



Governing the trade-off between the co-production of actionable knowledge and academic publishing in transdisciplinary sustainability research

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ABSTRACT

Despite their stated ambitions, the societal outputs of many transdisciplinary sustainability research projects remain at the level of research dissemination to policy makers and concerned stakeholders, rather than organizing a truly interactive knowledge co-production process. In addition, projects that organize interactive knowledge co-production often achieve either a high level of actionable knowledge outputs for the key societal stakeholders or a high level of publication outputs for the scientific community. This paper analyses this trade-off in more detail based on the survey results from a unique sample of 50 completed EU research projects that fall under the same funding requirement to combine societal impact and scientific excellence in so-called "Research and Innovation Actions". The results confirm the difficulty for many projects to achieve both goals. In fact, the results show that only about half (54 %) of the projects produced actionable knowledge outputs at the end of the project, and only 34 % achieved both a high level of actionable knowledge outputs and a high level of peer-reviewed articles. The analysis of the survey results shows that co-design of research tasks related to field work, such as social science data collection or technical experimentation in real-world environments, contributes to actionable knowledge, but also potentially leads to fewer publications. An important exception to this finding is the case of intermediate levels of field research co-design. In this case, the strengthening of relational and reflective-normative trust between scientific researchers and social actors contributes to both actionable knowledge outputs and academic publications.

In response to complex sustainability challenges, research funding agencies and research administrations around the world have promoted ambitious transdisciplinary research projects that involve the co-production of knowledge between scientific researchers and societal actors (Hirsh Hadorn et al., 2008). These projects aim to generate improved understanding and propose solutions in support of societal transformations. Nevertheless, despite their stated ambition, the societal outputs of many transdisciplinary sustainability research projects remain at the level of research dissemination to policy makers and concerned stakeholders (Horcea-Milcu et al., 2024). As such, these projects continue to adopt a linear approach to social impact, focusing on communicating research results to potential users, such as through policy briefs or technical reports produced by the scientific research partners of the consortia.

In contrast, many scholars consider the interactive production of actionable knowledge for societal stakeholders as a useful alternative approach to addressing societal sustainability challenges (Nelson et al., 2023). Indeed, due to complex socio-ecological interdependencies, sustainability problems often require coordinated actions across multiple levels of governance (Jordan et al., 2015; OECD, 2020). Moreover, they often involve interactions between social actors from different societal sectors of activity with diverse world views and value perspectives, which conventional linear approaches to social impact struggle to handle (Harris et al., 2010; Polk, 2014). Problem solving in such a context can be enabled by the interactive knowledge co-production dimension that transdisciplinary research has to offer, since it provides an arena for embedding knowledge production processes in ongoing innovation practices within the broader social environment

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(Polk, 2015; D'Este et al., 2018).

Nevertheless, although research funders recognise the contribution of such interactive production of actionable knowledge in addressing complex sustainability issues, this proves to be particularly challenging for participants in transdisciplinary research projects, mainly for two reasons:

- 1) Scientific researchers often face a trade-off between social impact requirements and requirements for scientific publishing in high-impact, peer-reviewed journals (Simonsen, 2009; Chambers et al., 2021) and
- 2) Scientific researchers often lack the time or resources to invest in "soft" factors that nonetheless support knowledge co-production with social actors, such as collaborative research design or building a sense of shared values, beliefs and norms – or transparency about them (Horcea-Milcu et al., 2022).

Although the trade-off between scholarly publishing and social impact has been documented through systematic surveys (Newig et al., 2019), there is still limited understanding of the key process features that play a role in generating the trade-off. Moreover, few studies have analysed the trade-off in the context of research oriented toward actionable knowledge co-production. The latter aims to embed the produced knowledge in wider social units of practice that extend beyond the collaboration between scientific researchers and social actors within the research project itself.

This paper aims to analyse this trade-off in more detail by conducting a comparative study of transdisciplinary research projects, based on a unique sample of 50 completed EU research projects that fall under the same funding requirements for combining societal impact and scientific excellence in so-called "Research and Innovation Actions". In particular, the paper focuses on the following research question: What governance features contribute to the success of research partnerships in terms of satisfying both the requirements of co-producing actionable knowledge outputs and publishing of academic papers in peer-reviewed journals?

The paper is structured as follows: Section 1 defines the scope of the paper, by identifying the main challenges that jeopardise the achievement of the combined goals of producing actionable knowledge outputs and scientific publishing, drawing upon the emerging literature on knowledge utilisation in transdisciplinary research. Section 2 reviews the literature on fostering tangible societal outcomes, in order to develop a model to guide the empirical analysis of the trade-off between implementation practices and publication outcomes. Section 3 describes the data and methodology, while Section 4 presents the statistical analysis of the survey results. Section 5 discusses the research findings and draws the conclusions.

1. Challenges for academic publishing in transdisciplinary knowledge co-production

Knowledge co-production through substantive interactions between social actors and scientific researchers is essential for the production of actionable knowledge from transdisciplinary research. For instance, as stated in a review of two decades of research on the utilisation of social science research (Nelson et al., 2023, p. 29), "the literature is [...] univocal; research utilisation benefits from sustained, direct, and interactive relationships between practitioners and scholars".

However, the scholarly literature on knowledge co-production for actionable knowledge reveals a wide range of practices that vary according to factors such as the frequency of interactions, the origin of the research project, and the relationship with the target audience (cf. Mach et al., 2020, Fig. 1). In particular, as various scholarly reviews of transdisciplinary research have shown, knowledge co-production practices range from consultative forms of transdisciplinary research to more collaborative modes and fully participatory, social actor driven research practices (Jahn et al., 2022; de Jong, 2016). In order to analyse the role of knowledge co-production in contributing to actionable knowledge outputs, this paper follows Mach et al. (2020) in their conceptual analysis of engaged research for actionable knowledge by considering knowledge co-production not as an ideal type, but as a governance issue that covers different process features fostering substantive interactions. Adopting such a perspective allows for the disentangling of the complexity of knowledge co-production, focusing for instance on how knowledge co-production is organised, in what stages of the research process or through what type of relationships between researchers and social actors.

In particular, although there is strong empirical evidence that knowledge co-production processes increase the likelihood of producing knowledge that is both scientifically credible and socially robust (Nelson et al., 2023), these processes may also be difficult to reconcile with the objective of scholarly publishing (Simonsen, 2009; Horcea-Milcu et al., 2024). For example, as noted by Horcea-Milcu et al. (2022), based on the research of Newig et al. (2019) and Steelman et al. (2021), among others, "there is clear evidence that transdisciplinarity is a more time-consuming mode of conducting research and potentially yields less academic output – especially at the beginning of a project – compared to traditional science".

A large body of case study research has identified major difficulties that researchers in transdisciplinary projects face in pursuing academic publishing in knowledge co-production processes (Kieser and Leiner, 2009; Bandola-Gill, 2019; Chambers et al., 2021). For example, in their analysis of 32 science-society collaborations, Chambers et al. (2021) found that the pursuit of academic knowledge production was negatively correlated with achieving outcomes that inspire action, such as empowerment, network building and new organisational processes. At

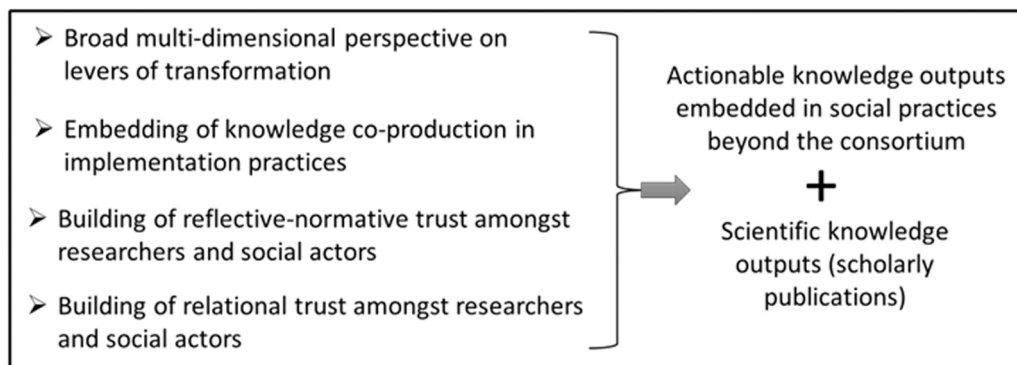


Fig. 1. Key features of knowledge co-production processes in transdisciplinary research contributing to both actionable knowledge outputs and a high level of scholarly publications.

the same time, societal actors may want outputs that are more relevant to their own organization's practice-oriented agenda (Harris and Lyon, 2013; Boon et al., 2014; Juerges and Jahn, 2020). As a result of these conflicting demands, scientific researchers and social actors may fail to establish an ongoing relationship based on mutual interests. These difficulties can be exacerbated by practical constraints, such as the need for government or private company approval before disseminating certain types of information (Buizer et al., 2016), or the process of turning informal and/or tacit knowledge from social actors into academic publication formats (Mertler, 2023). Overall, the evidence underscores two major challenges for scholarly publishing. The first relates to the potentially divergent interests of the scientific researchers and the societal actors that are member of the consortia and the conflicting demands arising from their respective institutional environments (Harris and Lyon, 2013). The second set of publishing challenges is related to the need to integrate knowledge from various actors with diverse and heterogeneous disciplinary and normative backgrounds (Finca et al., 2019; Verwoerd et al., 2023; Wittmayer et al., 2024).

2. Identifying core process features for analysing the trade-off between actionable knowledge production and scholarly publishing

In order to examine the trade-off between actionable knowledge production and scholarly publishing, it is necessary to identify the features of the research process that contribute to actionable knowledge from research – leading to effective implementation practices in broader societal units beyond the research consortia – and the features that contribute to alleviating the trade-off with academic publishing. This section provides a brief overview of these features, with the view to analysing them through the structured survey.

2.1. Fostering tangible societal outcomes that extend beyond the immediate realm of the consortium partners

A wide range of studies has analysed the process characteristics of knowledge co-production in the context of transdisciplinary research (see for instance the seminal work in Bergmann et al. 2012 and Lang et al. 2012, among others). Nevertheless, for the purpose of assessing measurable knowledge outputs that contribute to societal impact, these characteristics must be combined with the insights from the literature on research utilisation and the implementation of co-produced knowledge (Bammer, 2013; Hoffmann et al., 2019).

In particular, Landry et al. (2001a, 2001b) and Mach et al. (2020) discuss actionable knowledge production, and this concept is further elaborated upon in the context of transdisciplinary sustainability research (Hoffmann et al., 2019; Räsänen et al., 2024). These studies emphasise both instrumental outputs, such as products and solutions, and more conceptual outputs, such as shared action strategies and organisational innovations (Meagher et al., 2008). As also underlined by these scholars (cf. for Hoffmann et al., 2019; Räsänen et al., 2024), extending the implementation of these different knowledge outputs beyond the immediate realm of the consortium partners requires an iterative process of productive interactions throughout the project cycle (cf. illustrative case study examples in Table 1).

In this context, scholars of transdisciplinary sustainability science underscore the importance of knowledge contributed by social actors throughout the research process as key to embedding knowledge co-production in implementation practices (Lang et al., 2012; Reed et al., 2010). According to their analysis, embedding knowledge co-production in effective implementation practices requires joint practices that link the scientific inquiry to wider communities and networks. This means moving beyond the mere contractual obligation of co-management in the implementation of the research tasks, as the latter can involve social actors into research partnerships as window dressing, assigning them a role without necessarily giving them influence. In contrast, according to

Table 1

Illustrations of direct knowledge outputs from transdisciplinary co-production contributing to social impact. Last four rows illustrate production of “actionable knowledge” outputs from research: new knowledge outputs for practice tested with the non-academic partners within the consortium and also beyond the consortium.

| Actors involved | Type of direct knowledge outputs | Illustrative case study examples | References |
|--|----------------------------------|---|--|
| Within consortium | Products | New patrimonial renovation techniques in historic inner city, France | Claude et al., (2017) |
| | Strategic outputs | Multi-stakeholder sustainability transition scenarios for the Upper Valais mountain area, Switzerland | Brand et al., (2013) |
| | Organisational innovations | Three cases of community capacity building for co-learning on economic opportunities in resource-poor local settings | Petersen et al., (2022) |
| | Transferable learning tools | User tested diagnostic tool of heat islands in urban environments | Bodilis, (2018). |
| Within consortium <u>and beyond consortium</u> | Products | Innovations for access to energy in an urban slum, through an emergent transdisciplinary design approach | Van Breda and Swilling, (2019) |
| | Strategic outputs | Improved vaccination strategies for nomadic pastoralists in Chad | Schelling et al., (2007); Hitziger et al., (2018). |
| | Organisational innovations | Establishment of a new stakeholder network (“Working for Waders”) based on new insights and opportunities for alignment in a nature conservation conflict | Ainsworth et al., (2020) |
| | Transferable learning tools | Use of a new ecosystem services assessment tool in public administration, including assessment of cultural services | Andersson-Sköld et al., (2018a); Andersson-Sköld et al., (2018b) |

de Jong et al. (2016), true knowledge co-production is characterised by co-design with the social actors regarding a range of relevant aspects of the scientific research cycle. The latter may include the joint supervision of the research of the doctoral and postdoctoral research fellows, the co-design of fieldwork data collection and/or technological experiments and the assessment of the research results. Overall, the impact on the production of actionable knowledge has been shown to increase with the number of stages in which both scientific researchers and social actors play a role (Pohl, Hadorn, 2007).

Further, in order, to achieve actionable knowledge outputs in the context of research on sustainability transformations, researchers underline the need to adopt a broad multi-dimensional approach that

implies the mobilisation of highly diverse disciplinary expertise and societal value perspectives. For instance, an extensive scholarly review and expert deliberation (Chan et al., 2020) found that the harnessing of mutually reinforcing levers of change across both technical and social dimensions is crucial for achieving transformational outcomes for sustainability. Similarly, case-study evidence suggests that combining interventions from different policy fields contributes to tangible societal impact (Messerli et al., 2019; Norton et al., 2024). Finally, the literature on knowledge utilisation in sustainability research has found that drawing on multiple knowledge systems and bringing them into conversation throughout the knowledge co-production process is conducive to social transformation (Steger et al., 2021).

2.2. Addressing the trade-off between academic publishing and actionable knowledge production

As documented in Section 1 above, research partners face different obstacles when attempting to reconcile actionable knowledge co-production with the objective of scholarly publishing. In some cases, research funders may prioritise one type of output over the other, whether that be outputs contributing to societal transformations or academic outputs. Other funding schemes have a clear focus on producing both actionable knowledge and academic publications. As highlighted for example in Newig et al., (2019), the latter can be achieved if appropriate measures are taken to organise the research process. These measures include maintaining a continuous focus on the scientific usability of the results, deliberately combining disciplinary, interdisciplinary and transdisciplinary research phases, and applying structured methods of knowledge integration.

Nevertheless, while these various measures for fostering collaboration are important, building trustworthy relationships between scientific researchers and social actors is also crucial for the production of actionable knowledge (Hoffmann et al., 2019). In this context, an increasing number of scholars underline the importance of two types of social-relational characteristics of trustworthy relationships in research partnerships (Harris and Lyon, 2013; Horcea-Milcu et al., 2022; Verwoerd et al., 2023): (1) recurrent trustworthy collaborations despite divergent interests, known as “relational trust” (Gundersen et al., 2022, p. 20), and (2) transparency about and dialogue about intentions and held values, which fosters mutual trust in the reliability of knowledge produced across different cognitive and value-related backgrounds, referred to as “reflective-normative trust” (see also Horcea-Milcu, 2024, p. 6; Metzen, 2024).

As discussed in the literature on knowledge utilisation, the two characteristics of relational and reflective-normative trust are key to embedding knowledge co-production in broader societal practices beyond the activities of research consortia (see, for example, Cvitanovic et al., 2021; Verwoerd et al., 2023; Wittmayer et al., 2024).

In the specific case of fundamentally different value orientations, transdisciplinary research may need to organize more elaborate dialogue processes. In this context, some methods integrate tools from the conflict resolution literature, as shown in various case studies of transdisciplinary research on environmental conflicts (Ainsworth et al., 2020) or on sustainability issues in the Global South (Schneider et al., 2023). Overall, scholars emphasize the importance of a reflexive use of different methods for building trust, depending on the level of scientific uncertainty and social controversy that characterizes the sustainability issue at hand (Minna et al., 2024).

A key hypothesis of this paper is that these process characteristics also contribute to overcome the more specific challenges discussed above, which play a role in the trade-off between co-producing actionable knowledge and scientific publishing. Some exploratory case study research into these social-relational characteristics has already provided some evidence in support of this hypothesis.

First, with regard to relational trust, D’Este et al. (2018) highlight in their review paper on the trade-off between publishing and social impact

that organising iterative processes of interaction between scientific researchers and social actors is “not only vital to achieve societal impacts from research activities, but also to resolve tensions between scientific and societal goals in research activities” (D’Este et al., 2018). This has been illustrated through case studies of transdisciplinary research in various contexts. Examples include relationships between academic and industry partners in the consortia (Cherney, 2015), between academic and policy-oriented partners (Nelson et al., 2023), and the engagement of the general public and community associations in research partnerships (Khan et al., 2024). In general, most studies identify the prior experience of working together as a strong enabling factor for a successful research partnerships, particularly in situations where institutional demands for academic publishing diverge from the practice-oriented agendas of social actors (Harris and Lyon, 2013; D’Este et al., 2018).

Second, as regards reflective-normative trust, it is important to uncover and critically evaluate background assumptions related to societal values and to include the diversity of views, with the view to address the risk of cognitive lock-in within existing relational networks of science-society research partnerships (Lacey et al., 2018; Jagannathan et al., 2023, p. 182; McCrear et al., 2024). As research has demonstrated, to foster a shared sense of objectivity of knowledge co-production amongst researchers and social actors, the successful functioning of research partnerships depends on mechanisms of deliberation that make the value related background assumptions more explicit and socially robust (Longino, 1990; Herrero et al., 2019; Worosz, 2022, p. 1187; Cartwright et al., 2023). As underlined by Schmidt et al. (2020, p. 2), organising an open and transparent dialogue about the value-related background assumptions also contributes to improving the “quality and the significance of research” (see also Finca et al., 2019; Gluckman et al., 2021; Verwoerd et al., 2023).

2.3. A basic model for analysing the trade-off between publishing and actionable knowledge co-production

To allow a consistent comparison of actionable knowledge co-production across the different cases, this paper focuses on so-called first-order effects (Karcher et al., 2021), or “outputs”, which can be verified through tangible documents, activities or products at the time of conclusion of each research project. The main categories of actionable knowledge outputs are drawn from the literature on the societal effects of transdisciplinary research (Schäfer et al., 2020; Dedeurwaerdere, 2024). On this basis the analysis in this paper considers a broad set of outputs including not only direct improvements in specific situations (so-called “solutions and products”), but also two categories of output from knowledge co-production with more indirect effects: firstly, organisational processes (“new networks, groups, or practices in organisations”), and, secondly, agreed upon action strategies with social actors beyond the project consortium. The extent to which these outputs were embedded in wider social units of practice beyond the research consortium was then assessed, based on a depth of implementation scale as specified below.

The focus of this paper is on one type of scholarly knowledge output, namely peer-reviewed journal articles. Scholarly publications are obviously much more diverse - including monographs and conference proceedings, among others - and the impact of scientific research is more complex and broader than scholarly publications (Marg and Theiler, 2023; Horcea-Milcu, 2024, pp. 9–10). For example, research excellence is also reflected in the depth and innovativeness of collaborative work in scientific teams (Stokols et al., 2008; Fam et al., 2020) and in scientific leadership, as evidenced, for example, by invited lectures in academic settings (Bandola-Gill, 2019). Nevertheless, the more restrictive focus on peer-reviewed articles in this paper serves the purpose of providing a sufficiently reliable metric for comparative analysis across a large sample of research consortia.

Based on the literature review provided above, this paper uses a basic

model for analysing the trade-off between publishing and actionable knowledge co-production, as illustrated in Fig. 1. The key features are summarized in table 2. They will be used in the next section to conduct the comparative analysis of transdisciplinary research consortia.

3. Data and methodology

3.1. Survey sample

To better understand the governance features of transdisciplinary research that contribute to successful co-production of actionable knowledge, we conducted structured interviews with a sample of 50 completed research projects under the “Research and Innovation Actions” (RIA) of the EU Framework Programme for Research and Innovation, between October 2024 and January 2025. All RIA projects are evaluated for their expected contribution to both social impact (social or technological innovation) and excellence in research, ex ante in the selection phase and during the project’s lifetime. They therefore provide an excellent “test bed” for analysing the various constraints faced by research consortia when trying to achieve both societal impact and a high level of academic publishing.

The initial set of projects were selected using a purposive sampling procedure (Miles and Huberman, 1994) of projects from the EU CORDIS database, which contains fact sheets for all EU Framework Program projects. The selection was based on the following criteria: (1) all projects ended between 31 October 2019 and 1 November 2024; (2) all projects were funded under the same funding scheme (RIA) and used the same selection and evaluation criteria in the considered period; and (3) all projects pertained to a specific topic within the domain of sustainability science that had been selected to ensure sufficient diversity

Table 2

Table with contributing variables to the different key features, as identified in the literature review above. Only those variables with “*” are included in the statistical model below (for the other variables, the survey did not collect enough reliable data, so they were not included in the regression analysis).

| | Contributing variables identified in the literature review |
|---|---|
| Explanatory factors | |
| Broad multi-dimensional perspective on levers of transformation | <ul style="list-style-type: none"> Addressing multiple levers of change across both technical and social dimensions* Considering interventions from different policy fields Drawing upon multiple knowledge systems |
| Embedding of knowledge co-production in implementation practices | <ul style="list-style-type: none"> Alignment of with social actors’ research interests* Knowledge contribution from practice throughout the research process* Research co-design by researchers and social actors* Joint supervision of Phd/post-docs; co-direction of the research consortia by researchers and social actors Joint research evaluation processes |
| Building of reflective-normative trust amongst researchers and social actors | <ul style="list-style-type: none"> Transparency about intentions and held values* Dialogue about intentions and held values* |
| Building of relational trust amongst research and social actors | <ul style="list-style-type: none"> Recurrent trustworthy collaborations* |
| Knowledge outputs considered in the model | |
| Actionable knowledge outputs embedded in social practices beyond the consortium | <ul style="list-style-type: none"> Technical solutions and products* Agreed upon action strategies* Organisational processes* Transferable learning tools |
| Scientific knowledge outputs | <ul style="list-style-type: none"> Scholarly publications* Invited lectures in academic settings New research grants building upon the research results |

within the sample. Based on these criteria we conducted a keyword search on the CORDIS database using the two keywords of “circular economy” and “environmental justice”. This resulted in a sample of 212 valid projects, 50 of which responded to the email invitation for an interview. All interviews were conducted using a multiple-choice survey tool (see the survey questionnaire in the electronic [supplementary material](#)). The surveys were conducted through face-to-face interviews via MS teams, each lasting between 40 and 60 min. To check for bias in the resulting dataset, we analysed the distinguishing characteristics of the projects that did not respond to the invitation to participate (such as project end date, type of coordinating organization, or topics), but no bias was found in the characteristics of our interview sample.

The consortia had an average budget of 5.1 million Euro (standard deviation 1.6) and involved on average 15.2 partners (standard deviation 5.3), for an average duration of 4 years. All projects had a multi-stakeholder composition as a requirement of the funding scheme: on average 35 % of the consortia members were higher or secondary education institutions, 20 % research organizations, 30 % private for-profit organisations and 15 % public bodies or private non-profit organisations.

3.2. Definition and coding of the outcome variables

Based on a comparison with the questionnaire used in [Jahn et al. \(2022\)](#), we developed a structured questionnaire to code the contribution to three actionable knowledge outputs, evaluated at the project closure date:

- Technical solutions and new products
- Joint action strategies agreed with the key stakeholders
- Organisational processes (networks, groups, rules or processes in organisations)

These three outputs will be designated below respectively with the short names “technical solutions”, “strategies”, “organisational processes”.

To ensure a reliable comparison across the 50 projects, each of the interviewees had to provide the following information:

- 1) For each of the three categories, a list of the most prominent examples of outputs, accompanied with detailed information;
- 2) Amongst this list, identification of the output with the highest scope of social impact in each of the three categories;
- 3) For each of the “highest” impact examples, an assessment of the implementation depth of the given output, based on a detailed depth of implementation scale (cf. [Table 3](#)).

The second output variable of the model, “scholarly publications”, was coded based on the information from the CORDIS website. To ensure the most reliable and verifiable comparative metrics, we only considered

- peer reviewed journal papers, published at the end date of the project
- research monographs, published at the end date of the project
- that explicitly acknowledge funding by the given EU project, and
- that are listed in the projects’ official final report (verified in the ex-post evaluation and published on CORDIS)

The choice for measuring scholarly outputs at the end date of the projects has the advantage of being consistent across different projects with different end dates (given that the sample includes projects with an end date between 31 October 2019 and 1 November 2024). Moreover, bibliometric analysis shows that the early publication rate of project consortia is a reliable predictor of their subsequent publication productivity after the project end date ([Adams, 2005](#)). Further, in order to ensure that the metrics were unbiased with regard to budgetary

Table 3

Depth of implementation scale (developed by the authors drawing on the work of Bruno et al. 2020 and Bernstein et al. 2022).

| implementation depth levels (IDL) of scientific knowledge outputs | |
|---|---|
| IDL1 | Outputs disseminated to practitioners beyond the consortium |
| IDL2 | Disseminated to and discussed with practitioners beyond the consortium |
| IDL3 | Disseminated to and discussed with practitioners beyond the consortium AND implemented with consortium partners |
| IDL4 | Disseminated to and discussed with practitioners beyond the consortium AND some elements implemented beyond consortium partners |
| | For technical solutions and new products < Some elements implemented and tested in the operational environment beyond consortium partners |
| | For agreed upon action strategies < Some elements agreed by all relevant stakeholders beyond consortium partners, including representatives from public authorities |
| | For organisational processes < Some processes established as a permanent process, continuously implemented by relevant stakeholders beyond consortium partners |
| IDL5 | Same as IDL4 but for “most elements” |

differences between projects, the total number of journal articles at the end date was divided by the total amount of funding allocated to each project.

For the different outcome variables, we tested both Logit and Probit regression models. As the Probit regression models were slightly more significant, we decided to use the Probit model. All analysis was done with the STATA 19.5. software. Tables 4 and 5

3.3. Definition and coding of the explanatory variables

To analyse the role of the different variables of the basic model specified above (see Fig. 1), we used the following stepwise approach: (1) all responses from the close-ended survey questions that provided information on the contributing variables of our model (cf. Table 2) were analysed for consistency and completeness of the responses; (2) the valid responses were coded on numerical scales and analysed with the STATA software; (3) amongst the resulting list of variables, we finally kept those variables that demonstrated significant correlations with the outcome variables (correlation coefficient > 0,2).

4. Results

To compare the regression equations for the different outcome variables, we proceeded as follows. We searched for equations containing at least one significant variable (P value (P > |z|) below 0,05) in the regression equation. Amongst the equations that satisfied this criterion we selected the equations with the highest pseudo R2 (see Tables 6 and 7 below). Finally, we checked for the absence of collinearity between the explanatory variables (all VIF factors below 2,2; mean VIF=1,5, see electronic supplementary material).

In addition to the core explanatory variables of our model, we also tested the following variables:

- research topic: environmental justice (n = 11), circular economy (n = 34) or both (n = 5)
- total project budget and total EU contribution
- proportion of funding awarded to each of the partners categories (higher or secondary education establishments, research organisations, private for profit entities, public bodies and other non-profit entities)
- gender of the scientific project coordinator

Table 4

Dichotomous outcome variables. Legend: n = number of projects of the sample, % percentage of projects in the overall sample (N = 50); in brackets (q#) = question number of the questionnaire (provided in the electronic supplementary material). More details on the coding and detailed descriptive statistics for the outcome variables are provided in the electronic supplementary material.

| Actionable knowledge outputs and publications overall | n | |
|---|---|-------------|
| Actionable knowledge outputs | = 1 if at least one of the actionable knowledge outputs (technical solutions, strategies, organisational processes) reaches implementation depth 4 or 5 | = 0 23 46 % |
| | = 1 otherwise | = 1 27 54 % |
| Above median level publications | = 1 if the ratio of the number of peer reviewed article publications to the amount funding is above the 50 % percentile of all projects with a minimal impact (IDL>2) | = 0 22 44 % |
| | = 1 otherwise | = 1 28 56 % |
| Actionable knowledge outputs AND publications | = 1 if (“Actionable K outputs”=1) and (pub_above_median=1) | = 0 33 66 % |
| | = 0 otherwise | = 1 17 34 % |
| Actionable knowledge outputs per 1 category | = 1 if the output with the highest impact in the category “new/improved technical solutions and products (both bio-physical and digital) reaches IDL 4 or 5 | = 0 31 62 % |
| | = 1 otherwise | = 1 19 38 % |
| Actionable knowledge outputs for technical solutions and products AND publications | = 1 if (actionable output_tech=1) and (pub_above_median=1) | = 0 38 76 % |
| | = 1 otherwise | = 1 12 24 % |
| Actionable knowledge outputs for action strategies (q16) | = 1 if the output with the highest impact in the category “Agreed upon action strategies (with stakeholders beyond the consortium)” reaches IDL 4 or 5 | = 0 40 80 % |
| | = 1 otherwise | = 1 10 20 % |
| Actionable knowledge outputs for action strategies AND publications | = 1 if (actionable output_strat=1) and (pub_above_median=1) | = 0 44 88 % |
| | = 1 otherwise | = 1 6 12 % |
| Actionable knowledge outputs for organisational processes (q17) | = 1 if the output with the highest impact in the category “Organisational processes (networks, groups, rules or practices in organisation” reaches IDL 4 or 5 | = 0 39 78 % |
| | = 1 otherwise | = 1 11 22 % |
| Actionable knowledge outputs for organisational processes AND publications | = 1 if (actionable output_organist=1) and (pub_above median=1) | = 0 40 80 % |
| | = 1 otherwise | = 1 10 20 % |

- degree of societal controversy around the proposed transformation pathways (q35 in the questionnaire)

These variables had none or very weak correlations (coefficient < 0.125) with the production of the actionable knowledge outputs (at IDL=4 or IDL=5, as defined above) and were not significant in the different probit regressions below (at the 10 % threshold). These variables were therefore not used in the regression equations for the purpose of analysing the actionable knowledge outputs.

4.1. Comparing “actionable knowledge outputs” and the combination of “actionable knowledge outputs and publishing”

Table 6 presents the most significant probit regression models for the

Table 5

Explanatory variables with descriptive statistics Legend: n = number of projects of the sample; % percentage of projects in the overall sample (N = 50); in brackets (q#) = question number of the questionnaire (provided in the electronic [supplementary material](#)). More details on the coding is provided in the electronic [supplementary material](#).

| Definition of the explanatory variables (question number in brackets (q#), questionnaire provided in the online supplementary material) | | | |
|--|--|-----|---------|
| Broad multi-dimensional research program | | n | |
| Addressing multiple levers of change (q38) | = 1 if at least 3 out of five levers of change (1) socio-technical, (2) planning through scenario-modelling, (3) socio-economic, (4) policy and governance and (5) sociocultural) are extensively addressed in the work program of the research consortium | = 0 | 35 70 % |
| | = 1 otherwise | = 1 | 15 30 % |
| Alignment with social actors' research interests Alignment of initial submission with social actors' research interests (q8) | = 1 if the project idea emerged from practitioners' research interests (equal share or mainly defined from practitioners' research interests) | = 0 | 27 54 % |
| | = 0 If the project emerged solely or mainly from academic/scholarly interests | = 1 | 23 46 % |
| Knowledge contribution from practice Knowledge input to research from social actors (q11) | Number (0,1,2 or 3) of research partners amongst the 3 overall highest contributing non-academic research partners that contributed knowledge for the research tasks in the project | = 0 | 3 6 % |
| | | = 1 | 5 10 % |
| | | = 2 | 13 26 % |
| | | = 3 | 29 58 % |
| Field research co-design Degree of technical research co-design (q12) | Number (0, 1, 2 or 3) of research partners amongst the 3 overall highest contributing non-academic research partners that <i>co-managed the organisation of technical experimentation</i> (whether related to bio-physical or digital technologies). | = 0 | 19 38 % |
| | | = 1 | 4 8 % |
| | | = 2 | 8 16 % |
| | | = 3 | 19 38 % |
| Degree of social science research co-design (q12) | Number (0, 1, 2 or 3) of research partners amongst the 3 overall highest contributing non-academic research partners that <i>co-managed the gathering of social science data</i> . | = 0 | 21 42 % |
| | | = 1 | 12 24 % |
| | | = 2 | 9 18 % |
| | | = 3 | 8 16 % |
| Total level of technical and social science research co-design | Number (0,1,2,3,4,5,6) resulting from the sum of "Research_CoDesign_Technical" and "Research_CoDesign_SocialScience". Measures the overall degree of field research co-design (as each partner can potentially contribute to both). | = 0 | 4 8 % |
| | | = 1 | 5 10 % |
| | | = 2 | 11 22 % |
| | | = 3 | 21 42 % |
| | | = 4 | 5 10 % |
| | | = 5 | 3 6 % |
| Intermediary level of Technical and social science research co-design | = 1 if sum of Research_Co-design_Technical and Research_Co-design_SocialScience has value 1,2,3 or 4 | = 0 | 8 16 % |
| | | = 1 | 42 84 % |
| Reflective-normative trust Co-formulation of social values (q11) | = 1 if at least 2 of the three highest contributing non-academic partners contributed to the formulation of values and normative contributions in the research process | = 0 | 31 62 % |
| | = 0 otherwise | = 1 | 19 38 % |
| Workshop for learning on social values (q33) | = 1 if there was an explicit workshop dedicated to social learning <i>among the consortium partners</i> on their normative orientations and societal values | = 0 | 19 36 % |
| | = 0 otherwise | = 1 | 31 62 % |
| Relational trust Prior collaborations (q25) | Number (0–4): collaborations by the coordinator with non-academic partners prior to the project on a scale from none (0), less than half of | = 0 | 8 16 % |
| | | = 1 | 21 42 % |
| | | = 2 | 9 18 % |

Table 5 (continued)

| Definition of the explanatory variables (question number in brackets (q#), questionnaire provided in the online supplementary material) | | | |
|--|-----|----|------|
| all the non-academic partners (1), half (2), more than half (3) and all (4). | = 3 | 10 | 20 % |
| | = 4 | 2 | 4 % |

Table 6

Results of the probit regressions on (1) the overall actionable knowledge outputs; (2) publications above median and (3) the overall actionable knowledge outputs combined with above median level publication outputs. Numbers in the table correspond to the regression coefficients and the asterisks indicate the significance of the p-values ($P > |z|$). The detailed results of these probit regressions is provided in the electronic [supplementary material](#).

| | Actionable knowledge outputs | | Above median level publications | | Actionable knowledge outputs AND publications | |
|---|------------------------------|-------|---------------------------------|--------|---|--------|
| | Reg1A | Reg1B | Reg1C | Reg1D | Reg1E | Reg1F |
| Addressing multiple levers of change | 1,6** | 1,35* | 0,5 | 0,25 | 1,56* | 1,27‡ |
| Alignment of initial submission with social actors' research interests | 0,25 | 0,71 | 0,16 | 0,03 | 0,07 | 0,40 |
| Knowledge input to research from social actors | 0,11 | 0,32 | - 0,35 | -0,44‡ | 0,13 | 0,38 |
| Total degree of technical and social science research co-design | 0,31 | - | 0,40* | - | 0,07 | - |
| Intermediary level of technical and social science research co-design | - | 0,84‡ | - | 0,97* | - | 1,35* |
| Co-formulation of social values | 0,33 | 0,34 | 0,87 ‡ | 0,63 | 1,51* | 1,77** |
| Workshop for learning on social values | 0,34 | 0,24 | 0,66 | 0,69 | 0,70 | 0,88 |
| Prior collaborations | 0,23 | 0,06 | 0,27 | 0,24 | 0,68** | 0,72* |
| N of observations | 50 | 50 | 50 | 50 | 50 | 50 |
| Prob > chi2(4) | 0,0128 | 0,009 | 0,020 | 0,0153 | 0,0006 | 0,0001 |
| Pseudo R2 | 0,26 | 0,27 | 0,24 | 0,25 | 0,40 | 0,48 |

Legend: (‡) P value ($P > |z|$) between 0,05 and 0,1; (*) P value ($P > |z|$) between 0,05 and 0,01; (**) P value ($P > |z|$) < 0,01. Results with (*) and (**) are statistically significant; results with (‡) are usually not considered statistically significant, but still provide evidence of a trend. Exact P values are reported in the electronic [supplementary material](#).

overall production of actionable knowledge outputs in combination with “above median level” academic publishing (Reg1E and Reg1F) and compares these regression models with regression models for actionable knowledge outputs only (Reg1A and Reg1B) and above median level publishing only (Reg1C and Reg1D). The overall R2 values in Reg1E and Reg1F are much higher than in the first regression equations, which is to be expected since this model combines all the variables identified in the literature review as contributing to overcoming the difficulties in achieving both high levels of actionable knowledge output and scholarly publications.

The main findings from these probit regressions in relation to the

Table 7

Comparison of probit regression models for the three categories of actionable knowledge outputs. Numbers in the table correspond to the regression coefficients and the asterisks indicate the significance of the p-values ($P > |z|$). Detailed results of the probit regressions in the online [supplementary material](#).

| | Reg 2 A: Actionable knowledge outputs for technical solutions and products Reg 2B: Actionable knowledge outputs for technical solutions and products AND publications | | Reg 3 A and 4 A: Actionable knowledge outputs for action strategies Reg 3B and 4B: Actionable knowledge outputs for action strategies AND publications | | | | Reg 5 A and 6 A: Actionable knowledge outputs for organisational processes Reg 5B and 6B: Actionable knowledge outputs for organisational processes AND publications | | | |
|--|--|-----------|---|-----------|------------|-----------|---|------------|------------|------------|
| Probit regression equations | Reg 2 A | Reg 2B | Reg 3 A | Reg 3B | Reg 4 A | Reg 4B | Reg 5 A | Reg 5B | Reg 6 A | Reg 6B |
| Addressing multiple levers of change | 1,88 * | 1,81 * | 0,06 | 0,40 | | | 2,32 ** | 2,42 ** | 2,22 ** | 2,53 ** |
| Alignment of initial submission with social actors' research interests | 0,49 | -0,27 | 1,16 | 1,00 | 0,75 | 1,24 | 0,59 | 1,19 | 0,61 | 1,11 |
| Knowledge input to research from social actors | -0,13 | -0,20 | -0,47 | -1,11 | | | -0,26 | -0,52 | -0,26 | -0,48 |
| Degree of technical research co-design | 0,60 * | 0,65 ‡ | | | | | | | | |
| Degree of social science research co-design | | | 1,26 ** | 2,14 ‡ | 1,06 ** | 1,53 * | -0,10 | 0,16 | | |
| Co-formulation of social values | 0,12 | 1,21 * | -0,55 | 0,71 | | | 1,20 | 1,48 ‡ | 1,09 ‡ | 1,61 * |
| Workshop for learning on social values | -0,72 | -0,04 | 1,04 | | 1,19 * | 2,09 ‡ | 1,11 ‡ | 1,72 * | 1,07 ‡ | 1,73 * |
| Prior collaborations | 0,25 | 0,84 * | 0,58 ‡ | 1,63 * | 0,62 ‡ | 1,51 * | 0,14 | 0,09 | 0,15 | 0,09 |
| N of observations | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Prob > chi2(4) | 0,018 | 0,006 | 0,001 | 0,001 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Pseudo R2 | 0,26 | 0,36 | 0,50 | 0,65 | 0,46 | 0,70 | 0,50 | 0,58 | 0,49 | 0,57 |

Legend: (‡) P value ($P > |z|$) between 0,05 and 0,1; (*) P value ($P > |z|$) between 0,05 and 0,01; (**) P value ($P > |z|$) < 0,01. Results with (*) and (**) are statistically significant; results with (‡) are usually not considered statistically significant, but still provide evidence of a trend. Exact P values are reported in the electronic supplementary material.

research question of the paper can be summarised as follows:

- (1) The key variable that is most significant overall in contributing to actionable outputs is the variable related to the **broad multidimensional research design** of the research project:
 - o actionable knowledge outputs beyond the project consortium (IDL=4 or IDL=5) are more likely to occur in projects that include both elements of bio-physical and social science related levers of change at the core of the research program (the variable “addressing multiple levers of change”).
 - o this result does not lead to a trade-off with publishing: multi-dimensional research design is also significant in the equations for combined actionable knowledge outputs and a high level of publications
- (2) The two main two variables that contribute to overcoming the trade-off between actionable knowledge outputs and scholarly publishing are related to building of reflective-normative trust and relational trust:
 - o **Co-formulation of social values** between researchers and social actors is significant in Reg1E and Reg1F – which is a variable identified in the literature review as contributing to reflective-normative trust (cf. [Table 2](#) above)
 - o **Prior Collaborations** are significant in Reg1E and Reg1F – which is a variable identified in the literature as contributing to relational trust (cf. [Table 2](#) above).
- (3) Finally, the variable **research co-design** also contributes to overcoming the trade-off, but only at intermediary levels of research co-design
 - o Total research co-design (the sum of technical and social science research co-design with social actors) is significant with a

negative sign in the Reg1C. This may indicate that the time and resources needed for very high levels of co-design are detrimental to the production of high levels of scholarly publication outputs

- o In contrast, intermediary levels of co-design favours both high levels of scholarly publications (reg1D) and combined scholarly publications and actionable knowledge outputs (reg1F).

It is important to note that the variable "Workshop for learning on social values" has a positive sign, but does not show much difference in its role in the different regression equations. In fact, this variable measures the organization of a workshop for general social learning about social values. It is related to general trust building among all partners and in relation to all activities of the consortia, including research and impact. In contrast, the variable "Co-formulation of social values" was measured by a question that dealt only with the research process and the type of contributions made by the non-academic research partners during this process. It is therefore more directly related to the building of reflexive-normative trust in relation to the scholarly publication process. There is no significant correlation between these two variables (correlation coefficient < 0.125).

4.2. Disentangling different categories of actionable knowledge outputs

[Table 7](#) presents the most significant probit regressions for each of the three sub-categories of the survey (“technical solutions and products”, “agreed upon strategies” and “organisational processes”) when considered separately. For each sub-category, [Table 7](#) first presents the regression model for the sub-category on its own (respectively Reg2A for the production of actionable knowledge outputs for technical solutions

and products; Reg3A and 4 A for actionable knowledge outputs for action strategies; Reg 5 A and 6 A for actionable knowledge outputs for organisational processes) and compares it with the regression models for actionable knowledge outputs combined with “above median level” academic publishing (same numbering but with letter “B”: Reg 2B, etc.).

These regressions provide further insight into the role of the different variables in relation to each of the 3 outcome variables considered separately. In practice, however, a project may contribute to more than one of these outcome variables (in this sample, 41 % of the projects contributed to 2 or 3 of these outcomes at the same time). Therefore, although the findings reported in Table 7 are relevant if one aims to strengthen one of the types of knowledge outputs separately, in practice one needs to combine these results if one aims to achieve a broad set of actionable knowledge outputs of different types - as in the overall regression equation above.

The main additional findings from these probit regressions with respect to the types of actionable knowledge outputs considered separately are:

- (1) The production of actionable knowledge outputs for technical solutions and products is specifically fostered by multidimensional research design, prior collaboration and value transparency through co-formulation of values – which are the three core variables also identified in the overall regression equation
- (2) The production of actionable knowledge actionable knowledge outputs for action strategies is specifically fostered by the variable related to relational trust (“prior collaboration”), which is consistent with the specific importance of trustworthy social relations in facilitating agreements on broadly adopted action strategies with the key stakeholders.
- (3) The production of actionable knowledge outputs for organisational processes is fostered also by the identified core variables related to multidimensional research design and value transparency through co-formulation of values. However, the variable “prior collaborations” is not significant for “organisational processes”. The latter may be related to the fact that prior acquaintance amongst the consortium partners is less of a contributing factor when it comes to building new organisational networks or proposing new organisational mechanisms that are implemented beyond the consortium partners (that is at IDL4 or IDL5).

Overall, the regression results confirm the trends identified in Section 4.1 when analysing the combined actionable knowledge outputs of the research consortia. In addition, by considering each category of actionable knowledge output separately as an outcome variable, it was possible to disentangle the contribution of the two sub-variables for field research co-design, related to co-design for technical experimentation and co-design for social science data collection, respectively. Consortia that contribute strongly to the first category of actionable knowledge outputs - technical solutions and products - are also more likely to organize some form of technical experimentation. Similarly, consortia that contribute strongly to the categories of “agreed action strategy” and “organizational processes” are more likely to organize some form of social science data collection.

5. Discussion and conclusion

The aim of this paper is to improve our understanding of the trade-off between producing actionable knowledge and academic publishing in transdisciplinary sustainability research. Table 8 provides some examples of successful synergies between actionable knowledge production and academic projects from our research sample. These successful projects produced both actionable knowledge outcomes beyond the project consortium and an average of about 40 peer-reviewed scientific articles at the end of the four-year funding period, which can reasonably be expected given the consortium composition of the projects in the sample

Table 8

Illustrations of projects in the surveyed research sample that achieved both actionable knowledge and a high level of publication outputs (limited to anonymized information for project presentations, per the interview protocol). The publication and citation counts are less than those reported for similar projects in Newig et al., (2019), but the latter were measured beyond the project end date and included also project that did not produce actionable knowledge outputs.

| Selected projects of the research sample of EU RIA projects 2014–2024 (anonymized). | Journal publications at the project end date | # citations from these publications (google scholar, 2025.03.01) | Illustration of actionable knowledge outputs implemented beyond the consortium partners at the project end date |
|--|--|--|--|
| Example 1: Improving C, N and P recycling in agriculture | 49 (2023) | 568 | <ul style="list-style-type: none"> • C,N, P Assessment tool used by farmer networks • Document with agreed recycling strategies agreed by the core societal and policy stakeholders • Network of EU recycling initiatives |
| Example 2: Developing a systematic framework for analysing sustainability innovations in rural areas | 39 (2020) | 1936 | <ul style="list-style-type: none"> • Market tools for sustainable produce from marginalized areas • Stakeholder governance board set up in several communities |
| Example 3: Analysis of nature based solutions in metropolitan areas | 35 (2021) | 5177 | <ul style="list-style-type: none"> • Action plans in local innovation partnerships • Capacity building tools and guidebooks • Spin off company for sustainable development assessment of nature based solutions |
| Example 4: Analysing circular waste flows in metropolitan areas | 42 (2020) | 1674 | <ul style="list-style-type: none"> • Implementation of circular economy solutions • Climate plans for specific given cities • Software for assessing value from circular waste |
| Example 5: Conceptual models of high biodiversity grasslands in support of sustainability transitions | 39 (2024) | 1630 | <ul style="list-style-type: none"> • Network of peer to peer farmer training • Implementation of virtual fencing (GPS connected collars) solutions |

(an average of 5 partners from higher education institutions and 3 from research organizations) and the overall funding (average budget of 5.1 million Euro (standard deviation 1.6)).

The projects in the sample dealt with a similar topic in the field of sustainability research and had a high degree of diversity in governance characteristics and disciplines. The analysis of the survey results from the sample of 50 completed EU research projects provided empirical evidence of both the trade-off and the specific social mechanisms that allow to alleviate the trade-off. The results confirm that many projects struggle to achieve both objectives. The results show that around two thirds of the projects faced a trade-off between scientific publications and the production of actionable knowledge outputs that go beyond the

regular dissemination requirements. In fact, only 34 % of the projects in the sample (=17 projects) achieved both actionable knowledge outputs at IDL4 or IDL5 in at least one of the three examined categories (solutions, strategies and organisational processes) and a high level of peer-reviewed articles.

The subgroup that combined both actionable knowledge outputs and a high level of publishing (34 % of the project sample) strongly relied on the building of trust between academic researchers and societal actors. First, the existence of prior collaborations between the academic and the societal actor partners of the consortium contributes to mitigating the trade-off with activities that require additional time and effort to achieve actionable knowledge outcomes, such as field research co-design between the partners. Second, the co-formulation of values and normative contributions in the research process by the social actors and researchers plays a key role in achieving both actionable knowledge outputs and a high level of academic publishing.

The latter finding hints to the importance of establishing reflective-normative trust around the scientific credibility of the joint research effort. This result is in line with work in responsible science and innovation, which highlights the importance of building trust between science and society in value-sensitive research (Von Schomberg and Hankins, 2019, Ivani and Archer, 2024). However, to the best of our knowledge, this is the first systematic comparative analysis of this process feature in the context of transdisciplinary sustainability research. Moreover, the result holds for projects in our sample with a high degree of social controversy in the media about the proposed transition paths as well as for projects with less social controversy about the plurality of value perspectives of the affected social actors (Q35 in the questionnaire). This finding therefore strengthens the importance of a reflexive use in transdisciplinary research of different methods for building mutual understanding on societal values, ranging from methods for making existing perspectives more explicit to dialogue process to dealing with situations of conflicting value perspectives (McDonald et al., 2009).

One of the main innovations of this study compared to the existing scholarly literature is the use of a detailed scale to measure the depth of implementation for different types of actionable knowledge outputs. This scale is measured using a cascade interview technique that (1) first identifies a list of high impact outputs in each category of knowledge output; (2) selects one with the best evidence of tangible impact in each of the three categories – if applicable – and (3) uses the scale to analyse the implementation depth of this set of selected outputs with the highest impact. As such the analysis goes further than the usual analysis of knowledge outputs without much evidence of implementation depth, such as policy briefs, patent applications or demonstration pilots. Moreover, this technique allows for a consistent comparative analysis of a wide range of both instrumental and more conceptual actionable knowledge outputs such as agreed upon action strategies.

A limitation of the present study is that the survey results do not provide sufficient detail on a fourth important category of actionable knowledge outputs: the contribution to the strengthening of human capacities and skills. Capacity building plays an important role in empowering disenfranchised social actors and redressing power imbalances both within and beyond the research consortia (Wittmayer et al., 2024; Hertting, 2024). This variable was included in the questionnaire (question 13 and 18, cf. online suppl. material). However, the responses covered very heterogeneous categories so that the results could not be compared in a consistent way across the interviews. Further follow-up research is needed further identify the trade-offs – or mutually supportive relationships – between societal capacity-building efforts that extend beyond the partners of the research consortia and academic publishing in transdisciplinary research.

A second limitation of the study is the use of an interview questionnaire with pre-defined options. Although the face-to-face interview format allowed for qualitative comments from respondents, these qualitative comments were mainly used to check the accuracy and

consistency of the interpretation of the interview questions by different respondents. More in-depth qualitative research on specific cases is needed to better understand the processes of research co-design and co-formulation of societal values.

The results of this study have several implications for practical reform of science policy and research management within universities and research institutions. First, the importance of fostering relational trust reiterates the need of clearly identifiable and recurring funding schemes tailored to knowledge co-production activities, so that researchers and social actors can invest time and resources in these programmes in the long term. This general observation also aligns with calls in the scholarly literature for general capacity building for transdisciplinary research, which helps researchers and social actors to design and conduct processes that build trust within various communities of practice (Bammer, 2013; Lyall and Fletcher, 2013; Belcher and Hughes, 2021; Philipp et al., 2023).

More specifically, widespread funding of early-stage and diversified networking activities is a key policy recommendation that follows from this paper's finding on the importance of prior collaborations in overcoming the trade-off between co-production of actionable knowledge and academic publication in large research consortia. Participating in such funded networking activities for one or two years can help to prepare a larger project proposal as a next step, rather than directly forming larger consortia with members who still need to learn how to work together - as was the case in many of the less successful research consortia interviewed in this study. There is ample evidence of the benefits of such funding for research coordination networks in the early stages of collaboration, whether between research organizations and universities (Porter et al., 2012) or within interdisciplinary centres at universities (Yang et al., 2021).

Second, the importance of building reflective-normative trust, by clarifying the background values, beliefs and norms amongst existing and potential project partners, points to the need of specific enabling activities of transdisciplinary research. Some of these can be conceived along the lines of the literature on the role of the “phase 0” in the formation of transdisciplinary research consortia (Horcea-Milcu, 2022). However, such enabling activities should be organized more broadly throughout the research process to support the emergence of research partnerships with high levels of reflective-normative trust. For example, tools such as open-ended search conferences (Weisbord and Janoff, 1995) or open space conference (Owen, 2008) can be used to facilitate mutual learning on value related background assumptions amongst research partners (see for instance the examples discussed in Dedeurwaerdere, 2024, ch5).

In this context, scholars have developed a wide range of tools to promote learning between researchers and social actors about the production of societal value throughout the research process, such as Evaluative Inquiry, ASIRPA, Contribution Mapping or Public Value Mapping, among others (McDonald et al., 2009; Smit and Hessels, 2021). These tools, if understood as tools for building reflective-normative trust between researchers and social actors, can clearly contribute to mitigating the trade-off between the co-production of actionable knowledge and academic publishing. Since such trust building cannot be achieved through external incentives, the policy recommendation from this study is to support the use of these tools as social learning mechanisms internal to research processes, for example by recognizing the additional research time that may be required as an eligible expense. An example along these lines is the funding of so-called interaction coordinators in large strategic research projects funded by the Strategic Research Council in Finland (Pulkkinen et al., 2024).

Third, although there is a considerable amount of scholarly literature on the acquisition of transdisciplinary research competencies through experiential and case study-based training in undergraduate curricula (Brundiers et al., 2021; Herweg et al., 2021; Vienni Baptista and Klein, 2022), comparatively less attention has been paid to the development of training tools related to the development of societal value-related

research competencies at the level of doctoral education or for researchers involved in transdisciplinary sustainability research consortia. This is an area that is currently understudied (Horn et al., 2023) and is clearly an important topic for future research.

Overall, this study shows that research partnerships that organize interactive co-production of actionable knowledge with societal stakeholders are very diverse. Modalities range from partnerships that focus primarily on actionable knowledge outputs, to those with a more traditional focus on academic knowledge outputs, to research consortia that strive for a balanced contribution to both. The aim of this paper was to improve our understanding of the conditions that enable this last modality of transdisciplinary partnership research. The analysis shows that a more focused process of reflection among the project partners on the process characteristics could help to overcome some of the challenges for academic publishing in knowledge co-production processes, in particular by organizing the co-design of field research within the research process and by paying more attention to the social-relational dimensions of partnerships.

Online supplementary material (cf. pdf file provided with the submission)

- The 6 + 10 probit equations and results from the stata 19.5 software
- The cross correlation table and VIF factors
- Descriptive statistics
- Technical description of the coding of the variables
- Survey questionnaire

Open access data

An excel sheet with survey data and the pdf of the anonymized interview responses (both closed and open questions) will be provided and released through the open data platform Zenodo.

Author statement

We thank the reviewers for the careful review and constructive comments and valuable insights

We have revised the paper according to the indications provided and added the missing technical explanations

CRedit authorship contribution statement

Tom Dedeurwaerdere: Writing – review & editing, Writing – original draft, Validation, Investigation, Formal analysis, Data curation, Conceptualization. **Stephanie Jahn:** Writing – review & editing, Validation, Methodology, Formal analysis, Conceptualization. **Jens Newig:** Writing – review & editing, Validation, Methodology, 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.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.envsci.2026.104318](https://doi.org/10.1016/j.envsci.2026.104318).

Data availability

Original survey data can be downloaded on the EU portal zenodo (released upon publication of the paper)

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