Futures 164 (2024) 103499

Contents lists available at ScienceDirect

Futures

journal homepage: www.elsevier.com/locate/futures

The politics of transdisciplinary research on societal transitions

Jonas House [a,b,*,1], Natalie Davis [c,1,2], Brian J. Dermody [c], Hilje van der Horst [d], Frederike Praasterink [e], Sigrid Wertheim-Heck [f]

[a] Department of Industrial Economics and Management, KTH Royal Institute of Technology, Lindstedtsvägen 30, Stockholm SE-100 44, Sweden
[b] KTH FOOD, KTH Royal Institute of Technology, Stockholm, Sweden
[c] Copernicus Institute of Sustainable Development, Utrecht University, Vening Meinesz building A, Princetonlaan 8a, Utrecht 3584 CB, Netherlands
[d] Consumption & Healthy Lifestyles group, Wageningen University & Research, Hollandseweg 1, Wageningen 6706 KN, Netherlands
[e] HAS green academy, Onderwijsboulevard 221, 's-Hertogenbosch 5223 DE, Netherlands
[f] Environmental Policy group, Wageningen University & Research, Hollandseweg 1, Wageningen 6706 KN, Netherlands

ARTICLE INFO

Keywords:
Transdisciplinarity
Transdisciplinary research
Sustainability transitions
Politics
Interdisciplinary research

ABSTRACT

Within research on societal transitions, 'post-normal' scientific approaches such as transdisciplinary research are increasingly prominent. The difficulties of interdisciplinary and transdisciplinary research are well-established, but less attention has been paid to the underlying causes of these difficulties. In this essay, we argue that the political natures of both 'transdisciplinarity' and 'transitions' themselves underlie the more visible research challenges. While recent work has outlined how transitions research, embedded as it is in the sociopolitical milieu, can reproduce or challenge existing regimes, here we discuss more specifically the politics of projects themselves, which necessarily affect how they inform societal transitions. Using literature and examples from our own work, we outline three politically contested areas in projects – stakeholder inclusion, understanding of transitions, and research questions that are considered – and identify two broad orientations that research can follow to address these: incremental or fundamental. The interconnectedness of the political aspects of transdisciplinary transitions research requires explicit attention, we argue, if such work is to effectively address complex and 'wicked' societal challenges.

1. Introduction

Social-ecological and socio-technical systems underpinning western societies face significant, interlinked sustainability crises: housing, food, water, energy, and transportation systems are under increasing pressure and implicated in greenhouse gas emissions, biodiversity loss, and pollution (Hinrichs, 2014; Ivanova et al., 2016; Lamb et al., 2021; Rockström et al., 2020; Springmann et al., 2018). Attempts to address these challenges must account for systemic complexity and the heterogeneity of actors and goals involved in the system(s) under study. Correspondingly, approaches falling under the broad category of 'post-normal science' (Funtowicz &

* Corresponding author at: Department of Industrial Economics and Management, KTH Royal Institute of Technology, Lindstedtsvägen 30, Stockholm SE-100 44, Sweden.
E-mail addresses: jhouse@kth.se (J. House), n.a.davis@vu.nl (N. Davis), b.dermody@uu.nl (B.J. Dermody), hilje.vanderhorst@wur.nl (H. van der Horst), f.praasterink@has.nl (F. Praasterink), sigrid.wertheim-heck@wur.nl (S. Wertheim-Heck).
[1] Joint first authors.
[2] Current address: Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam, De Boelelaan 111, Amsterdam 1081 HV, Netherlands

https://doi.org/10.1016/j.futures.2024.103499
Received 24 May 2024; Received in revised form 11 September 2024; Accepted 29 October 2024
Available online 30 October 2024

Ravetz, 1993; Kønig et al., 2017) are becoming more widely used to address the 'wicked problems' that society faces.

Post-normal science is an approach rather than a prescriptive methodology, encompassing research that is "critical and reflective, uncertainty-aware, quality-focused, foster[s] plurality in scientific and normative perspectives on complex issues, and actively engage [s] extended peer communities in the production, appraisal and use of knowledge" (Dankel et al., 2017: 1). Post-normal approaches – including living labs (Engels et al., 2019), citizen science (Wildschut, 2017) and transdisciplinary research (Gugerell et al., 2023) – integrate diverse academic and non-academic knowledges and methods (Holbrook, 2013) to deepen system understanding and representation, incorporate stakeholders' goals and visions for future systems, and increase legitimacy and ownership of proposed solutions (Lang et al., 2012). Transdisciplinary research in particular has become a prominent focus of research seeking to elucidate possible, probable and desirable futures (e.g. Rinaldi, 2023), or with the broader aim to understand and govern sustainability transitions (e.g. Schäfer et al., 2020). Despite the advantages of this approach, it also – as we explore further below – brings a range of particular challenges. Many of these, we suggest, are likely to be symptomatic of underlying political issues within transdisciplinary collaboration.

In this essay we argue that the main challenge facing transdisciplinary transitions research projects is the highly political dimensions of both 'transdisciplinarity' (Klenk & Meehan, 2015; Kok et al., 2021) and 'transitions' (Avelino et al., 2016, Frankowski et al., 2021; Meadowcroft, 2011).[3] Further, the combination of the two raises numerous ethical, political, and practical challenges. These challenges are not insurmountable, we argue, but require explicit agreements to be made, in the formative stages of projects, if they are not to become practically problematic. Our arguments are based on existing literature on systems transitions and transdisciplinary research, and our own experiences as researchers on a large, transdisciplinary project focused on food system transition.

What does 'politics' mean in this context? Here we understand politics as the interpersonal and organisational processes by which power is realised (Busch & Lacy, 2019). Following Fritz and Meinherz (2020) we understand power in knowledge production as encompassing *power over*, which refers to control exerted over others; *power to*, which refers to the ability to achieve things despite resistance ('empowerment'); and *power with*, which refers to processes of collective learning and action to achieve shared ends.

In what follows, we first explore relevant debates around managing transdisciplinary research and further elaborate how politics and power are conceptualised in this paper. We then turn to our central analysis, outlining three key areas of transdisciplinary transitions research that exemplify political contestation. Building on this, we argue that transdisciplinary transitions research should explicitly address its political dimensions if collaboration is to be effective in achieving project aims, and illustrate potential tensions with an example from our own project. We then identify two broad political orientations transdisciplinary transitions research might adopt, indicating the opportunities each affords. In concluding, we reflect on the implications of this analysis for the role of transdisciplinary projects in sustainability transformations. Finally, we offer general suggestions for how researchers might begin to approach the politics within transdisciplinary research on societal transitions.

2. Transdisciplinary transitions research: practical and political challenges

Although transdisciplinary research has clear advantages as an approach to tackling complex societal issues (Newig et al., 2019), it also brings a range of challenges that are particularly pronounced in comparison with mono-disciplinary work (Brandt et al., 2013). These include terminological and methodological differences across disciplines and between academic and non-academic stakeholders, academic pressure to produce mono-disciplinary work (especially for early-career researchers, see e.g. Kelly et al., 2019) while satisfying transdisciplinary project goals, and project management challenges, such as misaligned research timelines (e.g. Pischke et al., 2017). There is a considerable literature on best practices for structuring interdisciplinary[4] and transdisciplinary work (Bergmann et al., 2021; Szostak, 2013; Tobi & Kampen, 2018), which offers solutions for these challenges, focusing especially on communication-related issues. These include transdisciplinary facilitators (Wang et al., 2019) and integrators (Deutsch et al., 2021, Hoffmann et al., 2022), structured dialogue tools and team-building (Freeth & Caniglia, 2020; Pischke et al., 2017; Winowiecki et al., 2011), boundary objects, and collective glossaries (von Wehrden et al., 2019). Frameworks have also been developed to address project management of inter- and transdisciplinary collaborations (König et al., 2013; Pricope et al., 2020), and to explore and manage transitions through iterative, experimental cycles that are monitored, evaluated, and improved upon over time (e.g. Loorbach, 2007; Loorbach & Rotmans, 2010).

For example, recent work has proposed including one or more members of the project team to act as 'integrators' (e.g. Hoffmann et al., 2022) to build bridges among project stakeholders, translate across disciplinary and non-academic terminology, combine insights from different approaches, and facilitate collaborative and co-creation processes, among other roles. However, this role has not yet been institutionalised, and therefore funding may not be available to include specific team members for this purpose (Deutsch et al., 2021, Hoffmann et al., 2022). All project members must also be willing to participate in the integration process to co-create project processes and outcomes. Therefore, to be effective, integrators must necessarily go beyond combining knowledge and instead focus on mediating and addressing interpersonal, interdisciplinary, and transdisciplinary conflicts. To date, the literature on integration and other best practices in inter- and transdisciplinary collaborations has not directly addressed paradigmatic differences

[3] We recognize that some aspects of the research may not directly engage with these political issues. However, our focus here is on overarching project aims and the deliverables linked directly to those.

[4] Here, we use the definitions of Holbrook (2013) to distinguish between interdisciplinary as collaborations among researchers from two or more distinct disciplines, and transdisciplinary as including non-academic stakeholders as well, such as partners from industry, government, or a local community. The focus of this paper is the latter.

(in epistemology, ontology, and methodology) and prescribed or perceived power differences between academic disciplines (Gardner, 2013; Jahel et al., 2023; Turnhout et al., 2020) that are likely the underlying challenge for integrators, project managers, and indeed, all project members. These differences can arguably be exacerbated in transdisciplinary research (Gaventa & Cornwall, 2008), with power-related tensions between research processes and the social, cultural, and institutional milieu in which they are embedded; between roles of academics in the process; and between members of the collaborating 'extended peer community' or experimental arena (Strumińska-Kutra & Scholl, 2022). While not yet discussed within the context of transdisciplinary research projects, we suggest that the politics around transitions and transformations[5] themselves (Shove & Walker, 2007) likely underlie the more visible miscommunications and disciplinary conflicts in these projects.

Our argument builds on work that emphasises the importance of addressing how power operates in transdisciplinary research (e.g. Fritz & Binder, 2020; Strumińska-Kutra & Scholl, 2022), especially insofar as it affects stakeholder inclusion (de Geus et al., 2023) and the collective definition of problems and goals (Fritz & Meinherz, 2020). Building off of these analyses, we adopt a broader view of the political dimensions of transdisciplinary transitions research, encompassing both long-term and project-specific power dynamics. Long-standing power dynamics are difficult – if not impossible – to address directly within the scope and timeframe of most research projects, though attempts to promote representational and procedural justice within a project often aim to change power relationships in the aspects of future societies on which the project focuses (e.g. Marshall et al., 2018). Even then, however, the politics of the project itself must still be managed. Whose ideas shape the design and aims of the research? Where will attention be directed, and to what end? Who should the research be 'for' (e.g. Busch & Lacy, 2019)? Such issues are crucial, as the power dynamics animating project politics shape the imaginable, possible, or desirable futures explored in that project, and therefore also in society more broadly (Hawxwell et al., 2024). Indeed, whether expressly intended or not, research projects can and do act as proto-governance mechanisms, shaping the terms of the debate around possible and desirable futures (e.g. Hawxwell et al., 2024; cf. Borup et al., 2006).

Political considerations of the type discussed above have motivated researchers to develop new ways of working that can account for the role of research and researchers in broader societal transformation (e.g. Scholz, 2017). Prominent among these is the literature on transition management, a broadly post-normal scientific approach that foregrounds the role of projects in designing, monitoring, and reflexively shaping transitions over time. Initially developed in the Netherlands around the millennium (see Kemp et al., 2007, Loorbach, 2010), transition management seeks to engender and manage transitions in key societal domains (e.g. energy, transport) by bringing interdisciplinary scientific insights (e.g. history, modelling, innovation studies) to bear on applied sustainability challenges in a collaborative and reflexive process (Meadowcroft, 2009). Although transition management is one among many post-normal approaches – and not the specific focus of this paper – we discuss it briefly here, as it provides a useful illustration of debates around the political dimensions of post-normal science.

While a stated aim of transition management is to address issues of politics and governance, the approach has also been criticised for its *lack* of engagement with the political (e.g. Kenis et al., 2016, Kern & Smith, 2008, Meadowcroft, 2011; see also Avelino et al., 2016). We do not stake a claim to either side of this debate, which is beyond the scope of this paper. However, one aspect of it has substantial implications for transdisciplinary research on societal transitions more broadly: the politics of the 'transition arena', a central element of the transition management process. The transition arena is a researcher-led space in which a group of 'frontrunners' (Loorbach, 2010) come together in the "co-production of a common language and future orientation" to guide the transition process (Loorbach & Rotmans, 2010: 237). This includes the collaborative definition of a particular transitions issue, development of a future vision, and identification of specific objectives (Loorbach, 2010). Crucially, however, the politics of the transition arena are often glossed over. As Voß and Bornemann (2011: 10) observe, "it is unclear how exactly, and through which mechanisms, the political process is linked to the transition arena and how it relates to the goal-setting activities that take place within the arena" (see also Hölscher et al., 2019, Meadowcroft, 2009). Indeed, this and subsequent stages of the transition management process – and their equivalents in projects more broadly – are likely to be politically fraught, beset by the kinds of issues highlighted in the debates on integration and the process of transdisciplinary research that we discuss above (Shove & Walker, 2008; see also Busch & Lacy, 2019).

A distinction is evident here that is germane to our argument. Transition management focuses, generally speaking, more on what we might term 'big P' politics: that is, politics as they relate to the broader sociopolitical (and party-political) context in which projects (and transitions) take place. This includes, for example, an explicit focus on policy and associated emphasis on traditional governance actors. Other approaches, such as debates around integration in transdisciplinary research, focus on political dimensions *within* projects: the kind of interpersonal, organisational, and bureaucratic issues that might be termed 'small p' politics. These have received relatively little attention, despite their influence on the process and outcome of transdisciplinary research. Such 'small p' political dimensions of transdisciplinary research on societal transitions must be addressed, we argue, if projects are to succeed. In particular, the 'small p' political dynamics are likely to have a considerable bearing on the ways in which projects can reproduce – or challenge – existing regimes (cf. Hawxwell et al., 2024). Despite this focus, we also briefly consider implications for the relationship between 'small p' and 'big P' politics in the closing stages of the paper.

In the remainder of the paper we elaborate our core argument, drawing on existing literature and our own experiences of participating in a transdisciplinary research project focused on transitioning to a sustainable food system in the Netherlands. Rather than providing a systematic review of examples, we use this project as a vignette to help illustrate some of the key concepts in our arguments. Following a brief introduction to the project, we begin our analysis by identifying three key areas of political contestation.

[5] While we acknowledge the contested distinction between these terms (e.g. Hölscher et al., 2018), our arguments in this paper apply to both. For the sake of simplicity we use 'transitions' hereon.

2.1. The project

The stated aim of our project was to provide the Dutch government with possible pathways, and analysis of synergies and trade-offs across them, to expedite the transition to a sustainable Dutch food system. The project was funded by the Dutch research council. It started with a 'sandpit' – a multi-day collaborative workshop – whose objective was to develop a transdisciplinary research proposal addressing the above aim. Participants were selected in two ways: individuals were either identified and approached by the funder in an effort to intentionally 'curate' novel collaborations, or had independently submitted motivation letters. This resulted in the inclusion of researchers from a range of disciplines – including soil science, wildlife ecology, nutritional epidemiology, consumption sociology, trade modelling, agent-based modelling, and governance – as well as societal partners from industry and NGOs. The participants grouped themselves into collaborative work packages focusing on the current food system, visions for the future food system, regional approaches, modelling and quantitative analysis, and development of the final 'acceleration agenda,' which brought together insights from each of the disciplines and work streams.

3. Underlying challenges

Using this project and the literature for examples, we here explore three key areas of political contestation associated with transdisciplinary transitions research: (i) who is included in the research, along with when, why and how; (ii) how 'transition' is understood; and (iii) what questions researchers are willing or able to explore based on their personal values and knowledge. These are not the only three areas of political contestation that such projects may face, and indeed the extent to which these issues arise will naturally vary between projects and transitions. However, these three areas capture a set of prominent themes in relevant literature, which were borne out to a significant extent in our own research. By elaborating them here, we provide a basis for understanding how some of the most pressing 'small p' political issues facing transdisciplinary research may arise.

3.1. Who is included, how and why?

The first highly political dimension of transdisciplinary transitions research we discuss relates to who is included, how, and to what extent. This applies both to who *participates* in the project and to who the project is *for*, which are not necessarily the same.

One issue relates to who is involved in shaping and conducting research. The disciplines and stakeholders represented determine the paradigms and types of knowledge involved, which ultimately shape the outcomes. For transdisciplinary transitions research, including non-academic stakeholders can increase the representational justice (cf. Jenkins et al., 2016) of planned transitions. While this can help achieve more just futures, creating a just transition demands careful attention to identifying and including marginalised groups and addressing power dynamics (Fritz & Binder, 2020; Turnhout et al., 2020). This connection between project ('small p') and sociopolitical ('big P') politics is complex and requires careful attention: for example, whereas groups that have been recognized as historically marginalised may be easier to identify and explicitly include, other groups may be excluded from projects in perpetuation of unacknowledged exclusion. However, even attempted inclusion does not always work, as some groups do not want to be included, or cannot participate in the same manner or to the same extent as others.

Specifically, some actors may be challenging – if not impossible – to include, based on the design of most participatory processes. Groups such as future generations; those in other countries connected by global trade networks to the focal system, or threatened by climate change linked to the focal system; and non-human animals, are all clearly impacted by current and future systems, but cannot usually be included directly. The means of stakeholder inclusion determine how much they can shape research, engage with decision-making based on the results, and retain ownership and use of outcomes (van Bruggen et al., 2019). Without explicit consideration and the support of the overall project design, which may be finalised before full stakeholder analysis and inclusion processes can begin, balancing these different ways of including and representing diverse groups is challenging. Despite best intentions, participatory processes can easily reflect and reinforce current system power dynamics (Chambers et al., 2021; Fritz & Binder, 2020), especially if those benefiting from current unsustainable systems are (over)represented in decision-making processes.

Within our project, considerable effort was made to include or represent the interests of diverse stakeholders. For example, project researchers developed 'a cow-human citizen's assembly' (van Veen & Helvoirt, 2024), where participants used embodiment exercises and individual and group reflection to design more just futures for non-human animals and future generations. However, due to funding and time constraints, competing interests (e.g. proprietary data), or the fact that the project was not their priority, many societal partners involved in the original research plan did not actively participate in the project long-term or extensively, which limited the extent to which their perspectives and insights could be incorporated. Another important stakeholder inclusion issue related to the 'curation' phase of the project (see Section 2.1). As a result of the dynamic between external 'curation' of participants and individual applications to join the project team, certain disciplines were ultimately more represented (e.g. ecology) than others (e.g. food safety).

Beyond who is included in designing and conducting research is the question of who research is intended to benefit (Brons et al., 2022), or indeed disadvantage (e.g. Frankowski et al., 2021). This relates to the question of project aims and outcomes, and whether those focus on co-producing and delivering solutions or creating a space for empowerment. In some projects, academic stakeholders step back into facilitating roles to actively empower traditionally marginalised voices, enabling pluralism and informed dissent rather than enforcing agreement and consensus (see review in Turnhout et al., 2020). However, in most large, externally funded projects, there is arguably pressure to produce clearly defined deliverables over more discursive and pluralistic outcomes (cf. Luka et al., 2015).

3.2. How are transitions conceptualised?

The next area of political contestation is the difference in how project partners (i.e. researchers and societal stakeholders) conceptualise 'transition;' that is, how social change arises and who is responsible for it. Differing ideas of transition entail differing roles and responsibilities for diverse social actors, including citizens, politicians, businesses, and researchers (Lamine et al., 2019). Exact specifications of what 'transition' involves are likely to vary widely, and project partners may not explicitly engage with the notion at all. However, three broad tendencies can be identified in how transitions are commonly conceptualised: individual, multi-level, and complex. These heuristic categories are not intended to account for all theories related to social change, but rather describe prominent trends that, as we discuss later in the paper, will play a role in how project politics are negotiated. Project-specific 'Theories of Change' – "a mapping of steps towards a desired long-term goal supplemented with continuous reflection on how and why change is expected to happen in a particular context" (Deutsch et al., 2021: 29) – will be informed, whether explicitly or not, by more general theoretical ideas about how social change occurs (Reinholz & Andrews, 2020; see also Section 4.4). We explain each of the three tendencies in turn, alongside their respective implications for how transitions can be imagined and governed.

The first view of transitions conceptualises them – usually implicitly – as the aggregate of shifts in 'individual behaviour.' This is prominent within Western policy debates and significant portions of academic research (e.g. economics, psychology), which often share an understanding that human activity derives from individual psychology. Although such work does not typically engage with the concept of 'transitions,' its implicit understanding of social change (cf. Fuchs et al., 2016) is commensurate with a view of transitions as essentially the result of changing people's minds, or enabling them to 'make better choices' (Barr et al., 2011; see also e.g. European Commission, 2023, Nguyen & Johnson, 2020). Framing transitions as a matter of individual agency has significant implications for the *kind of transition that can even be imagined* in a transdisciplinary transitions project: if transitions are understood – implicitly or otherwise – as driven by individual attitudes, values, and behaviour, transitions are seen as steerable. Corresponding governance mechanisms will focus on educating, nudging, or convincing individuals: whether consumers, policymakers, or other social actors (e.g. Lubowiecki-Vikuk et al., 2021; cf. Shove, 2010).

Contrasting with this methodologically individualistic approach is a multi-level conceptualisation of transitions as evolving from system-wide shifts across multiple domains (e.g. technology, culture, and politics). A prominent example is research on sociotechnical transitions, in particular the 'multi-level perspective' (henceforth 'MLP') (Geels, 2002, 2005; Geels & Schot, 2007). This approach conceptualises transitions as shifts in dominant sociotechnical regimes that are an incremental process, shaped by interactions between niche innovations, the 'landscape' of structural trends, and the sociotechnical regime itself. In the MLP, transitions evolve from interaction between the different 'levels,' a view in which the place of individual agency is rather attenuated. Indeed, the MLP has been criticised for its lack of specificity as to the role of individual agency in transition processes (Huttunen et al., 2021). Given the MLP's theoretical antecedents in evolutionary accounts of social change, it entails a relatively diffuse view of power and responsibility in system transition: not least because the sociotechnical regime itself involves markets and user preferences alongside a range of extra-individual factors, such as industry, policy, science, technology, and culture (Geels & Schot, 2007). This implies a quite different set of appropriate governance mechanisms to the individualistic approach: for example, protected spaces and funding for niche innovations (Smith & Raven, 2012). Building off of this model, transition management considers how specific actors – typically in policy or scientific positions instead of, for example, consumers – can help to bring about change (Hölscher et al., 2019, Shove & Walker, 2007). In this sense it is arguably closer to the individualistic conceptualisation of social change. In any case, both these iterations of the multi-level approach involve distinct notions of agency and responsibility for governing societal transitions.

A third way of conceptualising transitions takes a complex systems view: transitions emerge from interactions among actors, and between actors and the system itself. Rather than situating agency at the level of the individual, or separating individual actions from the system state, this approach views actors as both constrained by and creating the system through their actions (e.g. DeLanda, 2016; Shove & Walker, 2010). Notably, this understanding of transition raises governance challenges: emergence is impossible to predict from characteristics or states of individual actors in the system, with endogenous development of new actors and entities in complex systems rendering long-term predictions irrelevant (Polhill et al., 2021). Attempts to manage complex systems, and particularly transitions within them, are marked by unexpected and unintended outcomes (Latour, 1996). The unpredictability of complex systems is what initially gave rise to post-normal science, with its focus on reflexivity, experimentation, and co-production, possibly blurring the boundaries between what is governance and what is research (Funtowicz & Ravetz, 1993). One such example is the co-production and reflexive evaluation of urban food policies (e.g. Mangnus et al., 2019, Vara-Sánchez et al., 2021).

Our point here is that transdisciplinary projects will inevitably involve research components with distinct conceptual frameworks, and thus different assumptions regarding human activity and the nature of social transformation, whether expressed explicitly or not. As we will argue later, conceptual plurality does not have to frustrate collaboration. However, it can complicate efforts to agree on a project's overall objectives, consensus around which is crucial for project success.

3.3. Which aims may be considered?

The final political dimension of transdisciplinary transitions research we discuss is shaped by the aforementioned differences in how 'transitions' are conceptualised. What researchers may be willing to explore related to possible futures – such as the kind of futures that can be considered – are also highly politicised. Bringing these together within transdisciplinary research projects can quickly frustrate collaboration if not explicitly addressed.

For example, the issue of how societal change may be achieved relates to which transition governance measures are *politically acceptable*. Within research this raises an issue for project teams: which levers or mechanisms are we willing to explore, and suggest, as

a transition governance mechanism? The issue is compounded by adjacent political influence, such as from commissioning or funding organisations. Our project, for example, was ultimately funded by the Dutch government. Accordingly, there was an expectation that we would engage with a range of stakeholders, including large sectoral actors, which implicitly shaped the scope and extent of transformation mechanisms that we were able to propose. Similarly, in co-funded projects, or those related to national innovation agendas, it is unlikely that project partners would propose radical limitations to capitalist enterprise in order to achieve sustainable system transformation – despite the potential scientific case for such a position (e.g. Gunderson, 2014; Stuart et al., 2020).

Similarly, the anticipated *outcome* of a project, and what is considered 'successful,' may differ widely in ways that are shaped by personal, professional, and disciplinary politics. Project partners will vary in what they regard as a feasible and desirable outcome of a project, which may complicate research. In our project, for example, anticipated (or hoped-for) outcomes ranged from relatively modest adjustments to the 'choice architecture' of consumption to the reconfiguration of supply chains. Projects involving partners with divergent understandings of what a transition is (see Section 3.2) – which, given the nature of transdisciplinarity, is likely to be a significant proportion of them – are likely to involve corresponding differences in anticipated outcomes. Project partners with an individually-focused understanding of transitions, for example, may strive to produce a set of consumer guidelines, whereas partners with more complexity-oriented views may focus on facilitating interactions and networks to spread new ideas and value systems.

Professional politics also affect transdisciplinary research. Put bluntly, global corporations are unlikely to collaborate with community ownership advocates in envisioning shared ideas of a sustainable future. In more mundane terms, the aims of even broadly aligned actors are difficult to reconcile if their professional orientations and expectations fundamentally differ. Our project exemplified this, in that collaboration between societal advocates of particular products and social scientists was hampered by irreconcilable differences in what each party expected research to generate (i.e. actionable commercial insights into specific products vs. empirical insights into societal change more generally).

Anticipated project outcomes are also subject to disciplinary political differences, specifically with how much different disciplines are influenced by individual ethics. For a modeller, an appropriate project output may be the elaboration of a range of possible scenarios, whether or not the modeller personally regards them as politically or ethically desirable. In contrast, for a critical social scientist, certain scenarios may perhaps not even be explored based on normative grounds. The implications of personal, professional, and disciplinary political differences are the same: it is impossible to effectively collaborate (i.e. achieve project goals) if these issues are not recognized and explicitly addressed, a point explored further below.

4. Political orientations for transdisciplinary transitions research

Thus far we have discussed a number of commonly identified challenges with transdisciplinary collaboration (Section 2). We suggested that while these require attention, they are more symptom than cause when it comes to transdisciplinary research challenges. We argued that the inescapably political nature of transitions research raises fundamental challenges to transdisciplinary collaboration (Section 3). These relate to (i) who is involved, how, when, and why; (ii) how transitions are conceptualised; and (iii) which aims may be considered.

In this section we ask: what now? What are the implications of this for transdisciplinary transitions research, which evidently remains essential for societal transformation?

Here we argue that many challenges facing transdisciplinary transitions research could be addressed at an early stage by reaching explicit agreement on *what projects are supposed to achieve, for whom, when, and why*. While this may sound rather self-evident – few projects, we imagine, proceed without a clear idea of their objectives – it is the *political* dimensions of these decisions (both implicit and explicit) that require elaboration and agreement by project partners. If these remain unexamined, the articulation of superficially common project objectives may provide illusory coherence while masking fundamental differences, which may be ethical, epistemological, and indeed ontological.

We suggest that, broadly speaking, there are two main approaches (hereon, political orientations) relating to transdisciplinary transitions research, which we term the 'incremental' and 'fundamental' approaches. These are not rigid, all-encompassing categories but rather ideal types, which illustrate the ordering logics through which research may be configured and political differences managed and aligned. Simply put, the incremental approach involves accepting and working with the status quo in the near term, whereas the fundamental approach involves working against it – at least in terms of explicit calls for immediate social and political change that are absent in the incremental approach. Correspondingly, while both share the ultimate goal of system change, they also differ in terms of the scale and pace of desired change.

It is incumbent upon transdisciplinary collaborators, we argue, to agree on which of these orientations will be addressed and how to do this, which should be committed to throughout the lifespan of a project. Projects may well seek to include aspects of both, but this still requires careful planning and active management to allow for effective collaborations. We explore each orientation in turn, drawing out implications for projects and potential outcomes. We then provide examples from our own project, which did *not* explicitly commit to either orientation or a combination thereof, and experienced challenges as a result.

4.1. Political orientation #1: The incremental approach

The incremental approach within transdisciplinary transitions research involves accepting and working with the status quo, at least in terms of the current system configuration, and primarily considering the studied system separately from the broader societal context and related systems. Accordingly, anticipated project outcomes are incremental. They are relatively small, concrete steps towards system change at some unspecified point in the future – such as developing or reformulating food products – that do not demand an

immediate wholesale reconfiguration of social, economic and political relations (cf. 'degrowth').

This approach has particular implications for the aforementioned areas of political contestation. In terms of who is involved (Section 3.1), this approach is more likely to suit established current system actors who could benefit from incremental change. They may, for example, stand to benefit politically from being involved but also profit from maintaining or only slowly changing the overall structure of the current system. Moreover, practical constraints on projects (as discussed below) may favour including stakeholders who are easy to identify and with whom relationships already exist, especially if these stakeholders have sufficient resources (money, time, workforce) to fund their own involvement in a project. While theoretically relatively agnostic regarding how transition might be conceptualised (Section 3.2) – the principle of incremental change could apply equally to consumer behaviour or specific policy instruments, for example – this approach is more likely to be aligned with the individualistic model of transition, due to its emphasis on minor modifications within largely unchanged systems. Among the multi-level conceptualisations of transition, transition management arguably aligns more closely with the incremental orientation, as it emphasises the role of specific actors and governance mechanisms. The complex systems conceptualization may not obviously lend itself to an incremental approach: however, many methods linked to the complex systems conceptualization (e.g. agent-based modelling, participatory action research) can still be applied to understanding outcomes of more specific interventions, such as taxes on food products. The incremental approach has a much stronger bearing, however, on a project's operating assumptions about which aims may be considered (Section 3.3): namely, that levers or interventions should be modest and politically acceptable (vis-a-vis the status quo), aiming for stepwise rather than radical change.

There are many reasons why this political rationale might be considered for transdisciplinary research. Here we outline four examples. First, the politics of funding. If a project is state funded, for example, expected outputs are likely to be palatable, feasible, and useful for policymakers. Second, researchers may strive to meet these criteria (or associated ones, such as commercial product development) but without direct external influence. This potentially leads to 'plug and play' research insights with immediate impact, or at least the potential thereof. Third, this approach arguably makes research easier, in the sense that project parameters are pre-established: for projects with smaller funding and workforce allocations, shorter timelines, or both, an incremental approach may indeed be the only feasible option. This also relates to the stakeholders included and project aims, as described above. For example, in such terms it is not the entire food system that requires rethinking, but rather what meat-reduction interventions might look like. Fourth, researchers' personal politics might be 'pragmatic' and align with this approach, or they may be willing to 'park' more idealistic views in favour of more modest but tangible and potentially feasible change.

However, there is a risk that more incrementally-oriented projects can actually reinforce or be co-opted by current unsustainable regimes (Hawxwell et al., 2024, Pel, 2016): in such cases, projects may not only fail to make meaningful progress towards sustainability goals, but in fact impede it. While these projects could be valuable in developing smaller innovations that contribute to more fundamental changes, or 'trojan horses' that can ultimately induce quite radical change despite appearing to align with the status quo (Pel, 2016), careful planning is required to ensure incrementally-oriented projects are still effective. The burden of proof should rest with each project to carefully consider and justify how an incremental orientation is truly contributing to sustainability transitions.

For example, in our own project, an incremental orientation would likely have involved focusing on efforts to shrink the resource use and greenhouse gas footprint of the current food system, while maintaining its overall structure. This could include integrating technological innovations to improve yields, convert manure into energy, reduce food waste, and implement biodegradable packaging. While all of these are certainly improvements to the current food system, it remains possible that they will have little effect on overall system sustainability: or worse, that temporary increases in efficiency provided by these and similar changes could eventually be overtaken by increases in resource use (Paul et al., 2019; see also Guzzo et al., 2023). The transition to a sustainable food system, therefore, may never truly occur, or may need to be re-established as a system evolves around newly established incremental changes.

4.2. Political orientation #2: The fundamental approach

The fundamental approach to transdisciplinary transitions research involves, by contrast, not accepting the system status quo, and thus working against it. To 'work against' here means to seek far-reaching, meaningful change, potentially across multiple system domains (Liu et al., 2018), and can involve challenging current regimes, developing alternatives, or both (Hawxwell et al., 2024). Such research may be less focused on immediate, implementable results than on providing grounds for long-term transformation via system reconfiguration.

This approach has particular implications for the areas of political contestation outlined above. Selection of project partners (Section 3.1) is more likely to encompass more marginal voices and radical perspectives than the incremental approach, and projects themselves may be oriented around empowering and elevating these voices (Fritz & Binder, 2020). The fundamental approach is inherently systemic, which usually entails a conceptualisation of transition as evolutionary or emergent (Section 3.2). Its understanding of transitions is therefore unlikely to align with the individualistic perspective, in which societal actors' behaviour is central (Section 3.2). The aims considered in such a project will reflect this. Proposed levers or mechanisms for change are likely to be further-reaching and more politically risky (e.g. implementation of a true price scheme or changes to the legal structure of land use and tenure) (Section 3.3).

As above, we provide four (non-exhaustive) examples to illustrate how and when the fundamental approach can be an appropriate political orientation for a transdisciplinary research project. First, it explicitly includes the recognition and analysis of power (e.g. Fritz & Binder, 2020; Turnhout et al., 2020). Power is largely beyond the scope of some disciplines (e.g. biology) but central for others (e.g. human geography); others are more flexible (e.g. modelling; see Section 2). Project orientations towards fundamental change may be more appropriate for those including disciplines that explicitly engage with power. However, this does not preclude transdisciplinary

collaboration with partners without disciplinary commitments. This is a question of what a project hopes to achieve, in which consortium members' conceptualisations of power should be explicitly addressed in the design stage. Second, far-reaching or radical solutions may be mandated. We suggested above that particular funding schemes may implicitly favour incremental solutions, but conceivably a project's funders – including the state – may instead demand radical proposals for achieving societal transitions. Third, personal politics may also play a role. In contrast to the 'pragmatic' incremental approach, project partners in the fundamental approach may be more inclined towards radical change.

Finally, and most importantly, there is a scientific case for fundamental change: 'business as usual' represents a terminal problem for humanity (e.g. IPCC, 2023). Projects truly aimed at transitions toward sustainable futures, and ameliorating the pressures and crises in current systems, arguably must at least consider fundamental change.

In our project, pursuing a fundamental orientation could have involved exploring pathways toward restructuring production, consumption, and supply chains, such as reconfiguring systems in line with degrowth economics (Guerrero Lara et al., 2023), promoting and facilitating agroecological production methods for sustainable and healthy diets (Frison & Clément, 2020), and exploring new forms of land tenure and multi-use management (Goris et al., 2024). These would target the root causes of the impacts of the food system, rather than the immediate effects. In doing so, there could be a danger of not reducing greenhouse gas emissions and resource use quickly enough to address the very immediate threats of climate change and resource depletion, due in large part to the political resistance that such strategies would likely face. However, these and similar strategies may also be necessary to more holistically counteract the injustices in the current food system (Kaljonen et al., 2021). Notably, even fundamental changes may still rely on knowledge established within more incremental efforts, such as yield improvements and food waste reduction, to be feasible and successful (Navarre et al., 2023).

4.3. Competing political orientations: 'scenario' development

The two approaches outlined above are ideal types, intended to broadly capture the political orientation a transdisciplinary project might take. Naturally, the specifics of a project's 'real life' political objectives will evade such simplistic categorisation. While the two approaches are both potentially viable and realistic general orientations for transdisciplinary transitions research, in our view, a fundamental approach is ethically mandated unless there are compelling practical reasons to moderate a project's objectives. However, our core argument is that the political orientation of a project needs to be actively negotiated and managed by project partners. If not, latent and implicit political differences are likely to frustrate collaboration and limit impact.

To illustrate, we discuss an example from our own research project. One of our project's key deliverables was, as described in the grant application, the development of "one or more future scenarios for a sustainable food system." This was the objective of a dedicated work package, which sought to develop a set of scenarios based on "expert and lay stakeholder consultations" accommodating a range of factors, such as agricultural production, climate, environment, ecosystem services, animal welfare, local/global markets, food quality, food consumption, health parameters, and the 'new menu' (i.e. the EAT Lancet diet: see Willett et al., 2019). The scenarios were then to be analysed with both natural- and social-scientific methods to quantitatively and qualitatively "explore the boundaries, trade-offs, pain points and added value of the scenarios."

As coherent and feasible as these objectives might sound, they proved challenging, due to aspects related to the areas of political difference addressed above: surface-level terminological differences, different understandings of transitions and how to govern them, and different ideas of project aims regarding incremental versus fundamental change.

The first problem was superficially a matter of terminology, a commonly identified issue with transdisciplinary research (see Section 1). Namely: what is a scenario? In sociology, for example, the term has no fixed meaning, but often refers to a general 'anticipated state of affairs.' Thus 'futuring' methods – intended to explore plausible, possible and desirable visions of the future – often involve the development of 'scenarios', understood as imaginative vignettes exploring the consequences of possible societal trends: such as a future without cars, or where food production is state-controlled. In agent-based modelling, however, a 'scenario' refers to changes of model's design or parameterization, such that the agents' behaviour, the context with and within which they interact, or both, are changed. Different future states are thus explored through deliberate manipulation of variables and assumptions, elucidating what might happen to the system if particular aspects of it change. However, beyond the obvious methodological differences underlying these speculative endeavours (i.e. acts of creative extrapolation based on human imagination vs. projections of change based on quantitative empirical data), and attendant questions about how these might be reconciled, are a wider set of issues around the politics of transdisciplinary collaboration. These are captured by the second and third challenges we discuss here.

The second major challenge relates to different understandings of transitions and how they may be governed (Section 3). This is impacted by whose voices are included and privileged in the project (Section 3.1), such as whether scenarios are generated collaboratively with diverse stakeholders, or developed by a panel of academic experts. In the three conceptualisations of transitions discussed, explorations of future states usually include starting points (e.g. the 'scenario axes' technique; see van 't Klooster, van Asselt, 2006), that shape and constrain imagined future states, and ideas of potential interventions to help reach a preferred state. However, the approaches differ in how much they assume individuals and systems are predictable and steerable, and therefore how strong the relationship is between a given intervention or governance mechanism and the desired outcome. Specifically, the individualistic perspective, which assumes a high level of agency and cognition-driven action, therefore assumes that individual-level interventions have relatively straightforward behavioural outcomes. Starting from a desired end state, targeted governance mechanisms can move the system – via individual action – from current to desired state. For example, a scenario may include education and awareness-raising encouraging individuals to adopt more sustainable diets. In contrast, a complexity perspective on transitions, which assumes that emergent dynamics mean outcomes may be difficult – or impossible – to anticipate, does not assume clear causality between

interventions and (desired) outcomes. Instead, multiple scenarios can be explored to see which are more likely to result in a desired end state, and analyse the trade-offs and synergies across relevant interventions. For example, a scenario may include changing price structures around different food groups, and analysing the impacts of this on different income groups.

The third – and arguably underlying – challenge is the basic distinction between incremental and fundamental change. What is the project hoping to achieve, on what timeframe, and what sort of scenarios (in terms of scope and scale of change, as well as target audience) might therefore be entertained? Lack of explicit agreement around this point led to confusion in our project, as proposed scenarios varied widely: ranging from near-term dietary modifications to abolition of animal agriculture (see Section 3.3). Both of these, we emphasise, are potentially valid lines of enquiry. However, as the scenarios were meant to form the basis of further quantitative and qualitative analysis, the proposed scope of system change needed to be similar across them, even if multiple scenarios were eventually explored. Without a clear sense of a project's basic political orientation, and development of shared goals and normative frameworks (Cairns et al., 2020), effective collaboration is difficult.

4.4. How to move forward?

How then to address these challenges? Discussing the place of politics (whether personal or disciplinary) in a project, and collective agreement on the project's general political orientation, is crucial. Research consortia could adopt different strategies to achieve this. For example, a consensus strategy, in which political differences are 'parked' in order to align the project around a shared orientation (whether incremental or fundamental), or a plurality strategy, in which different political orientations (and associated foci, governance mechanisms, and outputs) are deliberately included. How this looks, and is managed in practice, is for specific project consortia to collaboratively decide: however, we provide some suggestions that may facilitate this.

Before a consortium is even established, or during the 'curation' of a consortium as in our case (Section 2.1), efforts can be undertaken to more thoroughly identify and build relationships with stakeholders (Section 3.1). This could potentially involve mapping actor-issue networks (Bergsten et al., 2019), identifying and contacting 'bridge' actors (Long et al., 2013) and peripheral actors, and – for universities and research institutes – establishing long-term partnerships in focal communities (Buys & Bursnall, 2007). Once a project team has been established, developing individual and shared Theories of Change may be a useful exercise for the team to elucidate members' conceptualization of transitions (Section 3.2) and anticipated project aims (Section 3.3) (Deutsch et al., 2021).

Similarly, using futuring methods (Neuhoff et al., 2023) at a project level, to explore the possible project outcomes and societal impacts of choosing either orientation (Sections 4.2 and 4.3), may help project teams identify and reflect on potential (un)intended consequences. As part of this, consortia could use anticipatory methods to consider how incrementally-focused (aspects of) projects may operate as a 'Trojan horse:' an innovation designed to be 'captured' by the regime but with "latent transformative force… only emerging after and *through* capture" (Pel, 2016: 678, original emphasis). Taking a broader view, projects could involve a trained 'integrator' (Hoffmann et al., 2022) whose role is to facilitate intra-group processes and project outcomes, which can also help manage project politics. Finally, funding agencies can also help by providing larger or more diverse funding mechanisms to support stakeholder identification and inclusion as well as project integrators, especially for funding calls that encourage or require transdisciplinary collaboration. While none of these suggestions will fully address the challenges of politics in transdisciplinary transitions research, they can help open up and support the discussions that each project team will have to undertake to decide how to most effectively manage politics within the project.

5. Discussion

While the practical challenges facing transdisciplinary research are widely acknowledged, we suggest that these are almost always underscored by the inescapably and deeply political nature of transdisciplinary collaboration. Furthermore, transdisciplinary research on societal transitions brings particular challenges, related to the fundamentally political nature of transitions and how they are understood. Different views on how to achieve transitions (incremental or fundamental), how they can arise (through individual action, multi-level system evolution, or emergent dynamics), and therefore what are appropriate interventions and governance strategies, are all issues that must be explicitly addressed if transdisciplinary collaboration is to achieve desired outcomes. The two broad political orientations we identified are also not mutually exclusive. However, adopting either approach – or a combination thereof – must be done clearly and explicitly during early project planning, with full involvement of the project team, and with careful consideration of how any approach or outcome could reinforce rather than challenge dominant, unsustainable systems.

Greater attention to the politics of research will have a range of implications for transdisciplinary transitions projects, two of which in particular are worth elaborating here. The first is a practical matter. As we noted above, explicitly addressing the politics of research will be necessary to avoid problems with collaboration. Our findings associated with this insight could be useful, we suggest, for particular approaches to transdisciplinary research such as integration and transition management. The issues we highlight in this paper – around stakeholder inclusion, goal definition, and shared understandings of transition, for example – are clearly relevant to what happens in the 'transition arena', and are aspects that integrators would need to consider. Indeed, they are emblematic of the "heavy-duty politics of definition" that must be negotiated in the transition management process (Shove & Walker, 2008: 1013).

Greater attention to the politics of research will also have a second major implication, which relates to the link between projects and transitions. We discussed above how various politicised dimensions of research – such as stakeholder inclusion and goal-setting – will ultimately have a bearing on the governance mechanisms that are seen as feasible and appropriate to address in research. However, the politics of research also shape the role that projects themselves have within societal transitions. Post-normal approaches are intended to serve, to at least some extent, as governance mechanisms; indeed post-normal science recognises that research and governance are

inextricably linked (e.g. De Marchi & Ravetz, 1999). Stakeholder selection in particular is emphasised in post-normal project design, perhaps most prominently in the 'transition arena' in which distributed and collaborative responsibility for the research-governance process is central. However, it does not necessarily follow that the range of associated political issues discussed above, such as conceptual or goal-related disagreements, are also fully recognised and addressed in post-normal approaches. Thus, while post-normal approaches have been quite successful in addressing the relation of projects to 'big P' politics, they have been less attentive to the role of 'small p' politics in shaping how projects operate as a governance mechanism in themselves. Recent work in this journal has begun to explore issues of this nature (Hawxwell et al., 2024), but clearly there is much still to learn, and we encourage future researchers to elaborate more fully how the politics of research shape the broader societal role that transdisciplinary research projects may play.

Ultimately, of course, the point of such projects is to contribute towards sustainability transitions, however modest this contribution may be. There is some debate around whether transdisciplinary research on societal transitions is actually able to achieve this: while successful project impacts have been observed in some quarters (e.g. Loorbach & Rotmans, 2010), elsewhere researchers have indicated how transition-oriented projects may – somewhat ironically – perpetuate the status quo (e.g. Hawxwell et al., 2024, Kenis et al., 2016). Our contribution to these debates has been to show that endogenous political dynamics are an important factor in this process too, which cannot be solved purely by practical collaboration advice. If we are to effectively address the wicked problems that our societies face, it is necessary that future transdisciplinary work on societal transitions engages more explicitly with the politics of research.

Funding

This publication is part of the project Transitie naar een Duurzaam Voedselsysteem (with project number NWA.1235.18.201) of the research programme Transitie naar een Duurzaam Voedselsysteem, which is financed by the Dutch Research Council (NWO).

CRediT authorship contribution statement

Sigrid Wertheim-Heck: Writing – review & editing, Funding acquisition, Conceptualization. **Frederike Praasterink:** Writing – review & editing, Funding acquisition. **Hilje van der Horst:** Writing – review & editing, Funding acquisition, Conceptualization. **Brian J. Dermody:** Writing – review & editing, Funding acquisition, Conceptualization. **Natalie Davis:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Jonas House:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to thank two anonymous reviewers, whose considered and constructive comments have done much to help us sharpen the paper's arguments.

Data availability

No data was used for the research described in the article.

References

Avelino, F., Grin, J., Pel, B., & Jhagroe, S. (2016). The politics of sustainability transitions. *Journal of Environmental Policy Planning, 18*(5), 557–567. https://doi.org/10.1080/1523908X.2016.1216782

Barr, S., Gilg, A., & Shaw, G. (2011). Helping People Make Better Choices': Exploring the behaviour change agenda for environmental sustainability. *Applied Geography, 31*(2), 712–720. https://doi.org/10.1016/j.apgeog.2010.12.003

Bergmann, M., Schäpke, N., Marg, O., Stelzer, F., Lang, D. J., Bossert, M., Gantert, M., Häußler, E., Marquardt, E., Piontek, F. M., Potthast, T., Rhodius, R., Rudolph, M., Ruddat, M., Seebacher, A., & Sußmann, N. (2021). Transdisciplinary sustainability research in real-world labs: Success factors and methods for change. *Sustainability Science, 16*(2), 541–564. https://doi.org/10.1007/s11625-020-00886-8

Bergsten, A., Jiren, T. S., Leventon, J., Dorresteijn, I., Schultner, J., & Fischer, J. (2019). Identifying governance gaps among interlinked sustainability challenges. *Environmental Science Policy, 91*, 27–38. https://doi.org/10.1016/j.envsci.2018.10.007

Borup, M., Brown, N., Konrad, K., & Van Lente, H. (2006). The sociology of expectations in science and technology. *Technology Analysis Strategic Management, 18*(3–4), 285–298.

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.

Brons, A., Oosterveer, P., & Wertheim-Heck, S. (2022). In- and exclusion in urban food governance: Exploring networks and power in the city of Almere. *Journal of Environmental Policy Planning, 24*(6), 777–793. https://doi.org/10.1080/1523908X.2022.2057936

Busch, L. M., & Lacy, W. B. (2019). *Science, agriculture, and the politics of research* [1983]. Routledge.

Buys, N., & Bursnall, S. (2007). Establishing university–community partnerships: Processes and benefits. *Journal of Higher Education Policy and Management, 29*(1), 73–86. https://doi.org/10.1080/13600800601175797

Cairns, R., Hielscher, S., & Light, A. (2020). Collaboration, creativity, conflict and chaos: Doing interdisciplinary sustainability research. *Sustainability Science, 15*(6), 1711–1721. https://doi.org/10.1007/s11625-020-00784-z

Chambers, J. M., Wyborn, C., Ryan, M. E., Reid, R. S., Riechers, M., Serban, A., Bennett, N. J., Cvitanovic, C., Fernández-Giménez, M. E., Galvin, K. A., Goldstein, B. E., Klenk, N. L., Tengö, M., Brennan, R., Cockburn, J. J., Hill, R., Munera, C., Nel, J. L., Österblom, H., … Pickering, T. (2021). Six modes of co-production for sustainability. Article 11. *Nature Sustainability, 4*(11). https://doi.org/10.1038/s41893-021-00755-x

Dankel, D. J., Vaage, N. S., & van der Sluijs, J. P. (2017). Post-normal science in practice. *Futures, 91*, 1–4. https://doi.org/10.1016/j.futures.2017.05.009

DeLanda, M. (2016). *Assemblage Theory*. Edinburgh University Press.

de Geus, T., Avelino, F., Strumińska-Kutra, M., Pitzer, M., Wittmayer, J. M., Hendrikx, L., Joshi, V., Schrandt, N., Widdel, L., Fraaije, M., Iskandarova, M., Hielscher, S., & Rogge, K. (2023). Making sense of power through transdisciplinary sustainability research: Insights from a Transformative Power Lab. *Sustainability Science, 18*(3), 1311–1327. https://doi.org/10.1007/s11625-023-01294-4

De Marchi, B., & Ravetz, J. R. (1999). Risk management and governance: a post-normal science approach. *Futures, 31*(7), 743–757. https://doi.org/10.1016/S0016-3287(99)00030-0

Deutsch, L., Belcher, B., Claus, R., & Hoffmann, S. (2021). Leading inter-and transdisciplinary research: Lessons from applying theories of change to a strategic research program. *Environmental Science Policy, 120*, 29–41.

Engels, F., Wentland, A., & Pfotenhauer, S. M. (2019). Testing future societies? Developing a framework for test beds and living labs as instruments of innovation governance. *Research Policy, 48*(9), Article 103826. https://doi.org/10.1016/j.respol.2019.103826

European Commission. (2023, May 22). *Evidence on food information – Empowering consumers to make healthy and sustainable choices*. ⟨https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/evidence-food-information-empowering-consumers-make-healthy-and-sustainable-choices-2022-09-09_en⟩.

Frankowski, A., Schulz, M., van der Steen, M., & Schröer, L. (2021). *Omgaan met verlies in transities: Voorbij een focus op koplopers*. Nederlandse School voor Openbaar Bestuur. ⟨https://www.nsob.nl/denktank/overzicht-van-publicaties/omgaan-met-verlies-transities⟩.

Freeth, R., & Caniglia, G. (2020). Learning to collaborate while collaborating: Advancing interdisciplinary sustainability research. *Sustainability Science, 15*(1), 247–261. https://doi.org/10.1007/s11625-019-00701-z

Frison, E., & Clément, C. (2020). The potential of diversified agroecological systems to deliver healthy outcomes: Making the link between agriculture, food systems & health. *Food Policy, 96*, Article 101851. https://doi.org/10.1016/j.foodpol.2020.101851

Fritz, L., & Binder, C. R. (2020). Whose knowledge, whose values? An empirical analysis of power in transdisciplinary sustainability research. *European Journal of Futures Research, 8*(1), 3. https://doi.org/10.1186/s40309-020-0161-4

Fritz, L., & Meinherz, F. (2020). Tracing power in transdisciplinary sustainability research: An exploration. *GAIA - Ecological Perspectives for Science and Society, 29*(1), 41–51. https://doi.org/10.14512/gaia.29.1.9

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. *Journal of Cleaner Production, 132*, 298–307.

Funtowicz, S. O., & Ravetz, J. R. (1993). Science for the post-normal age. *Futures, 25*(7), 739–755.

Gardner, S. K. (2013). Paradigmatic differences, power, and status: A qualitative investigation of faculty in one interdisciplinary research collaboration on sustainability science. *Sustainability Science, 8*(2), 241–252. https://doi.org/10.1007/s11625-012-0182-4

Gaventa, J., & Cornwall, A. (2008). Power and Knowledge. In In. P. Reason, & H. Bradbury (Eds.), *The SAGE Handbook of Action Research: Participative Enquiry and Practice* (pp. 172–189). Sage.

Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy, 31*(8), 1257–1274. https://doi.org/10.1016/S0048-7333(02)00062-8

Geels, F. W. (2005). The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930). *Technology Analysis Strategic Management, 17*(4), 445–476.

Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy, 36*(3), 399–417. https://doi.org/10.1016/j.respol.2007.01.003

Goris, M., Bakker, E., van den Berg, L., Siegmund-Schultze, M., Keeffe, O.', Ravesloot, S., Bufe, M., C, & Hassink, J. (2024). Collective land arrangements that decommodify land for agroecological transformations. *Elementa: Science of the Anthropocene, 12*(1), Article 00061. https://doi.org/10.1525/elementa.2023.00061

Guerrero Lara, L., van Oers, L., Smessaert, J., Spanier, J., Raj, G., & Feola, G. (2023). Degrowth and agri-food systems: A research agenda for the critical social sciences. *Sustainability Science, 18*(4), 1579–1594. https://doi.org/10.1007/s11625-022-01276-y

Gugerell, K., Radinger-Peer, V., & Penker, M. (2023). Systemic knowledge integration in transdisciplinary and sustainability transformation research. *Futures, 150*, Article 103177.

Gunderson, R. (2014). Problems with the defetishization thesis: Ethical consumerism, alternative food systems, and commodity fetishism. *Agriculture and Human Values, 31*, 109–117.

Guzzo, D., Walrave, B., & Pigosso, D. C. A. (2023). Unveiling the dynamic complexity of rebound effects in sustainability transitions: Towards a system's perspective. *Journal of Cleaner Production, 405*, Article 137003. https://doi.org/10.1016/j.jclepro.2023.137003

Hawxwell, T., Hendriks, A., & Späth, P. (2024). Transformative or incumbent futures? How the future of mobility is imagined in sustainability transitions research. *Futures*. , Article 103325. https://doi.org/10.1016/j.futures.2024.103325

Hinrichs, C. C. (2014). Transitions to sustainability: A change in thinking about food systems change? *Agriculture and Human Values, 31*(1), 143–155. https://doi.org/10.1007/s10460-014-9479-5

Hoffmann, S., Deutsch, L., Klein, J. T., & O'Rourke, M. (2022). Integrate the integrators! A call for establishing academic careers for integration experts. *Humanities and Social Sciences Communications, 9*(1), 1–10. https://doi.org/10.1057/s41599-022-01138-z

Holbrook, J. B. (2013). What is interdisciplinary communication? Reflections on the very idea of disciplinary integration. *Synthese, 190*(11), 1865–1879. https://doi.org/10.1007/s11229-012-0179-7

Hölscher, K., Wittmayer, J. M., & Loorbach, D. (2018). Transition versus transformation: What's the difference? *Environmental Innovation and Societal Transitions, 27*, 1–3. https://doi.org/10.1016/j.eist.2017.10.007

Hölscher, K., Wittmayer, J. M., Avelino, F., & Giezen, M. (2019). Opening up the transition arena: An analysis of (dis)empowerment of civil society actors in transition management in cities. *Technological Forecasting and Social Change, 145*, 176–185. https://doi.org/10.1016/j.techfore.2017.05.004

Huttunen, S., Kaljonen, M., Lonkila, A., Rantala, S., Rekola, A., & Paloniemi, R. (2021). Pluralising agency to understand behaviour change in sustainability transitions. *Energy Research Social Science, 76*, Article 102067. https://doi.org/10.1016/j.erss.2021.102067

IPCC. (2023). *AR6 Synthesis Report: Climate Change 2023*. Intergovernmental Panel on Climate Change. ⟨https://www.ipcc.ch/report/ar6/syr/⟩.

Ivanova, D., Stadler, K., Steen-Olsen, K., Wood, R., Vita, G., Tukker, A., & Hertwich, E. G. (2016). Environmental Impact Assessment of Household Consumption. *Journal of Industrial Ecology, 20*(3), 526–536. https://doi.org/10.1111/jiec.12371

Jahel, C., Bourgeois, R., Bourgoin, J., Daré, W., De Lattre-Gasquet, M., Delay, E., Dumas, P., Le Page, C., Piraux, M., & Prudhomme, R. (2023). The future of social-ecological systems at the crossroads of quantitative and qualitative methods. *Technological Forecasting and Social Change, 193*, Article 122624. https://doi.org/10.1016/j.techfore.2023.122624

Jenkins, K., McCauley, D., Heffron, R., Stephan, H., & Rehner, R. (2016). Energy justice: A conceptual review. *Energy Research Social Science, 11*, 174–182. https://doi.org/10.1016/j.erss.2015.10.004

Kaljonen, M., Kortetmäki, T., Tribaldos, T., Huttunen, S., Karttunen, K., Maluf, R. S., Niemi, J., Saarinen, M., Salminen, J., Vaalavuo, M., & Valsta, L. (2021). Justice in transitions: Widening considerations of justice in dietary transition. *Environmental Innovation and Societal Transitions, 40*, 474–485. https://doi.org/10.1016/j.eist.2021.10.007

Kelly, R., Mackay, M., Nash, K. L., Cvitanovic, C., Allison, E. H., Armitage, D., Bonn, A., Cooke, S. J., Frusher, S., Fulton, E. A., Halpern, B. S., Lopes, P. F. M., Milner-Gulland, E. J., Peck, M. A., Pecl, G. T., Stephenson, R. L., & Werner, F. (2019). Ten tips for developing interdisciplinary socio-ecological researchers. *Socio-Ecological Practice Research, 1*(2), 149–161. https://doi.org/10.1007/s42532-019-00018-2

Kemp, R., Rotmans, J., & Loorbach, D. (2007). Assessing the Dutch Energy Transition Policy: How Does it Deal with Dilemmas of Managing Transitions? *Journal of Environmental Policy Planning, 9*(3–4), 315–331. https://doi.org/10.1080/15239080701622816

Kenis, A., Bono, F., & Mathijs, E. (2016). Unravelling the (post-)political in transition management: Interrogating pathways towards sustainable change. *Journal of Environmental Policy Planning, 18*(5), 568–584. https://doi.org/10.1080/1523908X.2016.1141672

Kern, F., & Smith, A. (2008). Restructuring energy systems for sustainability? Energy transition policy in the Netherlands. *Energy Policy, 36*(11), 4093–4103. https://doi.org/10.1016/j.enpol.2008.06.018

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

Kok, K. P. W., Gjefsen, M. D., Regeer, B. J., & Broerse, J. E. W. (2021). Unraveling the politics of 'doing inclusion' in transdisciplinarity for sustainable transformation. *Sustainability Science, 16*(6), 1811–1826. https://doi.org/10.1007/s11625-021-01033-7

König, B., Diehl, K., Tscherning, K., & Helming, K. (2013). A framework for structuring interdisciplinary research management. *Research Policy, 42*(1), 261–272. https://doi.org/10.1016/j.respol.2012.05.006

Kønig, N., Børsen, T., & Emmeche, C. (2017). The ethos of post-normal science. *Futures, 91*, 12–24. https://doi.org/10.1016/j.futures.2016.12.004

Lamb, W. F., Wiedmann, T., Pongratz, J., Andrew, R., Crippa, M., Olivier, J. G. J., Wiedenhofer, D., Mattioli, G., Khourdajie, A. A., House, J., Pachauri, S., Figueroa, M., Saheb, Y., Slade, R., Hubacek, K., Sun, L., Ribeiro, S. K., Khennas, S., Can, S. de la R. du, & Minx, J. (2021). A review of trends and drivers of greenhouse gas emissions by sector from 1990 to 2018. *Environmental Research Letters, 16*(7), Article 073005. https://doi.org/10.1088/1748-9326/abee4e

Lamine, C., Darnhofer, I., & Marsden, T. K. (2019). What enables just sustainability transitions in agrifood systems? An exploration of conceptual approaches using international comparative case studies. *Journal of Rural Studies, 68*, 144–146. https://doi.org/10.1016/j.jrurstud.2019.03.010

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*(1), 25–43. https://doi.org/10.1007/s11625-011-0149-x

Latour, B. (1996). *Aramis, or the Love of Technology (C. Porter, Trans.)*. Harvard University Press.

Liu, J., Hull, V., Godfray, H. C. J., Tilman, D., Gleick, P., Hoff, H., Pahl-Wostl, C., Xu, Z., Chung, M. G., Sun, J., & Li, S. (2018). Nexus approaches to global sustainable development. Article 9. *Nature Sustainability, 1*(9). https://doi.org/10.1038/s41893-018-0135-8

Long, J. C., Cunningham, F. C., & Braithwaite, J. (2013). Bridges, brokers and boundary spanners in collaborative networks: A systematic review. *BMC Health Services Research, 13*(1), 158. https://doi.org/10.1186/1472-6963-13-158

Loorbach, D. (2007). Governance for sustainability. *Sustainability: Science, Practice and Policy, 3*(2), 1–4. https://doi.org/10.1080/15487733.2007.11907996

Loorbach, D. (2010). Transition management for sustainable development: a prescriptive, complexity-based governance framework. *Governance, 23*(1), 161–183. https://doi.org/10.1111/j.1468-0491.2009.01471.x

Loorbach, D., & Rotmans, J. (2010). The practice of transition management: Examples and lessons from four distinct cases. *Futures, 42*(3), 237–246.

Lubowiecki-Vikuk, A., Dąbrowska, A., & Machnik, A. (2021). Responsible consumer and lifestyle: Sustainability insights. *Sustainable Production and Consumption, 25*, 91–101.

Luka, M. E., Harvey, A., Hogan, M., Shepherd, T., & Zeffiro, A. (2015). Scholarship as cultural production in the neoliberal university: Working within and against 'deliverables. Article 2. *Studies in Social Justice, 9*(2). https://doi.org/10.26522/ssj.v9i2.1138

Mangnus, A. C., Vervoort, J. M., McGreevy, S. R., Ota, K., Rupprecht, C. D. D., Oga, M., & Kobayashi, M. (2019). New pathways for governing food system transformations: A pluralistic practice-based futures approach using visioning, back-casting, and serious gaming. *Ecology and Society, 24*(4), 2. https://doi.org/10.5751/ES-11014-240402

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).

Meadowcroft, J. (2009). What about the politics? Sustainable development, transition management, and long term energy transitions. *Policy Sciences, 42*, 323–340.

Meadowcroft, J. (2011). Engaging with the *politics* of sustainability transitions. *Environmental Innovation and Societal Transitions, 1*(1), 70–75. https://doi.org/10.1016/j.eist.2011.02.003

Navarre, N., Schrama, M., Vos, C. de, & Mogollón, J. M. (2023). Interventions for sourcing EAT-Lancet diets within national agricultural areas: A global analysis. *One Earth, 6*(1), 31–40. https://doi.org/10.1016/j.oneear.2022.12.002

Neuhoff, R., Simeone, L., & Laursen, L. H. (2023). Forms of participatory futuring for urban sustainability: A systematic review. *Futures, 154*, Article 103268. https://doi.org/10.1016/j.futures.2023.103268

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. https://doi.org/10.1016/j.envsci.2019.08.008

Nguyen, N., & Johnson, L. W. (2020). Consumer behaviour and environmental sustainability. *Journal of Consumer Behaviour, 19*(6), 539–541. https://doi.org/10.1002/cb.1892

Paul, C., Techen, A.-K., Robinson, J. S., & Helming, K. (2019). Rebound effects in agricultural land and soil management: Review and analytical framework. *Journal of Cleaner Production, 227*, 1054–1067. https://doi.org/10.1016/j.jclepro.2019.04.115

Pel, B. (2016). Trojan horses in transitions: A dialectical perspective on innovation 'capture. *Journal of Environmental Policy Planning, 18*(5), 673–691. https://doi.org/10.1080/1523908X.2015.1090903

Pischke, E. C., Knowlton, J. L., Phifer, C. C., Gutierrez Lopez, J., Propato, T. S., Eastmond, A., de Souza, T. M., Kuhlberg, M., Picasso Risso, V., Veron, S. R., Garcia, C., Chiappe, M., & Halvorsen, K. E. (2017). Barriers and Solutions to Conducting Large International, Interdisciplinary Research Projects. *Environmental Management, 60*(6), 1011–1021. https://doi.org/10.1007/s00267-017-0939-8

Polhill, J. G., Hare, M., Bauermann, T., Anzola, D., Palmer, E., Salt, D., & Antosz, P. (2021). Using Agent-Based Models for Prediction in Complex and Wicked Systems. *Journal of Artificial Societies and Social Simulation, 24*(3), 2.

Pricope, N. G., Cassidy, L., Gaughan, A. E., Salerno, J. D., Stevens, F. R., Hartter, J., Drake, M., & Mupeta-Muyamwa, P. (2020). Addressing Integration Challenges of Interdisciplinary Research in Social-Ecological Systems. *Society Natural Resources, 33*(3), 418–431. https://doi.org/10.1080/08941920.2019.1680783

Reinholz, D. L., & Andrews, T. C. (2020). Change theory and theory of change: What's the difference anyway? *International Journal of STEM Education, 7*(1), 2. https://doi.org/10.1186/s40594-020-0202-3

Rinaldi, P. N. (2023). Dealing with complex and uncertain futures: Glimpses from transdisciplinary water research. *Futures, 147*, Article 103113.

Rockström, J., Edenhofer, O., Gaertner, J., & DeClerck, F. (2020). Planet-proofing the global food system. Article 1. *Nature Food, 1*(1). https://doi.org/10.1038/s43016-019-0010-4

Schäfer, M., Lux, A., & Bergmann, M. (2020). Editorial to the special issue "Transdisciplinary Sustainability Research—Linking research processes and outputs to societal effects. *Environmental Science Policy, 107*, 206–210. https://doi.org/10.1016/j.envsci.2020.02.018

Scholz, R. W. (2017). The normative dimension in transdisciplinarity, transition management, and transformation sciences: New roles of science and universities in sustainable transitioning. Article 6. *Sustainability, 9*(6). https://doi.org/10.3390/su9060991

Shove, E. (2010). Beyond the ABC: Climate Change Policy and Theories of Social Change. *Environment and Planning A: Economy and Space, 42*(6), 1273–1285. https://doi.org/10.1068/a42282

Shove, E., & Walker, G. (2007). Caution! Transitions Ahead: Politics, Practice, and Sustainable Transition Management. *Environment and Planning A: Economy and Space, 39*(4), 763–770. https://doi.org/10.1068/a39310

Shove, E., & Walker, G. (2008). Transition Management™ and the Politics of Shape Shifting. *Environment and Planning A: Economy and Space, 40*(4), 1012–1014. https://doi.org/10.1068/a4004leb

Shove, E., & Walker, G. (2010). Governing transitions in the sustainability of everyday life. *Research Policy, 39*(4), 471–476. https://doi.org/10.1016/j.respol.2010.01.019

Smith, A., & Raven, R. (2012). What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy, 41*(6), 1025–1036. https://doi.org/10.1016/j.respol.2011.12.012

Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B. L., Lassaletta, L., de Vries, W., Vermeulen, S. J., Herrero, M., Carlson, K. M., Jonell, M., Troell, M., DeClerck, F., Gordon, L. J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., & Willett, W. (2018). Options for keeping the food system within environmental limits. Article 7728. *Nature, 562*(7728). https://doi.org/10.1038/s41586-018-0594-0

Strumińska-Kutra, M., & Scholl, C. (2022). Taking power seriously: Towards a power-sensitive approach for transdisciplinary action research. *Futures, 135*, 102881. https://doi.org/10.1016/j.futures.2021.102881

Stuart, D., Gunderson, R., & Petersen, B. (2020). Overconsumption as ideology: Implications for addressing global climate change. *Nature and Culture, 15*(2), 199–223.

Szostak, R. (2013). The State of the Field: Interdisciplinary Research. *ERA*. https://doi.org/10.7939/R3QB9V49Q

Tobi, H., & Kampen, J. K. (2018). Research design: The methodology for interdisciplinary research framework. *Quality Quantity, 52*(3), 1209–1225. https://doi.org/10.1007/s11135-017-0513-8

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

van Bruggen, A., Nikolic, I., & Kwakkel, J. (2019). Modeling with Stakeholders for Transformative Change. Article 3. *Sustainability, 11*(3). https://doi.org/10.3390/su11030825

van 't Klooster, S. A., & van Asselt, M. B. A. (2006). Practising the scenario-axes technique. *Futures, 38*(1), 15–30. https://doi.org/10.1016/j.futures.2005.04.019

van Veen, A., & Helvoirt, B. (2024). De-Mooo-cracy! A performative experiment with a cow-human citizen's assembly. *Evaluation Report*. https://doi.org/10.13140/RG.2.2.35140.44168

Vara-Sánchez, I., Gallar-Hernández, D., García-García, L., Morán Alonso, N., & Moragues-Faus, A. (2021). The co-production of urban food policies: Exploring the emergence of new governance spaces in three Spanish cities. *Food Policy, 103*, Article 102120. https://doi.org/10.1016/j.foodpol.2021.102120

von Wehrden, H., Guimarães, M. H., Bina, O., Varanda, M., Lang, D. J., John, B., Gralla, F., Alexander, D., Raines, D., & White, A. (2019). Interdisciplinary and transdisciplinary research: Finding the common ground of multi-faceted concepts. *Sustainability Science, 14*, 875–888.

Voß, J.-P., & Bornemann, B. (2011). The politics of reflexive governance: Challenges for designing adaptive management and transition management. *Ecology and Society, 16*(2).

Wang, J., Aenis, T., & Siew, T. F. (2019). Communication processes in intercultural transdisciplinary research: Framework from a group perspective. *Sustainability Science, 14*(6), 1673–1684. https://doi.org/10.1007/s11625-019-00661-4

Wildschut, D. (2017). The need for citizen science in the transition to a sustainable peer-to-peer-society. *Futures, 91*, 46–52. https://doi.org/10.1016/j.futures.2016.11.010

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., Vries, W. D., Sibanda, L. M., … Murray, C. J. L. (2019). Food in the Anthropocene: The EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet, 393*(10170), 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4

Winowiecki, L., Smukler, S., Shirley, K., Remans, R., Peltier, G., Lothes, E., King, E., Comita, L., Baptista, S., & Alkema, L. (2011). Tools for enhancing interdisciplinary communication. *Sustainability: Science, Practice and Policy, 7*(1), 74–80. https://doi.org/10.1080/15487733.2011.11908067