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# Collaboration between Heterogeneous Practitioners in Sustainability Research: A Comparative Analysis of Three Transdisciplinary Programmes

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**Abstract:** There is wide agreement about the importance of transdisciplinary research to address complex sustainability issues. Although there is a growing body of literature about the management of transdisciplinary research programmes as well as the challenges relating to the collaboration between academic researchers and practitioners, empirical research has to date paid little attention to the challenges related to the variation of practitioners involved in these programmes. This paper presents a comparative analysis of three transdisciplinary programmes addressing climate change and sustainability and identifies factors that contribute to fruitful collaboration between heterogeneous practitioners. Contrary to what could be expected from the literature, differences between the practitioners involved have only created significant issues in one of the programmes, and this programme has developed a way to cope with this difficulty. Effective strategies to avoid and limit tensions among practitioners include a focus on bilateral collaborations, the careful selection of programme participants, and the appointment of dedicated project monitors who are responsible for social learning processes.

**Keywords:** transdisciplinarity; practitioners; programme management; collaboration

## 1. Introduction

Transdisciplinary (TD) research is generally perceived as a promising mode to tackle complex sustainability issues [1–3]. In its ideal form, TD research is characterised by a longer-term collaboration between academic researchers from different disciplines and practitioners, typically from different sectors. TD research integrates knowledge and skills from these different backgrounds, aiming to solve a common practical problem [4]. Indeed, the involvement of practitioners has been found to result in knowledge that is more useful in practice [5,6]. Practitioners can help to adapt knowledge to local contexts and to translate scientific terminology to concepts that are understood in a practical context [7,8].

Given that the goals, incentive structures, and freedom of operation differ strongly between academic researchers and practitioners, the organisation of TD research requires additional efforts than more traditional research modes. For example, while scientific reward structures are still largely based on publications, practitioners are incentivised to contribute to profit or decision-making, so they have to balance long-term strategic goals with short-term relevance [9–11]. There is a growing literature that is dealing with experiences, barriers, and best practices for collaboration between academic

researchers and practitioners in TD research projects [2,11,12] and the organization of TD research programmes [13,14].

In addition to potential conflicts and tensions between researchers and practitioners, differences between various practitioners involved in TD research programmes may also impede the production of knowledge. There are often cognitive, organisational, social, and institutional differences that create potential barriers for collaboration [15]. The range of different perspectives and institutional logics among the participating practitioners can inhibit their collaboration [16]. Although the TD literature acknowledges that perspectives, interests, and behavior of practitioners may not align [17], so far the collaboration between heterogeneous practitioners within TD research programmes and the effects of this collaboration on the outcomes of TD research is underrepresented in literature. With this paper, we aim to address this gap by analysing three TD research programmes that are directed at sustainability and climate challenges. Our research question is: what factors contribute to a fruitful collaboration between heterogeneous practitioners in transdisciplinary research programmes? A better understanding of these factors can help to design TD programmes that contribute more effectively to sustainability.

## 2. Theoretical Framework

In this paper, we refer to TD research as a mode of knowledge production that involves perspectives and active contributions from different scientific disciplines and from practitioners [18]. The most important aspect of TD for our analysis is knowledge co-creation, or the creative interaction between researchers and non-researchers. The co-creation between science and practice has been found to be beneficial in a range of sustainability domains, such as sustainable agriculture [19], energy efficient food production [20], and ecosystem management [21]. The current paper deals with TD programmes, which we consider as knowledge production initiatives with a duration of several years, typically containing a portfolio of projects that are managed in a coordinated manner, and contributions from a number of scientific partners and practitioners.

In particular, we will focus on the collaboration between heterogeneous practitioners in these programmes. Practitioners can play a number of different roles in TD programmes. The involvement of practitioners in framing and influencing the research agenda can improve the relevance and impact of a given programme [22,23]. In more intensive co-creation constellations, practitioners actively participate in data collection, assist in the interpretation of findings, or translate research results to practical contexts [3,24]. On the programme level, practitioners typically participate in decision making about the overall goals, programme design, and the research priorities of the programme [13,25]. On the intermediate level, practitioners can be given the responsibility to oversee a particular set of research projects, to supervise the progress and relevance in a particular research theme, or to establish links between ongoing research activities and topical political, economic, or social developments [18]. On the project level, there are many different manifestations of TD in which practitioners participate to a varying extent [26].

Collaboration can be defined as “a mutually beneficial and well-defined relationship entered into by two or more organisations to achieve common goals” [27]. The ultimate goals of a TD programme are (1) to create scientific impact and (2) to contribute to sustainable development or to generate other societal impacts. For the assessment of scientific impact, well-established methods are available, however the measurement of the societal impacts of research is inherently complex due to the problem of causal attribution and the time lag that typically occurs between the moment of knowledge production and the moment of impacts [28]. To overcome the problems of measuring the eventual impacts, productive interactions can be used as a process indicator of the social impact of TD research. Productive interactions are exchanges between researchers and practitioners in which knowledge is produced and valued that is both scientifically robust and socially relevant [29]. These exchanges can be mediated through various objects such as a publication, an exhibition, or a design. The interactions are considered productive when they lead to efforts by practitioners to use or apply

research results, practical information, or experiences. Since productive interactions can be seen as a crucial condition for impact, we consider the collaboration between different practitioners fruitful if it leads to efforts to use or apply research results.

The literature on TD contains numerous publications on the barriers to and incentives for the participation of academic researchers, on the mismatch between TD research and existing scientific institutions [9,30], and on the discrepancies between the ideal form of TD and TD in practice [31,32]. A lot of work has been done to develop approaches for the quality assurance and evaluation of this kind of research [5,33]. Relatedly, numerous scholars have elaborated on the precise definition of the concept and on indicators of transdisciplinarity [34–36]. In terms of empirical analysis, the literature includes many case studies of transdisciplinary initiatives [10,37,38] and quantitative analyses of the relationships between project characteristics and its results or participant satisfaction [11,14,39].

Although the existing literature on TD programmes deals mainly with interactions between practitioners and researchers, it does provide some starting points for understanding the fruitful collaboration between different practitioners in TD programmes. The literature suggests that the success of this collaboration will depend both on the characteristics of the practitioners involved and on the way their interactions are organized. Regarding practitioner characteristics, a balanced team composition in terms of cognitive and normative backgrounds contributes to the success of TD projects [11], and the inclusion of open-minded stakeholders, forerunners, and out-of-the-box thinkers is important to successfully cope with ill-defined problems [40,41]. Moreover, the skills and capacity of TD researchers to pay attention to the friction and tensions provoked by TD collaboration and to reveal what is relevant to their practitioners have been found to be valuable for fruitful interactions [12,42]. Regarding their interactions, earlier research has shown that mutual interactions and understanding between the different actors involved are crucial for successful TD knowledge production. Success conditions reported for TD research include a shared understanding of problem definitions and organised reflection on the division of tasks [16,40,43]. Also, project size, the level of involvement of team members, the quality of communication, and the division of responsibilities within teams have been shown to influence the success of TD projects [11,20,42]. Finally, trust is reported as a beneficial factor as it facilitates communication and ownership of the project and its results [16,20].

The barriers for TD research that are identified in the literature can be divided into three categories: methodological and epistemological barriers (related to the content of the research), social and political barriers (related to communication and power relationships between the participants), and institutional barriers (related to characteristics of the research system), see Table 1 [18]. First, the integration of knowledge from different disciplines requires overcoming fundamental epistemological differences, for example different conceptualisations of the same phenomenon [44] or different methodologies [45]. A second, related barrier concerns the challenge of transcending academic disciplines and recognising the relevance of experiential knowledge (Benard and de Cock-Buning) [21]. Third, it can be difficult in TD research to overcome cultural differences in the norms and values of various disciplines [44] and between those of research and practice [46,47]. Moreover, various conflicts can occur when collaborations involve different partners, reflecting the different priorities of the research partners and of the practitioners [10], different expectations among the partners [11], or different problem definitions among actors [43]. Fifth, limited capacity can hinder the TD research since practitioners tend to play a more active role during the agenda-setting and a rather passive role during the execution of programmes or projects [13]. On the institutional level, interdisciplinary and TD research is more difficult to get published in high impact journals than disciplinary research [48] and disciplinary collaborations contribute more to career development than interdisciplinary collaborations [49]. Interdisciplinary research also has a lower funding success rate than disciplinary research [50]. Finally, the lack of generally accepted quality standards for societally relevant output is often mentioned as a barrier to TD research [31].

**Table 1.** Barriers for TD (transdisciplinary) research reported in the literature [18].

Type	Barrier
Methodological and epistemological	Integrating disciplines is difficult and laborious Difficulties of integrating scientific with practical knowledge
Social and political	Cultural differences Conflicting interests Limited capacity
Institutional	Reduced publication or career prospects Greater difficulty in accessing research funding Lack of quality indicators

Although previous research on TD has addressed the variety of actors or organisations that can participate in TD research *projects* [17,51], there has been little empirical attention to the ways in which TD *programmes* can deal with this variety. Given the wide range of possible stakes [52], the practitioners involved in a given programme can vary strongly in terms of their knowledge level, power, or normative position in relation to the research topic. These differences may create strong inequalities and tensions between them. Different preferences make it difficult to reach agreement about the relative emphasis on basic versus applied research projects in the research agenda [10] or between monodisciplinary versus interdisciplinary research priorities [18]. Heterogeneous practitioners can also have different expectations when it comes to project outcomes, for example the degree of uncertainty [11], or hold different perspectives on co-production, which can create conflicts about their precise role and responsibilities in the research process [53]. In its exploration of the possibilities of TD programmes to stimulate fruitful collaboration, one can distinguish between the design phase and the implementation phase of TD programmes [13].

Based on the considerations above, we distinguish between three categories of factors that may influence fruitful collaboration between practitioners in a TD research program: (1) participant characteristics, (2) programme design, and (3) interventions by programme management. With participant characteristics, we refer to the qualities and limitations of the different organisations participating in the programme before they took part (or independent of their participation) in the programme, such as their goals, individual qualities, mutual proximity, and absorptive capacity. With programme design, we refer to the way it is structured in terms of projects and other activities, its funding structure, and the responsibilities of various actors. Interventions refer to the actions taken by the programme management during the implementation of the programme, such as the organisation of meetings, communication efforts, and other coordination work. In the case studies below, we will explore the relative importance of these various factors in promoting fruitful collaboration among heterogeneous practitioners in a TD research programme.

There is a wide variety of sustainability initiatives exhibiting the principles of TD research, including living laboratories, real world laboratories, science-society partnerships, co-creation, and user engagement [16,22,54,55]. Not all of these initiatives are commonly referred to as TD. The current paper focuses on TD research programmes which typically involve a low to medium intensity of sustainability co-creation in the typology of Trencher et al. [54]. Although our analysis will focus on the interactions and collaborations within TD *programmes*, the insights gained from this analysis may also contribute to the broader literature on science-society interactions and partnerships.

### 3. Methods

In order to address our research question, we have conducted case studies of three TD programmes. As indicated above, we consider TD programmes as knowledge production initiatives with a duration of several years, typically containing a portfolio of projects and including contributions from a number of scientific partners and practitioners. Our cases have been selected based on five main criteria.

To classify as a TD programme, the cases should:

1. focus on a complex sustainability challenge;
2. involve different disciplinary perspectives and knowledge coproduction by researchers and practitioners.

To gather relevant data, the cases should:

3. include a variation of the practitioners involved in the projects in terms of their type of organisation (government, industry, NGO), size of organisation (fte), and/or knowledge level.
4. be well documented in open literature and/or accessible by the researchers.

To maximize comparability and reliability of the data, the cases should:

5. have an annual budget in the range of 1–10 Million euros;
6. be finished at the time of research so that key informants could speak openly, however not for longer than 10 years.

In order to identify suitable cases, we have conducted a snowball search on the internet, starting from prior knowledge and experience of the authors and consultation of experts in their network. Based on the selection criteria above, the number of cases available for analysis was limited. Ideally, but not necessarily, the cases would also have been equally distributed across countries or from a single country. In our selection, all but the geographical criteria could be met. One programme, Clipore, focuses on international climate policies; the second programme, Next Generation Infrastructures, focuses on future-proof infrastructures, and the third programme, TransForum, focuses on sustainable agriculture. Table 2 provides an overview of the characteristics of the cases. All programmes involved activities ranging from low to medium intensity of sustainability co-creation [54], with the emphasis on low intensity in Clipore and on medium intensity in the other two programmes. They did involve transformational interventions on a limited scale, however they did not aim at full scale knowledge implementation or societal transformation.

Given the different domains in which the three programmes operate, they vary in the types of practitioners involved and the roles of these practitioners in the programmes. We also expect to find differences in the programme design and interventions by the programme management. This variation enables us to investigate the influence of these factors on the collaboration among heterogeneous practitioners in the programmes.

**Table 2.** Characteristics of the cases.

	<b>Next Generation Infrastructures</b>	<b>Clipore</b>	<b>TransForum</b>
Mission	To understand how infrastructures work and to develop practical solutions that will steer infrastructural developments	To explore and develop effective mechanisms and instruments for international emission policies for climate change mitigation	To develop a vision on the future of Dutch agriculture, a structured approach to realise this vision, and the embedment of this vision and approach in agricultural practice
Main approach and methods	Studying infrastructures in a variety of sectors, drawing on theory and methods from engineering and social sciences	Design, evaluate, and experiment with policy instruments	Studying innovation processes within > 100 practice projects and their interface with society
Main disciplines	Civil engineering, public administration	Economics, environmental science, political science and law	Agricultural engineering, environmental science, innovation studies

Table 2. Cont.

	Next Generation Infrastructures	Clipore	TransForum
Main knowledge users involved	Utilities, public authorities, consultancies, SMEs <sup>1</sup>	Industry, national governments, multinational authorities, advocacy groups (NGOs)	Farmers, food industry, government, NGOs
Duration	2004–2015	2004–2010	2005–2010
Funding amount and source	19 M euros from BSIK <sup>2</sup> fund and 21 M euros matching from programme partners	108 M Swedish Kronas (about 11 Million euros) from Mistra Foundation	30 M euros from BSIK <sup>2</sup> fund and 30 M euros matching from programme partners
Location	The Netherlands	Sweden, USA, India	The Netherlands
Number of projects	145	31	>100 (33 innovation projects)
Key references	[25,56]	[57,58]	[59,60]

<sup>1</sup> Small and medium enterprises; <sup>2</sup> Investment grants for knowledge infrastructure from the Dutch government.

For each case, we conducted a systematic review of relevant documents about the programmes, including annual reports, evaluation reports, project proposals, and academic papers. In addition, we conducted 20 interviews with key informants. The interview questionnaire was developed based on the review of the literature, personal experience with transdisciplinary research, and informal discussions with key informants. It contained questions on issues such as the characteristics, positions, and interests of different practitioners, and the dynamics of collaboration among the various actors involved. Some sample questions about productive interactions are provided below:

- How were the relationships per stakeholder during the program?
- How were the interactions between stakeholders; Frequency, composition, type of communication?
- Did the nature of these interactions change over time?
- What was the most important output of the program in terms of meetings, presentations, texts, objects, models?
- Were contacts still present after the finalization of the program?
- How did the different stakeholders contribute to;
  - The relevance of the produced knowledge (research agenda)
  - The material output of the program
  - The implementation and impact of the produced knowledge?
- What was the impact of the program on the different stakeholders?

All interviews were conducted in a semi-standardised manner, allowing the interviewer to ask additional questions to stimulate more mindful and considered responses, while responses to the questions remain highly comparable [61]. Judgement sampling was used to identify a keynote individual in a senior position at each scheme with snowball sampling used thereafter to access additional respondents. Respondents included programme directors, project leaders, relevant researchers, and representatives of practitioners (see Table 3).

All interviews were conducted between January and August 2017, lasted between 30 and 60 min, and were either recorded or notated for subsequent analysis. To ensure that interviewees' points of view were well captured, all interviews were summarised in a report which key interviewees were invited to review and approve. Next, a qualitative analysis was executed to identify patterns, to make comparisons, and to contrast one set of data with another [62]. In this manner, all information became systematic and available for reporting and for drawing conclusions.

**Table 3.** Details of conducted interviews.

Case	Number of Individual Interviews	Participants
NGInfra (Next Generation Infrastructures)	8	Managing director, scientific director, former managing director, corporate strategist, Asset owner, manager industry & energy, former PhD-student, former senior researcher
Clipore	7	Programme director, former work package leaders (3×), consultant, former business board member, UNFCC <sup>1</sup> representative
TransForum	5	Managing director, programme manager, director knowledge programme, senior researcher, former PhD student and project monitor

<sup>1</sup> United Nations Convention on Climate Change.

## 4. Results

In this section, we first describe the variation that was observed between the different practitioners who were involved in the three programmes under study and the roles they have played in each programme (Section 4.1); then, we provide a comparative analysis of the different programmes. Our comparative analysis deals respectively with the collaboration between different practitioners (Section 4.2), barriers to collaboration (Section 4.3), and the factors promoting fruitful collaboration (Section 4.4). While our analysis focuses on the programme level, we will refer to individual projects within the programs to illustrate the collaboration dynamics.

### 4.1. The Role of Practitioners

All three programmes under study involved a large variety of practitioners, including public and private organisations of various sizes.

NGInfra involved practitioners working with physical infrastructures in the railway, utilities, roads, and water sectors. These included public bodies, such as the Ministry of Infrastructure and the Environment, semi-privatised firms, and private companies from the utilities sector. In size, the organisations involved varied from around 20 to thousands of employees. The majority of the larger organisations were geographical monopolists that were responsible for or provided a specific and often critical infrastructure, and their functioning and processes are closely followed by politics, the media, and the public. Similarities include the types of sustainability challenges they face related to the future availability, affordability, and acceptability of infrastructure bound services (NGInfra, 2015. Final report Next Generation Infrastructures. Delft: NGInfra, p 3) and a cautious attitude because of their position under public scrutiny. On the project level, representatives from large and small organisations collaborated with researchers on concrete problems. However, the involvement of multiple practitioners in a single project was rare: only 20% of the projects involved more than one.

The practitioners that were involved with the Clipore programme were actors contributing to the design of carbon emission trading systems and actors participating in the international negotiations about their implementation, in particular: industry, national governments, state governments (USA), and NGOs (advocacy groups). In spite of the general controversies about climate policies, the practitioners who were structurally involved in the Clipore programme did not vary strongly in their opinions or stakes with regard to the topic. The programme focused on effective instruments in emission trading rather than the need for emission trading as such. Only actors that were in favour of climate policies were involved in the programme in the first place. The fossil fuel industry and advocacy groups, which had the strongest opinions about climate change and climate policies, were not structurally involved. The practitioners of Clipore on the project level varied strongly in terms of their knowledge level with regard to the topic.

The practitioners participating in the TransForum programme were civil society organisations (including consumer organisations), governmental bodies, and industry (including farmers) that had a stake in the transition towards a more sustainable development of the Dutch agricultural sector [63]. The programme's Advisory Board was (in the second stage of the programme) composed of representatives from multiple interest groups and the scientific community. The active collaboration between governmental bodies, civil society organisations, the business community, and knowledge institutes was—except for at the very start—prerequisite for the programme funding of all innovation projects in the Practice Programme. In the two other parts of the programme, the Scientific and Learning Programme, practitioners were mostly only indirectly involved, for instance, by formulating research questions or sharing best-practices. In TransForum, there was a large variation in terms of knowledge level, goals, and (organisation) power among practitioners. In terms of the three sustainability dimensions, the agricultural entrepreneurs primarily focused on profit, whereas environmental NGOs instead first and foremost focused on the planet. Instead of avoiding value conflicts, a distinctive feature of the programme was that it intentionally embraced this variation. One of the key assumptions of the programme is that a system innovation requires a multi-stakeholder approach exactly for the reason that, in this instance, farmers, citizens, researchers, and governments all have different values concerning environmental, social, and economic aspects of agricultural production [60].

The ways in which practitioners were involved vary strongly across the three cases. In all programmes, the practitioners were involved in the agenda-setting phase; in TransForum, they were also strongly involved in carrying out projects and the implementation of the outcomes. Here, the collaboration in the innovation projects in the Practice Programme sometimes entailed almost daily interactions. In the other programmes, practitioners participated in various meetings and events. In NGInfra, some researchers also held office at the practitioners office for part of their time.

In all of the programmes, researchers engaged with practitioners on the programme level by direct representation in the programme board or participation in a programme-wide user committee or advisory committee. At NGInfra, major infrastructure providers, such as a railroad infrastructure manager ProRail, were involved in designing the programme and were represented in the programme's users council. In Clipore, industry and government met as members of the programme board, as well as at a number of meetings and workshops, such as the European Climate Platform. In TransForum, practitioners participated in the Advisory Board.

On the project level, there was intensive involvement in TransForum, formal yet less intensive involvement in NGInfra, and only incidental involvement in Clipore. In TransForum, the interaction between practitioners and knowledge producers was most manifest on the project level. Especially, agricultural entrepreneurs and knowledge institutes were present at all project phases from agenda-setting to implementation. Governmental bodies were an important funder of the programme, however their role generally remained rather distant and evaluative rather than active or reflexive.

The NGInfra programme management allowed project leaders to shape the involvement of practitioners as they saw fit. On this level, practitioners could closely collaborate with academic researchers. This included jointly establishing research agendas and submitting proposals, designing and conducting research, and disseminating, including co-authoring academic papers and implementing results. Practitioners made financial and in-kind contributions. The intensity ranged from periodical meetings to academics working on the premises of practitioners for a prolonged time.

In Clipore, practitioners were not structurally involved on the level of work packages or projects and most of the projects were relatively academic in nature, however one project leader (C3) indicated that practitioners indirectly had a strong influence on the agenda of the work package about the design and implementation of emission trading. In many projects, practitioners gave feedback to (preliminary) findings during side-events, workshops, or other meetings. In one case, the UNFCCC secretariat contributed to the data collection by giving permission to circulate a survey among the participants of the Conference of the Parties (COP), the supreme decision-making body of the UN Framework Convention on Climate Change).



#### 4.2. Collaboration among Practitioners and Productive Interactions

In all cases, the mutual relationships among practitioners involved in the programmes have been characterised by our interviewees as functional and constructive. The NGInfra programme management increasingly involved users after its fifth year through large annual events such as NGInfra Trends, summer school NGInfra Academy, websites, information booklets, a Massive Online Open Course, and a magazine to facilitate learning among practitioners and projects, to wider disseminate results and to create a network among and between practitioners and academic researchers. In the case of Clipore, the interaction with the fossil fuel industry was complicated, however these interactions did not take within the programme as the programme has deliberately chosen to collaborate with partners with more common ground. In TransForum, the relationships were generally perceived as productive, however they required substantial efforts because of the large variation and different values and accompanying visions of a sustainable agriculture. Acknowledging each other's differences and making an effort to understand them was therefore considered very important. In some TransForum projects, interactions with external stakeholders, in particular environmental NGOs that were not part of the programme, were considered complicated.

In spite of the varying degree to which they have been involved, it is clear that practitioners have contributed to the relevance and impact of all three programmes. At NGInfra, the interactions with practitioners have helped to improve the relevance of the research capacity and to develop a cross-sectoral network. This network has continued to exist after the programme ended. Six practitioners have initiated a follow-up programme and there are still follow-up projects outside the programme with funding from other schemes. In the Clipore programme, the board has helped to design mechanisms for disseminating the knowledge both to negotiators and to a broader audience. The (limited) interactions that have taken place between researchers and practitioners on the project level have contributed to the relevance of the programme, to the implementation of some research findings in the design of emission trading systems in Europe and USA, and to the generation of sustainable knowledge networks. In TransForum, all interviewees recognised the significance and value of the multi-stakeholder approach that was chosen in the programme. The involvement of a combination of actors, and in particular entrepreneurs on the project level, has been crucial for developing new conceptualisations of sustainable agriculture, building enduring networks, and implementing a number of successful innovations. By accepting the different values of the different practitioners, room has been created for new solutions and ideas. An appealing example in this respect is the innovation project Rondeel in which entrepreneurs, research institutes, and societal organisations jointly developed a sustainable housing system for poultry with less of an environmental impact, improved animal health and welfare, as well as business efficiency. Today, Rondeel eggs are on the shelves of all major Dutch supermarkets [64].

#### 4.3. Barriers for Collaboration

Altogether, differences between heterogeneous practitioners have hindered collaboration only to a limited extent. Surprisingly, the power and knowledge differences that existed in all three cases hardly hindered mutual collaboration.

Differences in value orientation and interests seem the most hindering. In TransForum, these differences generated semantic discussions on the concept of sustainability, both in the programme board and in some of the innovation projects. For instance, in the project Streamlining Greenport Venlo, which aimed at strengthening and (re)organising the horticulture chain and societal co-operation structure in the region, differences became manifest in the search for environmental NGOs to join as they often did not agree with the project's goal of stimulating the economy. In the TransForum project New Mixed Farm, aiming to combine different businesses by making use of each other's waste and residual streams, the differences in value orientation and interests, became most manifest outside the project [59]. Although some—what interviewees refer to as—“constructive” environmental NGOs were part of a special advisory board, more activist environmental NGOs were heavily opposed.

These created a massive social resistance which, in turn, had negative effects on the internal support and cooperation between the project partners.

Within NGInfra, possible tensions between practitioners seem to have been avoided either as a deliberate or as an emergent strategy by organising bilateral relationships and by carefully selecting motivated practitioners. On the programme level of NGInfra, the interactions were mainly bilateral by setting up specific sub programmes for the most prominent practitioners in the second half of the programme. On the project level, such situations seem to have been avoided by (1) organising most projects as bilateral projects involving only a single practitioner or (2) carefully selecting practitioners to make sure that they were capable and motivated to collaborate.

In Clipore, differences among practitioners do not seem to have significantly hindered the cooperation because the practitioners that most actively contributed to the programme (1) were only involved to a limited extent and (2) did not vary strongly in terms of knowledge level or interests. The knowledge level varied most significantly among practitioners engaging on the project level, yet did not hinder the interactions. Also, the value orientation did not differ strongly between the board members or between the main practitioners on the project level. All were in favour of climate policies and were interested in effective policy instruments. The practitioners who were involved on the project level differed more and they also changed opinions or priorities rapidly, which complicated the cooperation. However, also on the project level, the practitioners we interviewed did not experience the differences to have complicated the cooperation: “I don’t think the differences among stakeholders complicated things. I believe that diversity of opinions always makes stronger research” (interview with knowledge user).

#### 4.4. Explaining Fruitful Collaboration

Based on the theoretical framework introduced above, we will now attempt to explain the collaboration that was observed within these three programmes by a combination of (1) characteristics of the programme participants, (2) design of the programme, and (3) interventions by the programme management (see Table 4).

In terms of *participant characteristics*, personal leadership, social proximity (trust, good atmosphere), and cognitive proximity promoted the collaboration in all three programmes. According to various interviewees, the success of projects was related to the commitment and leadership of individual actors who were willing to go that extra mile, such as a committed alderman or an avid project leader. In Clipore, the programme director and the chairman of the board together made sure that the board meetings were attractive to attend. All board meetings started by giving everyone the opportunity to talk for a couple of minutes with particular news, concerns, or research results. Interactions in NGInfra also seem to have benefitted from social and cognitive proximity. In successful projects, we found academics who were interested in the daily operating of companies or were trained in understanding the practitioner by holding office at the practitioner’s premises, and we found practitioners with experience in academic research or with an intrinsic interest in the research matter. In TransForum, the different practitioners shared an indefinable feeling that the practice of Dutch agriculture had to radically change at some point. Combined with the idea that this transition could not be established by practitioners alone, this shared conviction facilitated the collaboration.

When looking at the *programme design*, choosing a strategic focus for the programme has been a decisive step. The initiators of both NGInfra and Clipore have chosen a relatively safe approach within an area that is full of controversies. In NGInfra, the recognition of each other’s problems and challenges (both in terms of managing infrastructures and in being closely monitored by government, politics, and the general public) brought practitioners together and created a willingness to exchange experiences and to jointly work on solving these problems. The different sectoral backgrounds created a safe context in which experiences could be exchanged without competitors being around. The choice of the Clipore board not to focus on the question of how stringent emission policies should be, however instead to look into effective mechanisms and instruments helped to create a neutral identity towards

all practitioners and a safe atmosphere. A crucial aspect of the TransForum programme design was the rule that all projects in the Practice Programme required the involvement of and collaboration between governmental bodies, civil society organisations, the business community, and knowledge institutes, in order to qualify for funding.

The three programmes used a wide range of *interventions* to promote fruitful collaboration.

Participants of TransForum have been careful in the inclusion and deliberate exclusion of actors, i.e., the selective recruitment of actors to ensure a productive interaction between participants. Various interviewees stated that they were keen on inviting (or not inviting) specific individuals within organisations in (particular phases of) the process. One programme manager, for instance, remarked: “some individuals were excluded as they lacked the willingness to innovate or the courage to choose for a new manner of collaboration”. Second, all TransForum practice projects were supported by an institutionalised monitoring mechanism, which is part of the learning programme. After some successful pilots, a so-called project monitor was assigned to each practice project, aiming to improve and speed up social learning by offering reflections on on-going events and by facilitating reflection meetings [65]. Initially, the involvement of a project monitor was optional; later, it was conditional to qualify for funding. Third, TransForum applied a so-called Connected Value Development approach, aiming at transforming perceived trade-offs into complements by connecting the values held by the different practitioners. This approach encompassed the explicit recognition of differences between practitioners in terms of problem definitions, proposed solutions, interests, and values. The project monitors helped to identify existing differences and to treat them as assets rather than smoothing them over or ignoring them. Another element of TransForum, exemplifying the programme’s application of Senge’s organisation theory [66], was the establishment of the guiding idea of “metropolitan agriculture”, which helped to mobilise the different practitioners [65].

At NGInfra, the introduction of prizes and competitions such as the Infra Spark Award for the most impactful research project seem to have stimulated collaboration among programme participants. Moreover, NGInfra Trends and NGInfra Magazine (under different names), organised by the programme, provided a stage for project participants to interact with practitioners that were not directly involved in the project. Smaller events that were organized on the project level served the same purpose. Projects also used communication and coordination instruments of the university which involved things such as prizes, alumni events, and YouTube channels.

**Table 4.** Factors promoting fruitful collaboration.

	<b>NGInfra</b>	<b>Clipore</b>	<b>TransForum</b>
Participant characteristics	Cognitive and social proximity Personal factors	Personal qualities Social proximity	Social and geographical proximity Individual leadership and commitment Shared feeling of crisis
Programme design	Combining different sectors with similar problems Dedicated sub-programmes	Focusing on a relatively safe topic Board composition	Programme funding prerequisites
Interventions	Competitions and prizes Periodicals	Policy Forum Financial flexibility	Project monitors Selective recruitment Connected Value Development

In the Clipore programme, two interventions can be distinguished that have promoted fruitful collaboration. The first concerns dedicated funds for the “Clipore Policy Forum” (later renamed European Climate Platform), a series of events organised together with the Centre for European

Policy Studies (CEPS). These events and the contributions to formal side events of COPs seemed to have been crucial for interacting with key practitioners (Christian Grorud, 2006, Mistra's Climate Policy Research Program—Phase II; Evaluation of value to users). The second intervention is the organisation of financial flexibility: the programme has gradually learned to find a good balance between accountability and flexibility in the research agenda. "In the first phase we had told all work packages and authors specifically what to do. Towards the end we found out that we had to be more flexible towards questions from knowledge users." (work package leader).

## 5. Discussion

Some factors that contribute to fruitful collaboration are characteristics of the participants, which cannot be immediately influenced by the programme management apart from inviting the right practitioners to participate in the programme. In this category, we found similarities between our three case studies, in particular the influence of personal qualities and trust. This finding resonates with economical geography literature, which suggests that social proximity can help to overcome organisational and cognitive distance [15], and with previous studies that identified personal competences and leadership as key factors for successful TD research [18,67].

Possibly the most significant finding of this paper is that the programme design can help to deal with variation between practitioners, as illustrated by two of the cases. The case of NGInfra shows that setting up specific programmes for the most prominent practitioners to work bilaterally with the research organisations can limit the confrontations among heterogeneous practitioners. Bilaterally organised projects may also reflect a balance between the demand of the programme to involve practitioners and the academic preference to limit the involvement of practitioners in order to maintain sufficient autonomy to deliver project outcomes that meet academic quality standards [68,69]. The outcome is involving a single practitioner to meet funding demands, simultaneously ruling out potential hampering effects of differences between practitioners. In the case of multi-partner projects, the programme seems to have followed a strategy of carefully selecting those practitioners that will bring energy and commitment to the project. The case of Clipore illustrates how the choice of the programme's topic can help to reduce tensions between practitioners. By formulating a rather instrumental and modest mission, the programme has managed to create a fruitful atmosphere for collaboration in a policy domain that is full of tension and controversies.

The interventions we found to promote fruitful collaboration vary strongly across the programmes, ranging from competitions to practice-oriented meetings and the appointment of project monitors. This suggests that each programme has chosen tailor-made interventions. The most distinctive and innovative intervention we found is the appointment of project monitors, responsible for improving social learning processes in TransForum. Although initially often looked upon with suspicion by regular project managers, in a later stage, the feedback and added value of these monitors, who were not involved in day-to-day network orchestration, however acted from a more distanced position, were generally organized. This finding is in line with earlier studies that indicated the value of organized reflection and dedicated facilitators for transdisciplinary collaboration [37,70,71].

## 6. Conclusions

This paper addresses the question, what factors contribute to fruitful collaboration between heterogeneous practitioners in the production of knowledge for sustainability? We have analysed three transdisciplinary research programmes and compared the way they have dealt with variation among the practitioners involved. In all three programmes, the involvement of heterogeneous practitioners was experienced by participants as an added value. Contrary to what could be expected from the literature [10,11,17,53], it turns out that the differences between practitioners have only created significant issues in one of the programmes (Transforum), and this programme has developed a way to overcome this difficulty. This paper shows that the quality of the collaboration between heterogeneous

practitioners is influenced by a combination of participant characteristics, programme design, and interventions by programme management.

Based on our analysis and informed by the existing literature about TD research initiatives, we express four recommendations for initiators and managers of TD programmes:

1. Choose your programme participants carefully: although heterogeneity among the participating practitioners is generally beneficial, sufficient social and cognitive proximity among them can help to overcome organisational distance and normative conflicts
2. Tailor the design of your programme to its specific goals and its participants: depending on the variety in normative positions and expectations of programme participants, more intensive or extensive collaboration will be possible and necessary
3. Do not immediately spend all available money on research: reserve funding for communication and coordination instruments and maintain a form of financial flexibility in the research agenda
4. In the case that the programme aims to facilitate collaboration among practitioners with conflicting perspectives, consider the appointment of project monitors.

While these recommendations can help to limit conflicts within TD programmes, a certain degree of tension among participants may be part of the game [12]; ruling out all potential disagreements could harm the innovative potential of the TD approach. The three programmes we studied have all gone through a learning process about how to deal with their different practitioners. They have dealt with this issue to some extent in their programme design, however they have also adapted their strategies along the way. Few of the interventions that were made by the programme management to deal with the variation were chosen or implemented at the start of the programmes. Most were invented in reaction to the way that the programmes proceeded over time.

This paper has identified a number of factors that influence the collaboration between practitioners in transdisciplinary programmes. In order to get a better understanding of the effectiveness of possible interventions by programme managers to stimulate fruitful collaboration, further research is needed, preferably using a larger dataset. Follow-up research with a quantitative setup could provide more insight into the relative influence of geographical, social, and cognitive participant characteristics on their mutual collaboration. Another question that deserves further attention is how practitioners that are excluded from participation in order to smoothen the collaboration can be involved in the programme in order to achieve solutions with broader support.

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