Zwischenbilanz ziehen Sie aus Ihrem bisherigen Engagement in dem Projekt und dem Austausch mit den Forschenden?

Nachfragen:

- Was waren Highlights? Warum liefen diese Dinge besonders gut?
- Was war besonders herausforderungsreich? Warum?
- Gab es Dinge, dich sich anders entwickelt haben als gedacht?
- Gab es Momente/Orte, an denen sich Unterschiede im Zugang von F. und P. besonders manifestierten?
- Gab es Momente, in denen Sie Sorge trugen, dass Ihre Belange zu kurz kommen und/oder dass die Interessen anderer Akteure aus Forschung oder Praxis zu viel Raum einnahmen?

RAHMENBEDINGUNGEN

[zurück zu den aufgezeichneten Akteuren:]

Wenn wir uns Ihre Verbindungen zu den anderen Personen nochmal ansehen:

4. Welche Rahmenbedingungen begünstigen oder erschweren die Zusammenarbeit /den Austausch zwischen Ihnen und den Forschenden?

[falls nicht im Verlauf des Gesprächs angesprochen, direkt auf diese potentiellen Faktoren ansprechen]

Fragen 5-8:

5. In Bezug auf die Zusammenarbeit von F und P ist oft von der Herausforderung die Rede, ein Umfeld zu schaffen, in dem, alle Akteure gleichermaßen das Gefühl haben, sich offen ausdrücken zu können und ihr jeweiliges Wissen einzubringen. Was denken Sie darüber? Inwiefern haben Sie im Projekt X Erfahrungen diesbezüglich gemacht?

Entweder auf Karten schreiben und jeweils nach Rolle im Projekt fragen. Am Schluss nach einer Reihung in Bezug auf deren Wichtigkeit in der Ausgestaltung von Zusammenarbeit fragen ODER AHP und dann fragen warum und was fehlt?

6. Vertrauen, z.B. in die Expertisen der Anderen, aber auch in die Bereitschaft über einen längeren Zeitraum mitzuwirken, wird häufig als zentrales Element von Zusammenarbeit beschrieben. Welche Erfahrungen haben Sie diesbezüglich im Projekt X gemacht?

7. Es wird häufig von unterschiedlichen Erwartungshaltungen von Seiten der Forschenden und der Praxisakteure berichtet. Was denken Sie darüber? Spielt das in Ihrer Zusammenarbeit eine Rolle?

   Also z.B. Erwartungen an Ergebnisse oder auch an die Intensität und Dauer des Prozesses

8. Man hört oft, dass die Verfügbarkeit von Ressourcen, insbesondere auch für Akteure aus der Praxis, die Zusammenarbeit formen. Was denken Sie dazu? Inwiefern äußert sich dies im Projekt X?

   Nachfrage:

   - *Es ist öfters von der Sorge die Rede, die Praxisakteure zeitlich zu sehr zu belasten. Welche Rolle spielt der Faktor Zeit in der Zusammenarbeit mit F-/ P.?*
   - *Was wäre anders, wenn im Rahmen des Programmes WFNE eine Finanzierung für Praxisakteure explizit vorgesehen wäre?*
   - *… Ungleicher Zugang zu Ressourcen, ökonomische und Zeitressourcen aber auch Ressourcen im Sinne von Kompetenzen, politische Ressource etc. …*

9. Das Projekt X ist ja in das Themenfeld „Nachhaltige Entwicklung" eingebettet. Es ist immer wieder von der Herausforderung die Rede, unterschiedliche Vorstellung von Nachhaltigkeit in Einklang zu bringen. Inwiefern spielt das in Ihrer Zusammenarbeit mit verschiedenen Akteuren aus F/P eine Rolle?

10. Was würden Sie in der Zusammenarbeit mit den Forschenden anders machen, wenn Sie dieses Projekt nochmals planen könnten?

In Bezug auf Forschungs-Praxis Interaktionen, haben wir im Laufe des Interviews Aspekte ausgelassen, die Sie sich vielleicht schon im Vorfeld überlegt haben oder die Ihnen gerade noch durch den Kopf gehen?

C Supplementary Material Participatory Observation

C.1. Table. Observation Guideline

BeobachterIn:

Gruppenfarbe: **Iteration:**   **Datum:**

Schwerpunkt der Beobachtung: Wie interagieren Forschende und VerteterInnen aus Wirtschaft, Politik, Industrie, Zivilgesellschaft etc.? Welche Elemente formen diese Interaktion?

GRUPPENDYNAMIKEN	
Dominanz: Gib es Momente in den Diskussionen, in denen einzelne Personen dominieren? (wer, wann, wie äussert sich das? Wie wird damit umgegangen)	
Autorität: Gibt es Personen, deren Beiträge mehr Gewicht haben bzw. worauf beruht deren «Autorität»? Basiert diese auf spezifischem Wissen einer Person? Ist es deren Position, oder Art der Argumentation?	
Antiautorität: Gibt es Situationen, in denen es einzelnen Personen schwer fällt sich Gehör zu verschaffen oder sich zu artikulieren?	
Uneinigkeit: Wie wird mit Situationen umgegangen, in denen Uneinigkeit zwischen Personen /Gruppen besteht?	
Unzufriedenheit: Gibt es Momente der Unzufriedenheit im Sinne von bestimmte Personen haben das Gefühl nicht gehört, missverstanden oder ähnliches zu werden? (z.B.	

Forscher sind frustriert, weil man ihre Resultate doch nicht verstanden hat)	
Diskussionsverlauf: Nehmen die Personen Bezug auf den vorangegangenen Prozess im Rahmen der Forschungsprozesse? (z.B, dass etwas dort anders diskutiert wurde, Schwierigkeiten, Enttäuschungen …);	
Wird auf die Argumente der Anderen eingegangen oder bleibt man bei seinem Argument? Wie «entwickeln» sich die Argumente?	
WISSENSCHAFT/POLIITK	
Erwartungen: Was erwarten die einzelnen Personen von dem Prozess (informell fragen). Lassen sich Unterschiede in den Erwartungen der Beteiligten an die Resultate des Prozesses erkennen? Inwiefern? (auch Motivationen)	
Interessengruppen: Lässt sich die Formierung von «Interessensgruppen» erkennen? Inwiefern?	
Wissenschaftsverständnisse: Welche Rolle spielen unterschiedliche Wissenschaftsverständnisse, z.B. Aspekte wie Objektivität, in den Argumentationslinien?	
Unsicherheiten: Wie wird mit Unsicherheit über «die beste Lösung» eines Problems umgegangen?	

WISSEN UND WERTE	
Wissensintegration: findet eine Integration von Wissen statt? Wie äussert sich diese?	
Neues Wissen: entsteht neues Wissen, das im NFP 68 nicht vorhanden war? Oder ist es die Wissenstransfer und Umsetzung?	
Gibt es Momente, in denen «Konflikte» verschiedener Wissensformen beobachtbar sind?	
Anmerkungen zur «Atmosphäre» und Stimmung im Raum	

D Supplementary Material Expert Workshop

D.1   Workshop Invitation

ENAC/ I I E
Laboratory on Human-Environment Relations in Urban Systems
Swiss Mobiliar Chair in Urban Ecology and Sustainable Living
HERUS

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Invitation to a Pre-Workshop to the Swiss Inter-and Transdisciplinarity Day 2018

Assessing power in transdisciplinary sustainability research

EVENT DETAILS

Date: 14.11.2018, 15:00-18:00, followed by joint dinner
Location: AAC 0 06, SG Building, EPFL, Lausanne
*Contact: Livia Fritz (livia.fritz@epfl.ch), Chair for Human Environment Relations in Urban Systems (*HERUS*), EPFL*

MOTIVATION

As part of my PhD project analysing the constitution of participation in sustainability research, I investigate the role of structural and actor-based factors shaping interactions between scientific and extra-scientific actors. In this expert workshop, we would like to put the spotlight on a much discussed, yet empirically little explored issue: the role of power relations in transdisciplinary sustainability research. Guided by social theories of power (such as power "over", "to" or "with"), we propose to jointly enquire how power relations between heterogeneous actors and contexts shape participation in transdisciplinary sustainability research.

- How can we empirically and analytically grasp different facets of power which exist in and shape participation in transdisciplinary sustainability research?
- What can an analysis of power teach us for enhancing the transformative capacity of transdisciplinary research?

GOAL AND ENVISAGED OUTPUT

Based on the experience and expertise of the workshop participants, we aim to develop a framework for analysing different forms of power along the ideal-typical phases of a transdisciplinary research process: (i) in framing the problem and research goal; (ii) in (co-)producing knowledge; and (iii) in bringing results to fruition. The framework will provide transdisciplinary researchers with empirical questions as well as with examples of indicators and indications of power.
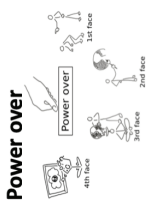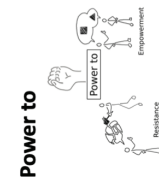
FORMAT

Small, discussion-based workshop with 5-10 experts on transdisciplinarity.
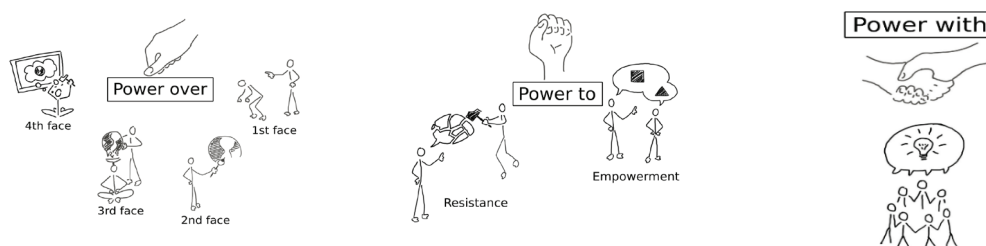
Illustrations: Fritz and Meinherz, 2020

355

D.2 Mapping grid used

	Development Phase	Knowledge Production Phase	Dissemination Phase
	development of research proposal in line with funding conditions, selection of partners, framing of the (sustainability) problem, process design	*application of methods, workshops etc., (co-)production of knowledge, integration of knowledge from different actors*	*re-integration of results in science and practice (e.g targeted outputs such as recommendations), discussion of follow-up steps, implementation*
Power over ▪Who set the terms of how you and the practitioners interacted (formats, timing, agenda)? ▪How were resources (financial, time,...) distributed among you and the practitioners? ▪In which situations and/or for which tasks did you depend on practitioners or vice versa? ▪Whose knowledge and whose values entered and shaped different phases of the project and why? Were there forms of knowledge or values that you found difficult to integrate?			
Power to ▪In which situations did you achieve your personal goals? Did this prevent others from achieving their respective goals? ▪In which situations did you feel empowered by practitioners in your project? In which situations do you think did you empower them? ▪Were their situations in which you opposed actions/decisions by the practitioners or vice versa?			
Power with ▪In which situations did you jointly act or create something new with the practitioners involved in your project (e.g. something that you might not have been able to create individually)?			

356

E Supplementary Survey

E.1   Table. Survey for researchers

Source: Balthasar and Roose 2019

Befragung von Forschenden des Nationalen Forschungsprogramms „Steuerung des Energieverbrauchs" (NFP 71) Survey of researchers involved in the National Research Programme „Managing Energy Consumption" (NRP 71) Bitte wählen Sie oben die gewünschte Sprache - Please choose above your preferrred language		
Sehr geehrte Damen und Herren Das Nationale Forschungsprogramm „Steuerung des Energieverbrauchs" (NFP 71) stellt praxistaugliche wissenschaftliche Grundlagen für die Diskussion über die Gestaltung der Zukunft des schweizerischen Energiesystems bereit. Um die Wirkung des Forschungsprogramms in der Praxis beurteilen zu können, führen wir im Auftrag der Leitungsgruppe des NFP 71 eine Befragung der Forschenden zur Zusammenarbeit mit den Praxispartnern/-innen sowie zu deren Nutzen durch. Da Sie uns von der Programmleitung als Forschende/-r genannt worden sind, möchten wir Sie bitten, sich an dieser kurzen Befragung (max. 10 Minuten) zu beteiligen. Die Auswertung erfolgt anonymisiert. Für Rückfragen steht Ihnen gerne [Name und Kontaktdate der Person in der Version entfernt] zur Verfügung. Vielen Dank für Ihre Teilnahme!		
1.1	Sind/waren Sie bei einem oder bei mehreren Projekten beteiligt im Rahmen des NFP 71?	$\square_1$ Bei einem Projekt $\square_2$ Bei zwei Projekten $\square_3$ Bei mehr als zwei Projekten
1.2	Kamen Sie in Ihrem Projekt/einem Ihrer Projekte im Rahmen des NFP 71 in Kontakt mit Praxispartner/-innen?	$\square_1$ Ja $\square_2$ Nein ►*abschliessende Fragen*
1.3	Bitte geben Sie an, wer der/die Leiter/-in Ihres Projekts war. *Falls Sie an mehr als einem Projekt beteiligt waren, beziehen Sie Ihre Antworten auf das Projekt, in dem Sie Praxispartner/-innen hatten. Falls Sie in mehreren Projekten Praxispartner/-innen hatten, beziehen Sie Ihre Antwort auf das für Sie wichtigste Projekt.*	Liste der Projektleitenden
Zur Zusammenarbeit		
Bitte beziehen Sie Ihre nachfolgenden Antworten auf das Projekt, das von (Antwort von Frage 1.3) geleitet wurde.		
2.1	Welches war Ihre Motivation, Praxispartner/-innen am Projekt zu beteiligen? *Mehrfachantworten möglich*	$\square_1$ Sicherstellung des Praxisbezugs unseres Projekts $\square_2$ Glaubwürdigkeit der Ergebnisse erhöhen $\square_3$ Validierung der Ergebnisse $\square_4$ Anwendbarkeit der Ergebnisse erhöhen $\square_5$ Frühere positive Erfahrungen mit Einbezug von Praxispartnern/-innen $\square_6$ Die Mitwirkung von Praxispartnern/-innen erhöht die Legitimität unserer Forschung. $\square_7$ Ich hatte keine konkreten Erwartungen. $\square_8$ Das war eine Vorgabe der Programmleitung. $\square_9$ Ich war nicht in diese Entscheidung involviert. $\square_{10}$ ……………………………………………………………………

2.2	In welcher Art haben sich die Praxispartner/-innen am Forschungsprojekt beteiligt? *Mehrfachantworten möglich*	$\square_1$ Finanzielle Beteiligung mit Cash-Beitrag $\square_2$ Finanzielle Beteiligung durch Eigenleistung $\square_3$ Daten zur Verfügung gestellt $\square_4$ Doktorand oder Postdoc im Betrieb/in der Institution arbeiten lassen $\square_5$ Geräte/Software zur Verfügung gestellt $\square_6$ Kommunikation von Resultaten unterstützt $\square_7$ Mitglied in einer Begleitgruppe/Advisory Boards $\square_8$ Für Interviews zur Verfügung gestanden $\square_9$ Teilnahme an Workshops u.ä. im Rahmen des Projekts $\square_{10}$ Zugang zu Informationen (z.B. Daten, Kunden, Akteuren) unterstützt/Rolle als Türöffner/-in $\square_{11}$ Ich weiss es nicht $\square_{12}$ ……………………………………………………………....
2.3	Bitte geben Sie an, wie intensiv Sie mit den Forschenden in den folgenden drei Phasen des Projekts in Kontakt standen. Entwicklung der Forschungsfrage	$\square_1$ Kein Kontakt $\square_2$ Seltener Kontakt (1–2 Mal) $\square_3$ Gelegentlicher Kontakt (3–5 Mal) $\square_4$ Reger Kontakt (mehr als 5 Mal) $\square_5$ Ich weiss es nicht
	Bearbeitung der Forschungsfrage	$\square_1$ Kein Kontakt $\square_2$ Seltener Kontakt (1–2 Mal) $\square_3$ Gelegentlicher Kontakt (3–5 Mal) $\square_4$ Reger Kontakt (mehr als 5 Mal) $\square_5$ Ich weiss es nicht
	Verbreitung der Ergebnisse	$\square_1$ Kein Kontakt $\square_2$ Seltener Kontakt (1–2 Mal) $\square_3$ Gelegentlicher Kontakt (3–5 Mal) $\square_4$ Reger Kontakt (mehr als 5 Mal) $\square_5$ Ich weiss es nicht
2.4	Welche der folgenden Aussagen beschreibt Ihren bisherigen Austausch mit den Praxispartnern/-innen am besten?	$\square_1$ Information an die Praxispartner/-innen mit Möglichkeit, Feedback zu geben $\square_2$ Konsultation: Wir holen den Ratschlag der Praxispartner/-innen ein $\square_3$ Zusammenarbeit: Gemeinsame Entscheidungen, Absprache des Vorgehens $\square_4$ Die Praxispartner/-innen formulieren Vorgaben $\square_5$ Ich weiss es nicht
2.5	Bitte reihen Sie die folgenden Faktoren nach ihrer Wichtigkeit für das Gelingen der Zusammenarbeit zwischen Forschung und Praxis (1=wichtigster Grund, 2=zweitwichtigster Grund usw.) *Klicken Sie jeweils auf eine Aussage und ziehen Sie diese an die entsprechende Position.*	$\square_1$ Die Forschenden haben genügend Zeit $\square_2$ Die Praxispartner/-innen haben genügend Zeit $\square_3$ Die Praxispartner/-innen haben genügend finanzielle Ressourcen $\square_4$ Übereinstimmende Wahrnehmung des zu lösenden Problems $\square_5$ Geographische Nähe zu den Praxispartnern/-innen
2.6	Welche weiteren Faktoren begünstigten oder erschwerten Ihren Austausch mit den Forschenden?	…………………………………………………………… …………………………………………………………… ……………………………………………………………...........

2.7	Wie sehr treffen die folgenden Aussagen auf Ihre Erfahrung zu?	
	Der Aufbau einer vertrauensvollen Beziehung mit den Praxispartnern/-innen war zentral für die Zusammenarbeit.	$\square_1$ Trifft zu $\square_2$ Trifft eher zu $\square_3$ Trifft eher nicht zu $\square_4$ Trifft nicht zu
	Es war zunächst wichtig eine „gemeinsame Sprache" mit den Praxispartnern/-innen zu finden.	$\square_1$ Trifft zu $\square_2$ Trifft eher zu $\square_3$ Trifft eher nicht zu $\square_4$ Trifft nicht zu
	Es gab Momente, in denen die Anliegen der Praxis zu viel Raum einnahmen.	$\square_1$ Trifft zu $\square_2$ Trifft eher zu $\square_3$ Trifft eher nicht zu $\square_4$ Trifft nicht zu
	Es gab Momente, in denen mir nicht klar war, worin die Rolle der Praxispartner/-innen im Projekt besteht.	$\square_1$ Trifft zu $\square_2$ Trifft eher zu $\square_3$ Trifft eher nicht zu $\square_4$ Trifft nicht zu
	Der Nutzen der Zusammenarbeit war hoch im Vergleich zum Aufwand für den Einbezug der Praxispartner/-innen.	$\square_1$ Trifft zu $\square_2$ Trifft eher zu $\square_3$ Trifft eher nicht zu $\square_4$ Trifft nicht zu
Zu den Ergebnissen		
3.1	Denken Sie, dass die Praxispartner/-innen die bisherigen Ergebnisse des Forschungsprojekts kennen?	$\square_1$ Ja $\square_2$ Teilweise $\square_3$ Nein $\square_4$ Ich weiss es nicht
3.2	Denken Sie, dass die Ergebnisse relevant sind für die Arbeit Ihrer Praxispartner/-innen?	$\square_1$ Ja $\square_2$ Teilweise $\square_3$ Nein $\square_4$ Ich weiss es nicht
3.3	Worin liegt der Nutzen der Zusammenarbeit bzw. der Ergebnisse bisher für Sie? *Mehrfachantworten möglich*	$\square_1$ Der Praxisbezug unserer Ergebnisse konnte gesteigert werden. $\square_2$ Die Ergebnisse werden rascher umgesetzt. $\square_3$ Wir haben Ressourcen (bspw. Personal, Software usw.) zur Verfügung gestellt bekommen. $\square_4$ Wir haben finanzielle Mittel erhalten. $\square_5$ Wir haben Wissen erhalten, über das wir ohne die Zusammenarbeit nicht verfügt hätten. $\square_6$ Wir haben Zugang zu Interviewpartnern/Akteurgruppen erhalten. $\square_7$ Wir haben potenzielle künftige Arbeitgebende kennengelernt. $\square_8$ Wir konnten neue Kontakte knüpfen/bestehende Kontakte vertiefen. $\square_9$ Ich sehe keinen Nutzen. $\square_{10}$ ....

Gesamtbeurteilung		
4.1	Haben Ihre Praxispartner/-innen ihre Praxiserfahrungen in das Forschungsprojekt eingebracht?	$\square_1$ Ja $\square_2$ Eher ja $\square_3$ Eher nein $\square_4$ Nein $\square_5$ Ich weiss es nicht
4.2	Haben Sie die Inputs Ihrer Praxispartner/-innen in das Projekt einfliessen lassen?	$\square_1$ Ja $\square_2$ Eher ja $\square_3$ Eher nein $\square_4$ Nein $\square_5$ Ich weiss es nicht
4.3	Wurden Ihre Erwartungen an die Zusammenarbeit mit den Praxispartnern/-innen bisher erfüllt?	$\square_1$ Ja $\square_2$ Eher ja $\square_3$ Eher nein $\square_4$ Nein $\square_5$ Keine Antwort
4.4	Hat die Zusammenarbeit mit den Praxispartnern/-innen einen echten Mehrwert bewirkt?	$\square_1$ Ja $\square_2$ Eher ja $\square_3$ Eher nein $\square_4$ Nein $\square_5$ Ich weiss es nicht
4.5	Was denken Sie, wie sich die drei Phasen des Projekts ohne Zusammenarbeit mit Ihren Praxispartnern/-innen entwickelt hätten? Entwicklung der Forschungsfrage	$\square_1$ Verbessert $\square_2$ Gleich $\square_3$ Verschlechtert $\square_4$ Ich weiss es nicht
	Bearbeitung der Forschungsfrage	$\square_1$ Verbessert $\square_2$ Gleich $\square_3$ Verschlechtert $\square_4$ Ich weiss es nicht
	Verbreitung der Ergebnisse	$\square_1$ Verbessert $\square_2$ Gleich $\square_3$ Verschlechtert $\square_4$ Ich weiss es nicht
Abschliessende Fragen		
Diese Befragung untersucht die Zusammenarbeit zwischen Forschung und Praxis sowie deren Nutzen. Da Sie nicht mit Praxispartnern/-innen zusammengearbeitet haben, gelangen Sie bereits zu den abschliessenden Fragen *(nur, wenn kein Kontakt mit Praxispartnern/-innen ►Frage 1.2=nein)*		
5.1	Welcher Gruppe von Akteuren ordnen Sie Ihre Institution zu?	$\square_1$ Universität $\square_2$ Fachhochschule $\square_3$ Private Unternehmung $\square_4$ ....
5.2	Haben Sie uns noch etwas mitzuteilen?	....
Dies war unsere letzte Frage. Wenn Sie unten auf den „Weiter"-Button klicken wird die Befragung abgeschlossen, Ihre Antworten werden abschliessend gespeichert, und Sie können nicht mehr zurück zum Fragebogen gelangen.		
Herzlichen Dank für Ihre Teilnahme!		

E.2 Table. Survey for practitioners

Source: Balthasar and Roose 2019

Enquête auprès des partenaires de terrain du Programme national de recherche „Gérer la consommation d'énergie" (PNR 71) Befragung von Praxispartnern/-innen des Nationalen Forschungsprogramms „Steuerung des Energieverbrauchs" (NFP 71) Veuillez sélectionner la langue désirée ci-dessus – Bitte wählen Sie oben die gewünschte Sprache		
Madame, Monsieur, Le Programme national de recherche « Gérer la consommation d'énergie » (PNR 71) pose des bases scientifiques ancrées dans la pratique afin d'étayer le dialogue concernant l'avenir du système énergétique suisse. Pour évaluer l'impact de ce programme sur la pratique, nous conduisons une enquête au nom du comité de direction du PNR 71 auprès des partenaires de terrain sur la collaboration avec les équipes de recherche impliquées et ses avantages. L'une des équipes de recherche vous ayant mentionné comme partenaire, nous serions ravis que vous répondiez à ce bref questionnaire (max. 10 minutes). Le traitement des résultats est entièrement anonyme. [Nom de la personne] se tient à votre disposition pour toutes questions [coordonnées supprimées de cette version]. Merci de votre participation !		
1.1	Saviez-vous que vous figuriez comme partenaire d'un projet du Programme national de recherche « Gérer la consommation d'énergie » (PNR 71)?	$\square_1$ Oui $\square_2$ Non ▶ *questions de conclusion*
1.2	Etes/Etiez-vous partenaire de terrain d'un ou de plusieurs projets dans le cadre du PNR 71 ?	$\square_1$ Un projet $\square_2$ Plusieurs projets
1.3	Veuillez indiquer le nom de la personne responsable du projet auquel vous participez/avez participé en tant que partenaire de terrain ? *Si vous êtes/avez été impliqué dans plusieurs projets, veuillez-vous référer au projet le plus important pour vous.*	Liste des responsables des projets
1.4	Aviez-vous déjà participé à des projets PNR auparavant ?	$\square_1$ Oui $\square_2$ Non
La collaboration		
Veuillez-vous référer aux réponses ci-dessous au projet mené par *(réponse de la question 1.3).*		
2.1	Quelle était la nature de votre participation en tant que partenaire de terrain au projet de recherche ? *Plusieurs réponses possibles*	$\square_1$ Participation financière avec contribution cash $\square_2$ Participation financière via contribution personnelle $\square_3$ Mise à disposition de données $\square_4$ Accueil de doctorant/-e ou post-doctorant/-e pouvant travailler au sein de l'entreprise/institution $\square_5$ Mise à disposition d'appareils/de logiciels $\square_6$ Soutien à la communication de résultats $\square_7$ Membre d'un groupe de suivi/Advisory Board $\square_8$ Disponibilité pour des entretiens $\square_9$ Participation à des séminaires et autres dans le cadre du projet $\square_{10}$ Aide à l'accès aux informations (par ex. données, clients, acteurs) /Rôle de facilitateur $\square_{11}$ ………..………………………………………………

2.2	Qu'est-ce qui vous a donné envie de participer au projet en tant que partenaire de terrain ? *Plusieurs réponses possibles*	☐1 Développer un produit concret ou un processus ☐2 Suivre la recherche ☐3 Encourager la relève ☐4 Générer de nouvelles connaissances avec les équipes de recherche ☐5 Trouver des solutions à des problèmes concrets ☐6 Etoffer son réseau/acquérir de nouveaux contacts ☐7 Soutenir les chercheurs ☐8 Expérience antérieure en tant que partenaire de terrain d'un projet ☐9 Je n'avais aucune attente précise ☐10 …………………………………………………….…………
2.3	Veuillez indiquer dans quelle mesure vous avez été en contact avec l'équipe de recherche au cours des trois phases du projet. Définition de la problématique	☐1 Aucun contact ☐1 Contact rare (1–2 fois) ☐2 Contact occasionnel (3–5 fois) ☐3 Contact fréquent (plus que 5 fois)
	Traitement de la problématique	☐1 Aucun contact ☐1 Contact rare (1–2 fois) ☐2 Contact occasionnel (3–5 fois) ☐3 Contact fréquent (plus que 5 fois)
	Diffusion des résultats	☐1 Aucun contact ☐1 Contact rare (1–2 fois) ☐2 Contact occasionnel (3–5 fois) ☐3 Contact fréquent (plus que 5 fois)
2.4	Parmi les éléments suivants, lequel décrit le mieux votre échange avec l'équipe de recherche jusqu'à présent ?	☐1 Information avec la possibilité de soumettre des commentaires ☐2 Consultation : l'équipe de recherche nous demande conseil ☐3 Collaboration : Décisions conjointes, consultation de la procédure ☐4 Formulation d'objectifs à l'équipe de recherche
2.5	Veuillez classer les facteurs suivants selon leur importance pour le succès de la coopération entre la recherche et la pratique (1=facteur le plus important, 2=deuxième facteur le plus importante, etc.) *Cliquez sur une proposition et faites-la glisser jusqu'à la position appropriée.*	☐1 Les chercheurs/chercheuses ont suffisamment de temps ☐2 Les partenaires du terrain ont suffisamment de temps ☐3 Les partenaires du terrain ont suffisamment ressources financières ☐4 Consensus concernant le problème à résoudre ☐5 Proximité géographique avec l'équipe de recherche
2.6	Quels autres facteurs ont facilité ou freiné votre échange avec l'équipe de recherche ?	……………………………………………………………… ……………………………………………………………… ………………………………………………………………

2.7	Les déclarations suivantes correspondent-elles à votre expérience ?	
	Le développement d'une relation de confiance avec l'équipe de recherche était un aspect central de notre collaboration.	$\square_1$ Oui $\square_2$ Plutôt oui $\square_3$ Plutôt non $\square_4$ Non
	Nous sommes parvenus à établir une relation de confiance avec les chercheuses et chercheurs.	$\square_1$ Oui $\square_2$ Plutôt oui $\square_3$ Plutôt non $\square_4$ Non
	A certains moments, je craignais que mes intérêts ne soient laissés de côté.	$\square_1$ Oui $\square_2$ Plutôt oui $\square_3$ Plutôt non $\square_4$ Non
	Mes connaissances et mon expertise étaient estimées à leur juste valeur dans le cadre du projet.	$\square_1$ Oui $\square_2$ Plutôt oui $\square_3$ Plutôt non $\square_4$ Non
	Il importait tout d'abord de trouver une "langue commune" avec l'équipe de recherche.	$\square_1$ Oui $\square_2$ Plutôt oui $\square_3$ Plutôt non $\square_4$ Non
	A certains moments, les intérêts d'autres acteurs de la recherche ou de la pratique prenaient trop de place.	$\square_1$ Oui $\square_2$ Plutôt oui $\square_3$ Plutôt non $\square_4$ Non
	A certains moments, je ne savais pas vraiment quel était mon rôle dans le projet.	$\square_1$ Oui $\square_2$ Plutôt oui $\square_3$ Plutôt non $\square_4$ Non
Les résultats du projet		
3.1	Avez-vous connaissance des résultats obtenus jusqu'ici dans le cadre du projet de recherche ?	$\square_1$ Oui $\square_2$ En partie $\square_3$ Non ▶ *Question 3.4*
3.2	Ces résultats sont-ils pertinents pour votre travail ?	$\square_1$ Oui $\square_2$ En partie $\square_3$ Non
3.3	Selon vous, ces résultats sont-ils pertinents en dehors du domaine scientifique ?	$\square_1$ Oui $\square_2$ En partie $\square_3$ Non
3.4	Jusqu'à présent, quelle a été l'utilité de la collaboration ou des résultats pour vous ? *Plusieurs réponses possibles*	$\square_1$ Nouveau produit, amélioration d'un produit existant $\square_2$ Nouveau processus, amélioration d'un processus existant $\square_3$ Nouvelles connaissances, approfondissement des connaissances actuelles $\square_4$ Nouveau modèle, extension du modèle existant $\square_5$ Rencontre de futurs collaborateurs potentiels $\square_6$ Acquisition de nouveaux contacts, lien accru avec les contacts existants $\square_7$ …………..………………………………………………

3.5	Selon vous, quel est le rapport coût/bénéfice de votre participation ?	☐₁ Bénéfice majoritaire ☐₂ Bénéfice plutôt majoritaire ☐₃ Coût et bénéfice à peu près équivalents ☐₄ Coût plutôt majoritaire ☐₅ Coût majoritaire
3.6	Jusqu'ici, le projet de recherche répond-il à vos attentes ?	☐₁ Oui ☐₂ En partie ☐₃ Non
3.7	Pour votre activité, le projet de recherche dans son ensemble est :	☐₁ Important ☐₂ Assez important ☐₃ Peu important ☐₄ Pas important
3.8	Veuillez donner votre avis sur les affirmations suivantes : Nous pouvons appliquer/utiliser directement les résultats du projet.	☐₁ D'accord ☐₂ Plutôt d'accord ☐₃ Plutôt pas d'accord ☐₄ Pas d'accord
	Le projet aura un impact sur notre travail.	☐₁ D'accord ☐₂ Plutôt d'accord ☐₃ Plutôt pas d'accord ☐₄ Pas d'accord
	Les résultats donnent une légitimité à notre travail.	☐₁ D'accord ☐₂ Plutôt d'accord ☐₃ Plutôt pas d'accord ☐₄ Pas d'accord
Evaluation générale		
4.1	Avez-vous pu intégrer votre expérience pratique dans le projet de recherche ?	☐₁ Oui ☐₂ Plutôt oui ☐₃ Plutôt non ☐₄ Non
4.2	Pensez-vous que votre participation a contribué à la réussite du projet ?	☐₁ Oui ☐₂ Plutôt oui ☐₃ Plutôt non ☐₄ Non
Collaboration globale		
5.1	Pendant le déroulement du projet, avez-vous été en contact avec des chercheurs ou partenaires de terrain d'autres projets menés dans le cadre du PNR 71?	☐₁ Non, jamais ☐₂ Oui, une fois ☐₃ Oui, plusieurs fois ☐₄ Oui, régulièrement
Conclusion		
Cette enquête examine la coopération entre la recherche et la pratique et ses avantages. Comme vous n'avez pas travaillé avec des chercheurs en tant que partenaire de terrain, vous serez amené aux dernières questions. *(Seulement si la personne ne sait pas qu'elle figure comme partenaire d'un projet du PNR 71►question 1.1=non).*		
6.1	A quel groupe d'acteurs attribuez-vous votre entreprise/institution ?	☐₁ Confédération ☐₂ Canton ☐₃ Commune ☐₄ Entreprise privée ☐₅ Association professionnelle ☐₆ Etablissement d'enseignement ☐₇ ONG ☐₈ Etablissement de recherche ☐₉ Fournisseur d'énergie ☐₁₀ …………………………………………………………………

6.2	Où est-ce que votre entreprise/institution concentre-t-elle ses activités ?	$\square_1$ Suisse alémanique $\square_2$ Suisse romande $\square_3$ Suisse italienne $\square_4$ Toute la Suisse $\square_5$ En dehors de la Suisse
6.3	Vous intéressez-vous aux (autres) résultats du programme de recherche « Gérer la consommation d'énergie » (PNR 71)?	$\square_1$ Oui $\square_2$ Plutôt oui $\square_3$ Plutôt non $\square_4$ Non
6.4	Seriez-vous disposé à accepter une future demande de collaboration à un projet de recherche d'un PNR ?	$\square_1$ Oui $\square_2$ Eventuellement $\square_3$ Non
6.5	Avez-vous des commentaires ?	....
C'était notre dernière question. Si vous appuyez sur le bouton "Continuer" ci-dessous, l'enquête sera complétée, vos réponses seront enregistrées et vous ne pourrez plus retourner au questionnaire.		
Merci de votre participation !		

F Information about the Author (CV and Personal Bibliography)

![europass logo]

Curriculum vitae

PERSONAL INFORMATION   Livia Fritz

✉ livia_fritz@hotmail.com

Gender Female | Date of birth 28/06/1989 | Nationality(-ies) Austria

WORK EXPERIENCE

Since March 2016   **Doctoral Assistant**

Swiss Federal Institute of Technology Lausanne (EPFL), Lausanne
Laboratory on Human-Environment Relations in Urban Systems (HERUS)
Institute of Environmental Engineering (IEE), School of Architecture, Civil and Environmental
Engineering (ENAC)
https://www.epfl.ch/schools/enac/
Teaching assistant and researcher in the project "Civil Society and Research for Sustainable
Development" (ZiFoNE)
Teaching assistance (Course: Sustainability Assessment of Urban Systems); student super-
vision

Type of business or sector University

Mid-May 2015- February 2016   **Project Researcher**

Ludwig-Maximilians-Universität (LMU), Munich
Department of Geography; Chair for Human-Environment Relations
www.geographie.uni-muenchen.de
Researcher in the project "Civil Society and Research for Sustainable Development" (ZiFoNE)
Supervision of student assistants

Type of business or sector University

March 2015 – Mid-May 2015   **Intern**

Gesellschaft für Internationale Zusammenarbeit (GIZ), Berlin
Sector Project on Trade Policy and Trade and Investment Promotion
www.giz.de

Type of business or sector Development Agency

August 2013 - August 2014   **Junior Researcher**

Austrian Foundation for Development Research (ÖFSE), Vienna
www.oefse.at
Research on development finance and policy with a focus on tied and untied soft loan policies
of OECD donors; Post-2015 development agenda; conceptualizing and measuring ODA
Research stay in Copenhagen, Denmark (September 2013); invited speaker at the DAC De-
velopment Debates in Paris, France (September 2014)

Type of business or sector Independent Research Institute

October 2012 – March 2013

Intern

United Nations Industrial Development Organization (UNIDO), Vienna
Business, Investment and Technology Branch, Programme Development and Technical Co-operation Division (PTC/BIT) Investment and Technology Unit
www.unido.org

Type of business or sector International Organization

March 2012 – June 2013

Student Researcher in the Project 'Soft Loans: an Effective Instrument for Development Policy?'

Austrian Foundation for Development Research (ÖFSE), Vienna
www.oefse.at
Research stay at the OECD Archives in Paris, France (June 2012)

Type of business or sector Independent Research Institute

September 2011

Volunteer

TRIALOG – Development NGOs in the enlarged EU, Vienna
www.trialog.or.at

Type of business or sector Non-Governmental Organization

EDUCATION AND TRAINING

Since March 2016

Swiss Federal Institute of Technology Lausanne (EPFL)

Laboratory on Human-Environment Relations in Urban Systems (HERUS)
Institute of Environmental Engineering (IEE), School of Architecture, Civil and Environmental Engineering (ENAC), Doctoral Program of Architecture and Sciences of the City (EDAR)

PhD Candidate

May 2015 - February 2016

Ludwig-Maximilians-Universität (LMU)

Department of Geography; Chair for Human-Environment Relations

Phd Candidate

October 2007 - July 2013

University of Vienna

Diploma (Master-equivalent degree) in Development Studies; Graduation with High Distinction
International Development
Master Thesis: Tied Aid Credits – A Hybrid Instrument at the Interface of Export Promotion and Development Policy
Specialization: Economics and Development; Development Policy; International Political Economy; Political Ecology; Transformation Processes in the Post-Soviet Space

September 2010 - June 2011

Sciences Po Paris (I.E.P.)

International Relations / Affaires Internationales (Exchange Year)

Specialization: Sustainable Development; Environmental Policy; Regional Focus on East and South-East Europe and the CIS Region

March 2009 – January 2014

Vienna University of Economics and Business

Selected classes in Economic and Social Sciences

Introduction to Micro-and Macroeconomics, Statistics, Finance, as well as French and Russian Business Communication

October 2007 – June 2010	**University of Vienna**
	Department for Slavic Languages
	Selected classes in Russian Studies
	Language Stays: Linguistic University of Nizhny Novgorod, Russia (July/August 2008); Ukrainian-Bavarian Management Training Center, Odessa, Ukraine (August 2009)

June 2007	**Bundesgymnasium, Bludenz**
	Matura (Austrian A-levels), graduation with High Distinction

PERSONAL SKILLS

Mother tongue(s)   German

Other language(s)

	Understanding		Speaking		Writing
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
French	C2	C2	C1	C1	C1
Russian	B2	B2	B2	B2	B2

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2: Proficient user
Common European Framework of Reference (CEF) level

Computer skills and Competences   MS Office (Word, Excel, PowerPoint, Outlook), Atlas.ti Qualitative Data Analysis, MaxQDA, Latex

Scholarships and Awards   PhD thesis nominated for the "EPFL Doctorate award" and "The Doctoral Program Distinction (Best 8%)"
Best Sustainable Development Article Award, "First runner-up" [Link]
High Performance Scholarship (Leistungsstipendium) of the University of Vienna (2007-08, 2009-10, 2010-11)
Scholarship for participating in the European Forum Alpbach (August 2012, August 2013)
Vorarlberg-Scholarship for studying abroad 2010-2011
Erasmus Exchange Scholarship for studying abroad 2010-2011
Scholarship for participating in a linguistic program at the Linguistic University of Nizhny Novgorod, Russia (July/August 2008)

Personal Bibliography

Journal Articles

Fritz, Livia and Claudia R. Binder (2020). "Whose knowledge, whose values? An empirical analysis of power in transdisciplinary sustainability research". In: *European Journal of Futures Research*. DOI: 10.1186/s40309-020-0161-4.

Fritz, Livia and Franziska Meinherz (2020). "Tracing power in transdisciplinary sustainability research: an exploration". In: *GAIA- Ecological Perspectives for Science and Society*. In press.

Fritz, Livia, Thorsten Schilling, and Claudia R. Binder (2019). "Participation-effect pathways in transdisciplinary sustainability research: An empirical analysis of researchers' and practitioners' perceptions using a systems approach". In: *Environmental Science & Policy* 102, pp. 65–77. DOI: 10.1016/j.envsci.2019.08.010. URL: https://infoscience.epfl.ch/record/272347.

Fritz, Livia and Claudia R. Binder (2018). "Participation as Relational Space: A Critical Approach to Analysing Participation in Sustainability Research". In: *Sustainability* 10.8, p. 2853. DOI: 10.3390/su10082853. URL: http://infoscience.epfl.ch/record/256506.

Fritz, Livia and Werner Raza (2017). "Living up to Policy Coherence for Development? The OECD's disciplines on tied aid financing". In: *Development Policy Review* 35.6, pp. 20. 759–778. DOI: 10.1111/dpr.12264. URL: http://infoscience.epfl.ch/record/228432.

Book, Book Chapters, and Conference Proceedings

Fritz, Livia and Franziska Meinherz (2020). "The politics of participatory sustainability assessments: an analysis of power". In: *Sustainability Assessments of Urban Systems*. Ed. by Claudia R. Binder, Romano Wyss, and Emanuele Massaro. Cambridge: Cambridge University Press.

Meinherz, Franziska, Livia Fritz, and Flurina Schneider (2020). "How values play into sustainability assessments: challenges and a possible way forward". In: *Sustainability Assessments of Urban Systems*. Ed. by Claudia R. Binder, Romano Wyss, and Emanuele Massaro. Cambridge: Cambridge University Press.

— (2020). "Vom Öffnen und Verschließen von Alternativen: Implikationen der gesellschaftlichen Einbettung nachhaltigkeitsrelevanter Wertvorstellungen." In: *Gesellschaftliche Transformationen: Gegenstand oder Aufgabe der Technikfolgenabschätzung?* Ed. by Ralf Lindner, Michael Decker,

Elisabeth Ehrensperger, Nils Heyen, Stephan Lingner, Constanze Scherz, and Mahshid Sotoudeh. Baden-Baden: Nomos - edition sigma. In press.

Fritz, Livia (2018). "(De-)Constructing Participation in Transdisciplinary Sustainability Research: A Critical Review of Key Concepts". In: *Schafft Wissen: Gemeinsames und geteiltes Wissen in Wissenschaft und Technik: Proceedings der 2. Tagung des Nachwuchsnetzwerks.* INSIST Proceedings. 2. SSOAR, pp. 106–125. URL: http://infoscience.epfl.ch/record/256505.

Fritz, Livia, Werner Raza, Manuel Schuler, and Eva Schweiger (2014). *Export Promotion or Development Policy? A Comparative Analysis of Soft Loan Policies in Austria, Denmark, Germany and the Netherlands.* OEFSE Edition. 19. Vienna: Südwind Publishing. URL: http://infoscience.epfl.ch/record/222728.

Policy Notes and Working Papers

Fritz, Livia and Werner Raza (2014). *Living up to Policy Coherence for Development? The OECD's Disciplines on Tied Aid Financing.* Vienna. URL: http://infoscience.epfl.ch/record/222746.

— (2014). *Soft Loans as an Instrument of Development Finance: A Comparative Assessment and Options for the Future.* Vienna. URL: http://infoscience.epfl.ch/record/222747.

— (2014). *The Future of Soft Loans as an Instrument of Development Finance: an Assessment.* Vienna. URL: http://infoscience.epfl.ch/record/222757.

Conference Presentations and Posters

Binder, Claudia R., Livia Fritz, and Thorsten Schilling (2019). "Expected and experienced effects of participation –a systemic analysis of perceptions of researchers and practitioners in sustainability research". In: *International Transdisciplinarity Conference: Joining Forces for Change, Gothenburg, Sweden, September 10-13.* URL: http://infoscience.epfl.ch/record/271303.

Fritz, Livia (2019). "Tracing power relations in five sustainability research projects." In: *International Transdisciplinarity Conference: Joining Forces for Change, Gothenburg, Sweden, September 10-13.* URL: http://infoscience.epfl.ch/record/270468.

Fritz, Livia (2018). "Making spaces of participation: an enquiry into researchers' and practice actors' narrations of participatory knowledge production in sustainability research". In: *EASST 2018 Meetings – Making Science, Technology and Society together, Lancaster, UK, July 25-28*. URL: http://infoscience.epfl.ch/record/256364.

Fritz, Livia and Claudia R. Binder (2018). "The contours of participation spaces: an empirical enquiry into the making of participation in sustainability research". In: *RGS-IBG Annual International Conference 2018, Cardiff, UK, August 26-30*. URL: http://infoscience.epfl.ch/record/257142.

Fritz, Livia and Thorsten Schilling (2018). "Analysedimensionen für den Link zwischen partizipativen Prozessen und gesellschaftlichen Wirkungen in der Nachhaltigkeitsforschung". In: *Qualitäts- und wirkungsvolle transdisziplinäre Forschung – Meta-Perspektiven, Frankfurt a. M., Germany, September 25*. URL: http://infoscience.epfl.ch/record/263997.

Meinherz, Franziska and Livia Fritz (2018). "Die Politik von Wissensproduktion für eine nachhaltige Gesellschaftstransformation: eine Analyse der soziotechnologischen Wirkmächtigkeit partizipativer Nachhaltigkeitsbewertungen". In: *Gesellschaftliche Transformationen: Gegenstand oder Aufgabe der Technikfolgenabschätzung?, Karlsruhe, Germany, November 6-8*. URL: http://infoscience.epfl.ch/record/264020.

Binder, Claudia R., Livia Fritz, and Thorsten Schilling (2017). "Der Evaluationsprozess im Programm Wissenschaft für nachhaltige Entwicklung". In: *Statussymposium "Wissenschaft für nachhaltige Entwicklung", Hannover, Germany, January 23–24*. URL: http://infoscience.epfl.ch/record/226406.

Fritz, Livia (2017). "Participation practices in transdisciplinary sustainability research -an empirical enquiry". In: *2nd PhD's in Transition s Conference, Lausanne, Switzerland, April 27-*. URL: http://infoscience.epfl.ch/record/230452.

Fritz, Livia, Claudia R. Binder, Rico Defila, and Antonietta Di Giulio (2017). "A critical inquiry into participatory research practices in the field of sustainability [Eine kritische Betrachtung von Partizipation in der Nachhaltigkeitsforschung] (Poster)". In: *Statussymposium Wissenschaft für Nachhaltige Entwicklung, Hannover, Germany, January 23-24*. URL: http://infoscience.epfl.ch/record/226381.

Fritz, Livia and Thorsten Schilling (2017). "Societal impacts through participation: a critical investigation of participation as an enabler of societal impact of sustainability research (Poster)". In: *Resilience for Global Sustainability Conference 2017, Stockholm, Sweden, August 20-23*. URL: http://infoscience.epfl.ch/record/230450.

Fritz, Livia, Thorsten Schilling, and Claudia R. Binder (2017). "How do participation of practice partners and societal impacts interrelate? Perspectives from sci- ence and practice actors in transdisciplinary sustainability research projects". In: *International Transdisciplinarity Conference 2017, Transdisciplinary Research and Education – Intercultural Endeavours, Lüneburg, Germany, September 11-15*. URL: `http://infoscience.epfl.ch/record/253128`.

Binder, Claudia R., Rico Defila, Antonietta di Giulio, Livia Fritz, and Thorsten Schilling (2016). "Beteiligung an Begutachtungsprozessen am Beispiel der Begleitforschung „Wissenschaft für nachhaltige Entwicklung", Impuls-Referat an der Tagung „Kultur der Verantwortung - Transparenz in der Wissenschaft"". In: *Conference "Kultur der Verantwortung - Transparenz in der Wissenschaft", Hannover, Germany, May 11*. URL: `http://infoscience.epfl.ch/record/226453`.

Binder, Claudia R., Livia Fritz, Thorsten Schilling, Antonietta Di Giulio, and Rico Defila (2016). "Partizipation in und Transformationspotenzial von transdisziplinären Projekten". In: *Statussymposium „Wissenschaft für nachhaltige Entwicklung", Schloss Herrenhausen, Hannover, January, 23-24*. URL: `http://infoscience.epfl.ch/record/226375`.

Fritz, Livia (2016). "Bringing participation discourses into conversation: the contours of participation in sustainability research". In: *2nd Interdisciplinary Conference for Junior Researchers in Science and Technology Studies "Collaborative and Shared Knowledge in Science and Technology", Munich, Germany, October 7-8*. URL: `http://infoscience.epfl.ch/record/226380`.

— (2016). "The Contours of Participatory Dynamics in Sustainability Research at Science-Society Interface". In: *Presented at: International Sociological Association (ISA) Forum "The Futures We Want: Global Sociology and the Struggles for a Better World", Vienna, Austria, July 10-14*. URL: `http://infoscience.epfl.ch/record/226379`.

Fritz, Livia and Claudia R. Binder (2016). "Transformation through Participation? A critical inquiry into participatory research practices in the field of sustainability (Poster)". In: *International Sustainability Transitions Conference "Exploring Transition Research as Transformative Science", Wuppertal, Germany, September 6-9*. URL: `http://infoscience.epfl.ch/record/226378`.

Fritz, Livia and Werner Raza (2014). "The role of soft loans in the post-2015 agenda". In: *DAC Development Debates at the OECD, Paris, France, September*.